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OCT 31 2005

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 05-746
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Docket No. 50-305
License No. DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
FLOODING SIGNIFICANCE DETERMINATION PROCESS RISK ASSESSMENT REPORT

Nuclear Regulatory Commission (NRC) Inspection Report 05000305/2005011 documented a potential failure of multiple safety related equipment trains during internal flooding events. The NRC provided Dominion Energy Kewaunee, Inc. (DEK) with a preliminary significance determination for the performance deficiency and offered DEK an opportunity to present DEK's perspectives on the potential failure.

DEK has requested a Regulatory Conference to present our perspectives on the facts and assumptions used. This Regulatory Conference is scheduled for November 8, 2005, at the NRC Region III headquarters. Additionally, the NRC encouraged DEK to submit the supporting evaluation for the requested Regulatory Conference one week prior to the conference.

Enclosed is the requested evaluation for your review.

Further, Mr. J. L. Caldwell, NRC Regional Administrator, and Mr. S. C. Burton, Kewaunee Power Station NRC Senior Resident Inspector, are being provided with a copy of this letter and a CD containing the supporting evaluation.

If you have questions or require additional information, please feel free to contact Mr. Tom Breene at 920-388-8599.

Very truly yours,

MGaffney

Michael G. Gaffney
Site Vice President, Kewaunee Power Station

Enclosure

Commitments made by this letter: NONE

A001

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Mr. S. C. Burton
NRC Senior Resident Inspector
Kewaunee Power Station

Serial No. 05-746

Attachment 1

FLOODING SIGNIFICANCE DETERMINATION PROCESS RISK ASSESSMENT REPORT

SAFETY SIGNIFICANCE EVALUATION OF KEWAUNEE POWER STATION TURBINE BUILDING INTERNAL FLOODS

DOMINION ENERGY KEWAUNEE, INC.

U. S. Nuclear Regulatory Commission
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Volume 1 of 2

nion Energy Kewaunee, Inc.
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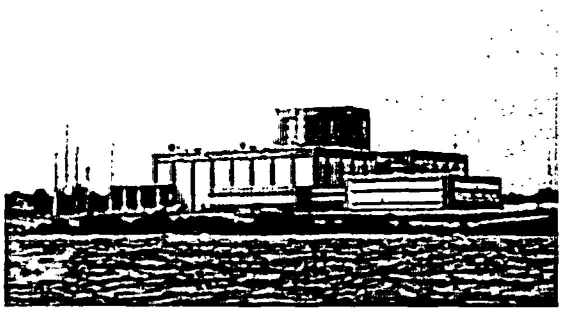
Flooding Significance Determination Process Risk Assessment Report
10/31/05



Safety Significance Evaluation of Kewaunee Power Station Turbine Building Internal Floods

October 31, 2005

Dominion

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Executive Summary

Executive Summary

A performance deficiency was identified in NRC Inspection Report 05000305/2005011 regarding internal flooding design features. The inspectors found that there was inadequate design control to ensure Class I equipment was protected against damage from the rupture of a pipe or tank resulting in serious flooding or excessive steam release to the extent that the Class I equipment's function was impaired. Specifically, the design did not ensure that the auxiliary feedwater (AFW) pumps, 480-volt (V) safeguards buses, safe shutdown panel, emergency diesel generators (EDGs) 1A and 1B, and 4160-V safeguards buses 1-5 and 1-6 would be protected from random or seismically-induced failures of non-Class I systems in the turbine building. Flood paths were present which would allow flood water from the turbine building to flow into the safeguards alley compartments containing the identified Class I equipment. These flood paths included floor drains without check valves, doors with sufficient bottom clearances to allow water to pass through, and open floor trenches which communicate between safeguards alley compartments.

The past safety significance of this performance deficiency was evaluated by performing a probabilistic risk assessment (PRA) of the subject internal flooding scenarios leading to core damage. The flood initiating events considered included: random pipe breaks, condenser expansion joint failures, steam line breaks with fire sprinkler actuation, feedwater line breaks with fire sprinkler actuation, seismic-induced breaks, turbine-missile induced breaks, and tornado-induced breaks. The scenarios were analyzed based on: surveyor floor measurements, dynamic flood level analysis using GOTHIC, equipment survivability evaluations, room heatup calculations using GOTHIC, simulator exercises, review of operator training materials, testing of 480-V breakers in simulated flooding conditions, and seismic fragility assessments. The turbine building flood sources capable of causing failure of Class I equipment in safeguards alley were determined to be: circulating water, service water, firewater, feedwater, condensate, and the condensate and reactor makeup water storage tanks.

The total contribution to core damage frequency (CDF) from this deficiency based on the plant design in 2004 was evaluated to be 5.9E-05 per year, which would be classified as mid-Yellow in the NRC Reactor Oversight Process (ROP) Significance Determination Process (SDP) risk determination. The total large early release frequency (LERF) contribution from this deficiency was estimated to be at least a factor of ten below the CDF, and thus not limiting in the NRC ROP SDP risk determination. Sensitivity evaluations were performed to determine the impact of changes in key assumptions such as initiating event frequencies and human error probabilities. All the sensitivity evaluations resulted in a CDF contribution of less than 8.5E-05 per year (Yellow).

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Table of Contents (cont.)

1 Introduction

A performance deficiency was identified in NRC Inspection Report 05000305/2005011 regarding internal flooding design features (Ref. 1). The inspectors found that there was inadequate design control to ensure Class I equipment was protected against damage from the rupture of a pipe or tank resulting in serious flooding or excessive steam release to the extent that the Class I equipment's function was impaired. Specifically, the design did not ensure that the auxiliary feedwater (AFW) pumps, 480-volt (V) safeguards buses, safe shutdown panel, emergency diesel generators (EDGs) 1A and 1B, and 4160-V safeguards buses 1-5 and 1-6 would be protected from random or seismically induced failures of non-Class I systems in the turbine building. Flood paths were present which would allow flood water from the turbine building to flow into the safeguards alley compartments containing the identified Class I equipment. These flood paths included floor drains without check valves, doors with sufficient bottom clearances to allow water to pass through, and open floor trenches which communicate between safeguards alley compartments.

2 Conclusions

The total contribution to core damage frequency (CDF) from this deficiency based on the plant design in 2004 was evaluated to be 5.9E-05 per year, which would be classified as mid-Yellow in the NRC Reactor Oversight Process (ROP) Significance Determination Process (SDP) risk determination. The total large early release frequency (LERF) contribution from this deficiency was estimated to be at least a factor of ten below the CDF, and thus not limiting in the NRC ROP SDP risk determination. Sensitivity evaluations were performed to determine the impact of changes in key assumptions such as initiating event frequencies and human error probabilities. All the sensitivity evaluations resulted in a CDF contribution of less than 8.5E-05 per year (Yellow).

3 Evaluation

3.1 Flood Sources

In this analysis, failures of non-Class I water system piping and equipment at Kewaunee Power Station (KPS) that can flood the turbine building and subsequently impact Class I components have been evaluated. Systems with sufficient inventory and flow rates to fail Class I equipment in safeguards alley were determined to be: circulating water, service water, firewater, feedwater, condensate, and condensate and reactor makeup water storage tanks. Eleven different random (8), tornado-induced (1), turbine-missile induced (1), and seismic-induced (1) flooding initiating events listed in Table 3-1 were evaluated. The frequencies of these flooding events were determined based on plant-specific analyses and industry references.

The critical flood levels for Class I equipment in safeguards alley potentially-impacted by turbine building floods are listed in Table 3-2. These levels were determined by measurements, engineering evaluations, and tests of equipment in flooded conditions.

3.2 Accident Scenarios

Based on identification and analysis of internal flood areas in the KPS turbine building and safeguards alley (including consideration of unoccupied floor space, risk-significant components and associated submergence depths, drainage paths and capacity, detection methods, operator actions, and propagation paths to/from other flood areas), accident scenarios were developed for each of the flooding initiating events described above. The accident scenarios for each initiating event are very similar with differences only in detection method and time to fail Class I equipment. For each initiating event the propagation paths into safeguards alley and the subsequent component damage are the same.

A flooding event due to a non-Class I break would be indicated by a turbine building miscellaneous sump level high alarm in the control room due to high level in either the turbine building or screenhouse sump. The drains and sumps alarm procedure instructs the operator to dispatch personnel to locally investigate the sump when this alarm sounds. Indication may also be provided by alarms related to the system with the break (e.g., low condenser vacuum, service water low discharge pressure, fire pump running or fire protection header pressure low, or steam generator low level depending on the break). The break would deposit water from the circulating water, service water, fire water system, or condensate and reactor makeup water storage tanks onto the turbine building floor. In addition, a break in the feedwater or main steam system that actuates the fire sprinklers would increase the temperature in the turbine building, which would impact the timing for investigation and isolation of the leak.

The water levels in the 480 V switchgear bus 61 and 62 room, the motor-driven auxiliary feedwater pump 1B (MDAFP 1B) room, the turbine-driven auxiliary feedwater pump (TDAFP) room, the MDAFP 1A room, and the CO_2 storage tank 1B room would closely match the water

level in the turbine building because the drain lines that connect these rooms to the turbine building sump do not contain check valves and would allow water to flow from the sump to these rooms. The water level in the 480 V switchgear bus 51 and 52 (bus 51/52) room would be lower than the turbine building because water would be entering this room via leakage under the doors from adjacent compartments. Water would rise in the bus 51/52 and diesel generator 1A (DG 1A) rooms simultaneously due to the trench connecting the two rooms. The only drainage from the DG 1A room would be leakage to the screenhouse pipe tunnel via the gap under the door and a four-inch opening into the trench. The DG 1A room drain line would not remove any of the flood water because its drain line (which contains a check valve) empties into the turbine building sump, which would already be above this level. If the water level in DG 1A exceeds a depth of 4 inches, 4 kV bus 5 and 480 V Buses 51 and 52 (which are powered from 4 kV bus 5) are conservatively evaluated to fail.

The water level in DG 1B room would also be fed by leakage under a door. The only drainage from the DG 1B room would be leakage under the door leading to the screenhouse pipe tunnel, because the room drain line (which contains a check valve) leads to the turbine building sump. Prior to late 2004, there was a six-inch curb in the DG 1B room that protected the diesel generator and 4 kV bus 6 from floods below six-inches. This curb was removed in late 2004. The curb has minimal impact on the analysis based on the dynamic water level evaluation and was not credited in the analysis.

Although propagation of water from the turbine building to the 4 kV buses would require some period of time, without a procedure or equipment for removing water from the room, it would have been inevitable for the water to eventually reach the buses if the flood source was not isolated.

3.3 Accident Sequence Progression

From the flooding initiating events and damage scenarios described above, the accident sequence progression has been analyzed. The accident sequence progression for each flooding event considers the response of the plant and operators to the initiating events and subsequent equipment failures, and is represented with an event tree. The flooding event trees are based on the KPS internal events PRA model event tree for loss of feedwater. In each case, if the operator successfully terminates the flood prior to failure of any buses, the accident progression would be identical to that of the existing loss of feedwater sequences except for equipment failed by spray from the initiating line break.

As with the accident scenarios, the accident sequence progression for each initiating event is very similar with differences only in the operator actions needed (i.e., isolation of the appropriate flood source) and the time required and available for those actions. The accident sequence progression following failure to isolate the flood before failure of any buses is described below.

A circulating water break would be isolated by manually tripping the circulating water pumps. For a service water break, the operator would isolate the turbine building header by closing valves SW-4A and -4B. For a high energy line break leading to fire sprinkler actuation, the operator would implement a procedure to isolate the discharge from the fire water system into

the turbine building by isolating the fire sprinklers on the turbine building mezzanine level, and isolating deluge and fire sprinkler valves in the turbine building basement. Also, the operators could trip the fire pumps locally at the 480V breakers or locally close the pump discharge valves to stop flow, but the operators were conservatively not credited to pass through flooded switchgear areas in safeguards alley to perform these actions.

If the operator fails to isolate a flood before the total volume of water released to the turbine building eventually reaches the failure height of 4 kV bus 5 (4 inches), then systems needed to mitigate the accident are impaired. When 4 kV bus 5 is lost, only one train of RCP seal cooling systems are available, and if they fail, a RCP seal LOCA could occur. The response to the RCP seal LOCA would depend on the leakage rate. The WOG 2000 RCP seal LOCA model as modified by the NRC was used for this evaluation.

If the operator fails to isolate the break initially, the water level would continue to rise in safeguards alley. Although 4 kV bus 5 and associated 480 V buses 51/52 would fail, 4 kV bus 6 and associated 480 V buses 61/62 would still be available, as well as the TDAFP. There is a second isolation opportunity in order to prevent eventual failure of the TDAFP's ability to start due to submergence of the associated auxiliary lube oil pump (at 9 inches). A third isolation opportunity exists to prevent eventual failure of 4 kV bus 6 (at 4 inches) and associated 480 V buses 61/62 (at 11 inches). The total volume of water required in the turbine building to flood 4 kV bus 6 is almost equal to that required to flood 480 V buses 61/62. The third isolation will also prevent submergence failure of the MDAFPs at 13 inches.

If the second or third isolation opportunity were successful, 4 kV power would be available to the already operating MDAFP 1B. If continued operation of this MDAFW pump succeeds, the operator performs RCS cooldown and depressurization by opening a SG PORV (which if necessary can be performed locally) to reduce RCP seal leakage. If cooldown fails, the operator could still remove decay heat by restoring RCS inventory using the available SI pump and throttling SI flow to conserve the water in the RWST per procedure.

If the available MDAFP fails, the TDAFP would be available to provide secondary heat removal. Successful cooldown using the TDAFP also requires opening a SG PORV. Additionally, long-term instrument power must be available to allow the operator to monitor SG level and prevent overfilling the SG and failing the TDAFP. Because the normal battery chargers would be unavailable due to the loss of the 480 V buses, providing long-term DC power for steam generator level indication and auxiliary feedwater control is credited by a number of means, including automatic or manual transfer of the inverters source from the batteries to their alternate source (offsite power), which would be available in many scenarios. In addition, a normal or spare battery charger could be powered from offsite power or the Technical Support Center (TSC) diesel to restore long term battery capacity and provide SG level indication. Due to the long time to steam generator dryout due to reduced decay heat levels at the earliest point the batteries might be depleted (eight hours), much more than eight hours would be available in the most limiting cases to implement these recovery actions (e.g., a minimum of 24 hours of battery life is available if the inverters are transferred to their alternate source at four hours).

A final isolation opportunity can prevent the water level in the turbine building from reaching 18 inches. If the water level reaches this height, core damage is assumed since the electrical connections of the reserve auxiliary transformer (RAT) to 4 kV buses 1 and 2 will be submerged leading to a loss of offsite power and the eventual failure of all safety-related buses. Additionally, this water level will result in the failure of the diesel generators since their air supply fans are powered from 480 V buses 51/52 and 61/62.

Seismic-induced floods were analyzed based on the EPRI 1989 hazard curve and associated spectra, detailed fragility assessments of the systems capable of causing critical floods in the turbine building impacting Class I components in safeguards alley, and random failures taken from the PRA models from the random pipe break analyses. Combinations of breaks which could occur in seismic events were explicitly considered in the analysis.

3.4 Operator Actions

As described above, the accident sequence progression for each initiating event is very similar with differences only in the operator actions and the time required and available for those actions. Most of these operator actions fall into one of three groups: isolation of the flood source before 4 kV bus 5 fails, isolation of the flood source before the TDAFP auxiliary lube oil pump fails, or isolation of the flood source before 4 kV bus 6 and associated 480 V buses 61/62 fail.

The human error probabilities (HEPs) for these actions vary for each flooding initiating event, based on the specific actions to be taken to isolate the particular flood source, the time required to complete those actions, the time available to complete those actions (based on the flow rate of the source), and the environment in which the actions must be performed. As noted above, the hot water and/or steam released from a feedwater or main steam line break would impact the operators' ability to investigate and isolate the flood. The impact of these conditions and dependencies among these three actions are also considered.

3.5 Results

The turbine building flooding analysis summarized above represents a conservative assessment for occurrence, plant response, and operator response to a flooding event in the turbine building. Quantification of this conservative analysis provides the core damage frequency (CDF) for the plant configuration in the year 2004. Table 3-3 presents the individual and total CDFs for each of the flooding scenarios.

The total contribution to CDF from the deficiency for the analyzed turbine building flood scenarios was calculated to be 5.9E-05. More than 84% of the CDF is due to four flood scenarios: large breaks in an inlet circulating water expansion joint (47%), feedwater line breaks that results in full flow discharge from the fire pumps (15%), main steam line breaks that results in full flow discharge from the fire pumps (12%), and seismic induced breaks of firewater, service water and condensate and reactor makeup water storage tanks (11%). Each of the remaining scenarios contribute less than 8% to the total CDF.

3.6 Conservatisms

Development of the initiating events, accident scenarios, accident sequence progression, and human error probabilities for turbine building floods in some cases required the use of conservative modeling methods or conservative assumptions. The noteworthy conservatisms inherent in the KPS turbine building flooding analysis are summarized below.

1. The potential for circulating water expansion joint breaks to result in tripping of the power source to the circulating water pumps prior to failing the TDAFW pump was not credited. At approximately an 18-inch flood level at 4160-V Buses 1 and 2, unisolable connections to the main and reserved auxiliary transformers would be shorted, resulting in almost instantaneous isolation of the transformers via switchyard breakers and loss of the power supply to the circulating water pumps. Based on GOTHIC analyses, the flood level in this scenario would not fail a running TDAFW pump.

2. The impact of tripping the feedwater and condensate pumps prior to emptying the hotwell was not evaluated. Instead it was conservatively determined that the entire feedwater and condensate inventory of 80,000 gallons would be pumped onto the turbine building floor. The feedwater pumps would likely be tripped early (within approximately ten minutes per the emergency operating procedures), and an extremely large break size (8,000 gpm) would be required to discharge 80,000 gallons within that period. A smaller break size would result in less water discharged and allow more time to isolate the break to prevent failure of risk significant components.

3.7 Sensitivity Analyses

Development of the initiating events, accident scenarios, accident sequence progression, and human error probabilities for turbine building floods requires many assumptions. To help characterize the modeling and data uncertainty due to assumptions made for this evaluation, a series of sensitivity analyses were performed and are summarized in Table 3-4. All the sensitivity evaluations resulted in a CDF contribution of less than 8.5E-05 per year (Yellow).

Table 3-1. **Flood Initiating Events and Frequencies**

Initiating Event	Frequency (per year)
Random circulating water inlet expansion joint break	2.8E-05
Random circulating water outlet expansion joint break	2.0E-05
Random service water system break with equivalent diameter greater than four inches	3.2E-05
Random fire water line with equivalent diameter greater than four inches	7.1E-05
Random feedwater or condensate high-energy line break that actuates sufficient turbine building fire sprinklers for full fire water flow	1.4E-04
Random feedwater or condensate high-energy line break that actuates 100 turbine building fire sprinklers	4.7E-05
Random main steam high-energy line break that actuates sufficient turbine building fire sprinklers for full fire water flow	2.5E-04
Random main steam high-energy line break that actuates 100 turbine building fire sprinklers	1.9E-05
Tornado-induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	Negligible
Turbine-missile induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	Negligible
Seismic-induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	EPRI,1989 Hazard Curve (see Appendix F, Table 3-1)

Table 3-2. **Flood Levels Impacting Class I Equipment**

Train A/B 480V switchgear (buses 51, 52, 61, 62)
• 2.75" flood level trips bottom row of breakers
• 4" flood level control power lost
• 11" flood level bus stabs covered and bus fails
Train A/B 4kV switchgear (buses 5 and 6 located in respective EDG rooms)
• 4" flood level control power connections covered and breaker control fails
• 6" flood level additional control power connections covered and breakers tripped
• 18" flood level bus stabs covered and bus fails
Turbine-driven AFW pump
• 9" flood level auxiliary lube oil pump fails
• 18" flood level pump fails
Motor-driven AFW pumps
• 9" flood level auxiliary lube oil pump fails
• 13" flood level pump fails
Instrument air compressors (A, B, C)
• 11" flood level compressor fails
Emergency diesel generators and dedicated shutdown panel
• Equipment is above 6" flood level, however associated 4kV buses fail @ 6" flood level

Note: Flood levels impacting equipment failure were conservatively assessed from measured levels to allow for measurement uncertainty (typically ¼" to ½" less than measurement). Flood levels provided in this table are relative to floor elevation at equipment. Flood levels used in analysis were relative to sea level.

Table 3-3. **Flood Scenario Contributors to Turbine Building Flooding Results**

Flood Scenario	Total CDF (per yr)	Percent of Total CDF
Random circulating water inlet expansion joint break	2.8E-05	47%
Random circulating water outlet expansion joint break	4.3E-06	7%
Random service water system break with equivalent diameter greater than four inches	1.2E-06	2%
Random fire water line with equivalent diameter greater than four inches	2.3E-06	4%
Random feedwater or condensate high-energy line break that actuates sufficient turbine building fire sprinklers for full fire water flow	8.7E-06	15%
Random feedwater or condensate high-energy line break that actuates 100 turbine building fire sprinklers	6.1E-07	1%
Random main steam high-energy line break that actuates sufficient turbine building fire sprinklers for full fire water flow	7.0E-06	12%
Random main steam high-energy line break that actuates 100 turbine building fire sprinklers	4.2E-07	1%
Tornado induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	Negligible	Negligible
Turbine missile induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	Negligible	Negligible
Seismic induced break of circulating water lines, firewater lines, service water lines, feedwater, condensate, and condensate and reactor makeup water storage tanks	6.6E-06	11%
Total	5.9E-05	100%

Table 3-4. Turbine Building Flooding Sensitivity Cases

Analysis Case	Total CDF	Percent Change
Baseline	5.9E-05	n/a
HEPs for operator actions with less than a 30-minute time window available from initiating event increased by 100%	6.5E-05	+9%
HEPs for operator actions with less than a one-hour time window available from initiating event increased by 100%	8.2E-05	+39%
HEPs for unproceduralized operator actions increased by 100%	7.1E-05	+21%
High energy (main steam and feedwater) line break frequencies increased by 100%	7.6E-05	+28%
Circulating water expansion joint break frequencies increased by 100%	7.7E-05	+31%
Random pipe break frequencies increased by 100%	7.7E-05	+31%

4 References

1. Letter, USNRC (Mark Satorius) to Dominion (David Christian), NRC Inspection Report 05000305/2005011(DRP) Preliminary Greater than Green Finding Kewaunee Power Station, October 6, 2005.

Appendix A

Initiating Events Analysis for Turbine Building Floods

INTERNAL FLOODING – Initiating Events Analysis for Turbine Building Floods

Owner's Acceptance: Thomas G. Hool (signature) THOMAS G. HOOI

Signature Print Name

10-28-05

Date

Kewaunee Power Station

Initiating Events Analysis for Turbine Building Floods

Revision No. 0

Effective Date: October 2005

Prepared By: R. J. Dremel — Date: 10/27/05

Reviewed By: D. M. Jones — Date: 10-27-05

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1.0 PURPOSE

The purpose of the internal flooding initiating events analysis is to define, quantify, and document the frequency results for potential internal flooding initiating events caused by breaks of non-safety-related piping/components in the Turbine Building before February 2005. That is, the analysis considers the plant prior to installation of the flood mitigation modifications installed in and around safeguards alley. Flooding events caused by earthquakes are considered separately.

The following information is identified, correlated, and developed as part of this analysis:

- Identification of pipe breaks of concern
- Quantification of the frequency expected for pipe breaks in those systems.

2.0 MODEL DEVELOPMENT

Internal flooding analysis encompasses the effects from the accumulation of fluids arising from the rupture, cracking or incorrect operation of piping/components within the station. In practice, major internal floods have occurred in nuclear power plants, from the rupture of pipes, valves and expansion joints as well as from operator errors during plant maintenance activities. All potential internal flood sources in the turbine building are considered in this analysis.

The steps for conducting the internal flooding initiating events analysis are described in the following section.

2.1 Steps for Turbine Building Internal Flooding Initiating Events Analysis

The analysis of the Turbine Building internal flooding initiating events analysis consists of the following steps:

1. Determine the volume of water that can be released before failure of equipment in safeguards alley would be expected.

2. Screen from consideration, those systems that cannot be significant contributors to the overall turbine flooding risk. This volume information can be used to screen from consideration systems that are not capable of causing failure of equipment even if the entire system volume is released or if a break in the system was allowed to flow for a long period of time.

3. Review information collected from the internal flooding walkdown and screening analysis [NB01] to identify potential flood sources. Review drawings to identify other potential flood sources not included in [NB01].

4. Identify the specific piping and components that can cause an internal flood. For these pipes and components, calculate the frequency for flooding events of concern.

The results from each of these steps are presented in Section 3.0.

Development of the flood scenarios and accident sequence progression for each of the identified initiating events is documented in a separate report.

2.2 Turbine Building Internal Flooding Initiating Events Major Assumptions

The key assumptions that were made during the internal flooding initiating events analysis are discussed in Section 3.0 for each of the specific flooding scenarios. In addition, the following general assumptions apply:

1. Actuation of sprinkler heads can also occur due to localized heating from operating equipment, aging failure, or impact damage from maintenance activities. Inadvertent actuation will result in discharge from a single sprinkler head, with a maximum rate of 30 gpm [CALC01]. The low flow rate from actuation of a single sprinkler head is assumed to be too low to cause equipment damage outside of the immediate area and, therefore it would be no more severe than a loss of main feedwater event. Therefore, it is concluded that flooding events that result only in failure of equipment located in the Turbine Building can be considered subsumed by the frequency of loss-of-main-feedwater transient events.

2. All piping systems in the Turbine Building are assumed to be non-safety related. Therefore, all pipes are initially considered as potentially causing an initiating event.

3. All flooding events in the Turbine Building are assumed to cause a loss of main feedwater and, therefore, result in a reactor trip. If a flooding event does not cause a reactor trip, the flood could be excluded as an initiator. The effect of this assumption is that all pipe breaks are initially considered as potentially causing an initiating event.

4. The service water return lines are assumed to operate at the same pressure as the supply headers. The impact of this assumption is that some breaks in service water return lines that may be screened as initiating events are included in the overall initiating event frequency. The impact of this assumption is expected to result in only a slight increase in the overall initiating event frequency.

3.0 TURBINE BUILDING FLOODING INITIATING EVENTS ANALYSIS

Identification and quantification of Turbine Building internal flooding initiating events is discussed below.

3.1 Determination of Water Volume to Fail Equipment in Safeguards Alley

For this analysis, failure of non-safety related systems in the Turbine Building are considered. A flooding event which does not result in failure of equipment outside the Turbine Building would be no more severe than a loss of main feedwater event. Although some equipment used to mitigate a loss of main feedwater event could be failed by the flooding event, the expected impact of these additional failures would be bounded by the loss of main feedwater event modeled in the internal events PRA for the following reasons.

First, other than main feedwater, the only potentially risk significant plant equipment located in the Turbine Building basement are the service air compressors and plant equipment water pumps. The plant equipment water pumps are located on the far southwest corner of the basement area such that a flooding event that would spray those pumps would be unable to spray any other equipment included in the PRA models. In addition, plant equipment water cooling is provided with a backup from service water so failure of these pumps would not directly cause failure of other equipment. The service air compressors are located in the north end of the turbine basement area such that a flooding event that would spray the service air compressors would be unable to spray any other equipment included in the PRA models. Also, the service compressors in the Turbine Building are provided with backup from instrument air compressors located in safeguards alley. Therefore, failure of the service air compressors located in the Turbine Building basement would not directly cause failure of other equipment. On the mezzanine level, non-safety related switchgear, Bus 3, Bus 4, and associated 480 VAC switchgear, and steam dump valves 11A and 11B are located. In the PRA models, the non-safety related switchgear is used only for equipment that otherwise would be failed by the Turbine Building flood. Failure of the steam dump valves can be mitigated by using the steam generator power operated relief valves (PORVs).

The frequency of Turbine Building flooding events is much less than the frequency of loss-of-main-feedwater transient events. Therefore, it is concluded that flooding events that result only in failure of equipment located in the Turbine Building can be considered subsumed by the frequency of loss-of-main-feedwater transient events.

Water released to the Turbine Building will flow to the basement. Drain lines and gaps in doors allow the water to flow to the rooms in the safeguards alley. If the total volume of water released from a pipe break is less than the volume of water needed to fail enough equipment located in the safeguards alley that accident mitigation response is significantly impaired, then the pipe break can be excluded from consideration in the internal flooding events analysis.

Water flowing from the Turbine Building basement to the safeguards alley could potentially fail instrument air compressors, auxiliary feedwater (AFW) pumps, 480 VAC switchgear buses 51, 52, 61, and 62, 4kVAC buses 5 and 6, and diesel-generators 1A and 1B. The first impact that a flooding event will have on equipment in the safeguards alley is when level reaches 2.75 inches on Bus 62 [CALC02] when the bottom row of breakers on the bus would open [CALC03] and the

loads listed in Figure 3-2 of [CALC03] would be lost. The next impact of the flood would be when water level reaches 2.75 inches of water on Bus 52 [CALC02] when the bottom row of breakers on the bus would open [CALC03] and the loads listed in Figure 3-1 of [CALC03] would be lost. After loss of the bottom row of breakers on the 480 VAC safety buses, the next impact of a turbine building-flooding event would be loss of the entire A-Train AC power safety buses [CALC02] when level reaches 4 inches on Bus 5 [CALC03].

Reviewing the loads supplied from the bottom row of breakers in the 480 VAC safety buses shows that their loss would not present an immediate challenge to the ability of the operators to mitigate a reactor trip provided that the flood is isolated prior to the flooding event causing failure of other equipment in safeguards alley, i.e., a loss of Bus 5. The battery chargers are lost when the bottom row of breakers open. Therefore, actions to ensure longer-term availability of DC power must be taken. If the flood is isolated before the A-train electrical safety buses would be failed when level reaches 4 inches on Bus 5, then the instrument inverters, BRA-111. BRA-112, BRB-111, and BRB-112, could be powered from their alternate power supply. An evaluation in Attachment 1 to Appendix D shows that adequate time is available to switch inverter power supplies and maintain battery capacity in excess of twenty-four hours. Therefore, this analysis will screen from consideration any flooding event that does not result in water level reaching 4 inches on 4kVAC safety Bus 5.

Analyses show that if 131,000 gallons of water is released to the turbine building in 10 seconds, water level would reach only 2.9 inches on Bus 5 and 3.1 inches on Buses 61/62 [CALC02]. The same analyses show that a release of 200,000 gallons of water into the turbine building in 10 seconds would cause level to reach 5.7 inches on Bused 61/62 and 4.3 inches on Bus 5. Interpolating between the two flood volumes above gives a flood volume of 185,000 gallons as the volume that would just fail Bus 5 and present the first significant challenge to the ability of the operators to mitigate a reactor trip. Therefore, any event that releases less than 185,000 gallons of water is screened from further consideration and the event can be considered subsumed by the loss of main feedwater event analyzed in the internal events PRA.

3.2 Screening of Systems as Potential Turbine Building Flooding Initiating Events

Not all flooding events that release greater than 185,000 gallons of water need to be considered as initiating events. Any pipe break where the flowrate from the break would require more than one hour to release 185,000 gallons is eliminated from consideration. It is reasonable to expect these pipe breaks can be detected and isolated within one hour for the following reasons. First, a Miscellaneous Sump Level High alarm would be received. The alarm response procedure for that alarm [PROC01] directs the operators immediately to the Miscellaneous Drains and Sumps Abnormal Operation procedure [PROC02], which specifies that an operator be sent to investigate this alarm. The Miscellaneous Sump Level High alarm would be actuated before water exceeded the capacity of the turbine room sump and spilled onto the floor. The alarm is received infrequently (See Attachment 1) and typically only during evolutions where excessive water is being directed to the sump. From [PROC02] the operators would enter the appropriate abnormal

operating procedure for the affected system.

For a system with a nominal pressure of 100 psig, a break with a three-inch equivalent diameter in a 4-inch line would result in a flow rate of 1800 gpm and a 3-inch equivalent diameter break in a 6-inch line would result in a flow rate of 2100 gpm (See Addendum 1 for details of the associated flow calculations). With these flow rates, 88 and 102 minutes respectively would be available for the operators to isolate the break before equipment in safeguards alley would be threatened to the point that the ability of the operators to mitigate a reactor trip would be seriously challenged by the failure of Bus 5. These flow rates are what would be expected from a sharp orifice-like break in a pipe and do not include any flow reduction that may occur due to head losses in the pipe from the pump to the break. The service water system supply headers are maintained at a nominal pressure of between 90 and 100 psig [REPORT06]. The service water return lines operate at a lower pressure, but will be assumed to operate at the same pressure as the supply headers. The fire protection system, when in standby is maintained at a pressure between 128 and 143 psig [REPORT01].

Although the volume of the potable water and service water pre-treatment systems is essentially unlimited, the systems contain only small-diameter lines and operate at pressures generally lower than 100 psig. A break in these systems would be expected to result in a release rate that would allow significantly longer than one hour to isolate the break. Therefore, these systems are eliminated from further consideration as causing a negligible increase in flooding risk.

The turbine oil systems contain less than 185,000 gallons and, therefore, are eliminated from further consideration.

The reactor makeup storage tanks have a maximum capacity of 80,000 gallons and, therefore, are eliminated from further consideration.

The condensate storage tanks (CSTs) have a maximum capacity of 150,000 gallons and, therefore, are eliminated from further consideration.

Therefore, all systems except the circulating water, fire protection water, service water, and high-energy line breaks (HELBs) that result in fire protection water system actuation are screened from consideration as flooding sources.

Turbine Missile-Induced Flooding Events

A flooding event could be caused if failure of the turbine generates a missile which then impacts and fails a system capable of causing a significant flooding event. An evaluation of turbine missile effects is presented in Appendix B.9 of the Kewaunee Power Station (KPS) Updated Safety Analysis Report (USAR) and is used as the basis for this analysis.

The probability of turbine missile generation due to fatigue has been determined to be much less than 1.0E-08. For stress corrosion, the probability of failure and missile generation by the original low-pressure turbine rotors is determined to be 1.64E-03 at rated speed and 1.49E-05 for overspeed [CALC05]. Note that the latter value is lower than the former because the latter includes the probability of the overspeed condition. The total probability of turbine missile generation is the sum of these two values or:

$$P_{TotMiss} = P_{MissRate} + P_{MissOver}$$

$$P_{TotMiss} = 1.64E\text{-}03 + 1.49E\text{-}05$$

$$P_{TotMiss} = 1.65E\text{-}03$$

These failure probability values are based on a five-year inspection interval so the frequency of turbine missile generation is determined as follows:

$$F_{TotMiss} = P_{ToteMiss} / 5 \text{ years}$$

$$F_{TotMiss} = 1.65E\text{-}03 / 5 \text{ years}$$

$$F_{TotMiss} = 3.30E\text{-}04 \text{ per year.}$$

Since the performance of the analysis that generated the above values, the low-pressure rotors have been replaced. As stated in USAR section 9.1, the probability of failure of the new rotors is less than the original rotors so the frequency calculated above is bounding for the current plant configuration.

Given that a turbine missile is generated, the probability that it impacts and fails a system capable of causing a significant flood must be considered. Missiles that occur on the operating deck may result in a steam release and could potentially impact the feedwater piping located on the southwest side of the building. Analyses [CALC06] have concluded that steam breaks on the turbine operating deck do not actuate sufficient fire protection sprinklers to present a flooding concern. Therefore, a turbine missile that impacts steam pipe on the operating deck does not present a flooding concern.

The feedwater piping on the operating deck is located on the southwest end of the building across from the southernmost low-pressure turbine. Between the turbine and feedwater piping is a moisture separator reheater (MSR), steam piping, and building structural supports. Only a very small portion of the piping could be impacted by a turbine missile that does not first impact the intervening equipment and structures. Assuming that a missile that impacts the intervening equipment will not cause failure of the feedwater piping on the operating deck, it is estimated based on visual inspections that only 5% of the missiles would be capable of impacting the feedwater piping. Assuming that all turbine missiles that impact the feedwater piping cause failure of the piping and actuate fire protection sprinklers, the frequency of such events is:

(3.30E-04 per year) * 0.05 = 1.65E-05 per year.

As described above, this frequency is bounding because the probability of failure for the new rotors is less than that of the old rotors on which these values are based. Also, this value assumes that all missiles that impact the feedwater piping penetrate the piping. Therefore, the frequency of turbine-missile-induced failures of feedwater piping on the operating deck would be negligible.

Turbine missiles that exit below the turbine shaft would be stopped by the concrete turbine support structure or imbedded in the condenser structure itself. Given the physical configuration of the turbine support structure and the condenser, a turbine missile would need to exit downward at a near vertical trajectory to imbed in the condenser. In doing so, the missile would contact the in-condenser feedwater heaters prior to contacting the circulating water tubes. If the missile did contact the circulating water tubes, such a failure would allow flow of circulating water back to the lake. Therefore, it is concluded that the flooding risk posed by turbine missiles that exit below the turbine rotor is considered negligible.

As described above, a conservative analysis of turbine-generated missiles concludes that the frequency of flooding events initiated by turbine missiles is sufficiently small as to be excluded from further analysis.

Tornado-Induced Flooding Events

Flooding events in the Turbine Building potentially could be initiated by the occurrence of a tornado which could fail systems either directly by wind loading or indirectly by causing a tornado-induced missile to impact and perforate a fluid system. Unlike random pipe failures where only a single system failure is considered at a time, a tornado could affect multiple systems simultaneously, thereby increasing the resulting flood height.

As described above, all systems except the circulating water, fire protection water, service water, and high-energy line breaks (HELBs) were screened from consideration as flooding sources. The systems were screened from consideration either because they contained insufficient inventory to damage equipment outside of the turbine building or because the flow rate that would result from any break would be low enough so that a very long time would be available for operator action to

isolate any flooding event prior to equipment damage outside the Turbine Building.

The screening of systems above is still valid with two exceptions; the condensate storage tanks (CSTs) and the reactor makeup storage tanks (RMSTs). When considered individually, the volume for each of these two sources is low enough that a flood which released their contents could not damage enough equipment outside the Turbine Building to seriously impair the ability of the operators to mitigate a reactor trip. Because the two sources are located near each other, a tornado could cause near simultaneous failure of all the tanks.

The primary flood risk in a tornado is due to a failure of the RMSTs and the CSTs in the tank room to the south of the auxiliary building. [CALC07] shows that the RMSTs would fail at lower wind loads than the CSTs. The capacity of each RMST is 40,000 gallons. Although some water could spill to other locations, such as outside, the maximum amount of water released from both RMSTs is 80,000 gallons. As discussed above, at least 185,000 gallons must be deposited in the turbine building basement to result in equipment failures in safeguards alley. Therefore, winds severe enough to fail the RMSTs, but not the CSTs, would not result in a significant risk increase. Since the combined capacity of the CSTs is 150,000 gallons, there is a potential of damage to equipment in safeguards alley due to flooding from the combination of the four tanks.

[CALC08] shows that the frequency of CST damage due to direct tornado impact is 6.7x10-7/yr. This reference also includes a discussion of tornado missiles. Specifically, the document states that tornado missiles are not a concern with wind speeds below 212 mph, which corresponds to an exceedance frequency of 7.1x10-6/yr. It also points out that most missiles would hit the upper portion of the tank, resulting in less that the full 150,000 gallons being released into the basement. Furthermore, for a missile to puncture the tank, the pipe must strike the tank nearly end-on along a radial line of the tank diameter. Any object that strikes slightly off normal or off the radial line would not be expected to penetrate the tank, but rather would be expect to glance off the tank without perforating it. Of the potential missiles that come within striking distance of the CST, only a fraction of them would be expected to strike the tank in such a manner as to be able to penetrate the tank. Therefore, the frequency of a tornado missile causing a flood of greater than 185,000 gallons of water to enter the turbine building basement is negligible.

Tornado-induced failure of the circulating water system is considered unlikely for several reasons. First, the majority of the piping is located in the basement under the main turbine. The turbine building is designed such that it will not collapse (although the panels may fail) following a tornado so it is unlikely that the piping would be failed directly by the tornado. Secondly, the circulating water pumps are powered from the non-safety buses which require offsite power. It is likely that a tornado severe enough to threaten the circulating water piping would also cause a loss of offsite power, thereby removing the motive force for system flow and stopping the flood. Third, tornado missile-induced failure is unlikely. A tornado missile risk analysis of the Kewaunee Power Station (KPS) was performed using the TORMIS methodology [CALC09]. In that study, the yearly probability of a tornado missile hitting either the diesel oil day tank vents, diesel exhaust stacks, or the turbine-driven auxiliary feedwater pump exhaust pipe is 9.5E-06 per year and the

probability of damaging one of the targets 1.7E-06 per year. These values are dominated by the concrete paver blocks located on the Turbine Building roof. Since all the circulating water piping is located below the turbine operating deck and, therefore, protected from such missiles, it is concluded that the tornado missile-induced failure probability is negligible.

The fire protection water header is located entirely in the Turbine Building basement, below grade. Several branch lines do extend to the mezzanine level to deluge valves and other equipment supporting system operation. Once on the mezzanine level, piping size reduces quickly. Only very short lengths of small-diameter piping to hose stations are located on the operating deck. As with the circulating water system, the fire protection water piping would be protected from direct failure in a tornado because of the ability of the Turbine Building to remain standing following such an event. The failure of fire protection water piping by missile impact is considered to be much lower than that calculated in [CALC07] and discussed above. Therefore, it is concluded that the risk from fire protection water flooding events initiated by tornados is negligible.

As with the fire protection water system, the majority of service water piping is located in the Turbine Building basement, below grade. No service piping is located on the operating deck. Service water piping located on the mezzanine level is generally smaller in size, e.g., less than six inches nominal pipe size. Because the Turbine Building is designed to not collapse under tornado winds, direct failure of the service water piping is not expected. Failure of service water piping due to missile impact is considered to be a negligible contribution to risk as discussed above. Also, the turbine header isolation valves would be available to isolate the Turbine Building header following a tornado. Therefore, it is concluded that the risk from service water flooding events initiated by tornados is negligible.

For a tornado to cause a HELB, the event must first expose the Turbine Building to the outside winds. Because the Turbine Building contains blowout panels that are designed to fail, it is likely that the building would be open to the outside winds. The analysis of sprinkler actuation due to HELB [CALC06] shows that Turbine Building temperatures are reduced rapidly once the blowout panels fail. For a tornado-induced HELB, the blowout panels would fail prior to the HELB and the tornado winds would help mitigate any temperature rise caused by steam release. Therefore, the number of sprinklers actuated for any HELB caused by a tornado would be much less than a similar size break initiated internally to the Turbine Building. Also, feedwater, condensate, and steam piping of concern to flooding events is designed for very high pressures and, therefore, much less likely than the diesel exhaust stacks to be damaged by tornado missiles. Therefore, it is concluded that the risk from tornado-induced HELBs that actuate the fire protection system is negligible.

3.3 Identification of Systems as Potential Flooding Sources

For piping in the turbine building, only the service water, circulating water, and fire protection

water contain sufficient volume or lines large enough to release fluid to the point that equipment in safeguards alley would be threatened in less than one hour. As described above, all other systems were screened as negligible contributors to flooding risk. Further analysis of these systems as potential flooding initiators is given in the sections that follow.

3.3.1 Service Water Flooding Events

This initiating event will assume that all service water piping in the turbine building is supplied from the 20-inch turbine building header and is downstream of motor-operated valves SW-4A and SW-4B. There is service water piping that is in the turbine building but is not supplied from the turbine building header. Examples include auxiliary feedwater pump room cooler return lines to the standpipe, diesel cooling return lines, and air compressor cooling lines. With the exception of the diesel cooling return lines, piping in the turbine building that is not supplied from the turbine building header is small, e.g., 1.5-inches or less. Any leak from such lines would result in a low flow rate thereby providing the operators with a long time period to isolate the break using manually-operated valves local to the component. The diesel cooling return lines are normally isolated so any break in those lines would not result in a flooding event.

As discussed in Section 3.2, service water lines with a nominal diameter of less than four inches would not release of sufficient water in one hour to threaten enough equipment in safeguards alley that accident mitigation would be significantly impaired. Therefore, only breaks in service water lines four inches or greater are considered as potential initiating events.

3.3.2 Circulating Water Flooding Events

A break from the circulating water system could result in the release of a very large amount of water in a short period of time. Calculations [CALC10] show that rupture of an expansion joint on the circulating water supply lines would be expected to release 58,000 gpm of flow. Because the pressure on the return lines is less and because gravitational effects would tend to direct flow to the return header, a break in the circulating water return lines would release less flow to the turbine building. A rupture of an expansion joint on the circulating water return lines would be expected to release 14,000 gpm to the Turbine Building basement [CALC10]. Because there is significant difference in the rate of release for the two locations, each is considered as a unique initiating event. A break of the piping will be assumed to result in the same flow rate as a rupture of the expansion joint.

3.3.3 Fire Protection Water Flooding Events

The flooding event could be caused by an uncontrolled release of water from the fire protection system either because of a random break in the system or as a consequential release caused by a high energy line break (HELB). As discussed in Section 3.2, fire protection water lines with a nominal diameter of less than four inches would not release of sufficient water in one hour to threaten equipment in safeguards alley. Therefore, only random breaks in fire protection water lines four inches or greater are considered as potential initiating events.

A HELB could raise temperatures in the Turbine Building to the point that fire protection sprinklers or deluge systems actuate. If a large number of sprinklers actuate, the potential exists to threaten equipment in safeguards alley. Breaks in the feedwater or condensate lines release a large quantity of water to the Turbine Building in addition to actuating fire protection systems. Breaks in the steam systems do not result in an appreciable quantity of water being released to the Turbine Building. Therefore, steam line breaks are considered separately from feedwater and condensate line breaks.

Steam Line Breaks

Analyses show that steam line breaks greater than nine inches equivalent diameter and upstream of the turbine building throttle valves will result in a safety injection (SI) signal [CALC06]. Because a SI signal inhibits operation of the fire pumps [REPORT01], large breaks in the main steam system can be excluded as initiating events. In addition, the same analyses show that steam line breaks on the operating deck of the turbine building and less than nine-inches in diameter will not actuate any fire sprinklers. Therefore, all steam lines on the operating deck can be excluded as initiating events.

For steam line breaks below the operating deck, calculations show that breaks smaller than two inches equivalent diameter actuate no fire protection sprinklers [CALC06], however, for the highest pressure main steam lines, i.e., upstream of the turbine throttle valves, a three-inch equivalent diameter break will actuate enough sprinklers that the fire pumps can be assumed to be providing full flow to the system.

For the extraction steam supply to the 15 feedwater heaters, a four-inch equivalent diameter break would actuate about 100 sprinklers while a six-inch or larger break would actuate enough sprinklers that the fire pumps can be assumed to be providing full flow to the system.

After steam exits the high-pressure turbine, a four-inch equivalent diameter break would actuate no fire protection systems while a six-inch break would actuate about 100 sprinklers.

Based on these results, two initiating events are analyzed for flooding events. The first is a steam line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. This event includes any break upstream of the turbine throttle valves with an

equivalent diameter less than nine inches but greater than two inches, any break in the extraction steam line greater than six inches, and any break in a line after exiting the high-pressure turbine with an equivalent diameter of six inches or greater.

The second event is a steam line break that actuates approximately 100 sprinklers. The Turbine Building HELB models show that 100 sprinklers is representative of moderate releases. This event includes breaks in the extraction steam lines with an equivalent break size between two and six inches, and breaks in a line after exiting the high-pressure turbine and having an equivalent diameter of two to six inches.

Feedwater and Condensate Line Breaks

This event initially considers breaks in any pipe containing main turbine working fluid above saturation conditions and includes all piping from the outlet of second feedwater heaters (12A and 12B). Analyses show that breaks upstream of the fourth feedwater heaters (14A and 14B) do not actuate any fire protection systems [CALC06]. In addition, the volume of water released from such breaks is less than the 185,000 gallons needed to threaten any equipment in safeguards alley. Therefore, all breaks upstream of the fourth feedwater heaters can be excluded from further consideration.

For piping between the 14 and 15 feedwater heaters, breaks smaller than four inches equivalent diameter actuate no sprinklers. A six-inch equivalent diameter break in these lines would actuate about 100 sprinklers and a nine-inch equivalent break would actuate enough sprinklers that the fire pumps can be assumed to be providing full flow to the system.

For piping after the 15 feedwater heaters, a two-inch or smaller equivalent diameter break would actuate no fire protection systems. A four-inch break would actuate enough sprinklers that the fire pumps can be assumed to be providing full flow to the system.

Based on these results, two initiating events are analyzed for flooding events. The first is a feedwater or condensate line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. This event includes any break between the 14 and 15 feedwater heaters with an equivalent diameter of greater than six inches or any break downstream of the 15 feedwater heaters with an equivalent diameter greater than two inches.

The second event is a feedwater or condensate line break that actuates approximately 100 sprinklers. The Turbine Building HELB models show that 100 sprinklers is representative of moderate releases. This event includes breaks in the lines between the 14 and 15 feedwater heaters with an equivalent diameter between two and six inches.

3.3.4 Summary of Turbine Building Internal Flooding Events

For internal flooding events in the turbine building, eight different initiating events have been defined for further analysis. The first is a break in the service water system in the Turbine Building and having an equivalent diameter of greater than four inches. The second event is a break in the circulating water supply lines. The third is a break in the circulating water return lines. The fourth is a random break in fire protection water piping with the break having an equivalent diameter of greater than four inches. The fifth is a steam line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. The sixth is a steam line break that actuates approximately 100 fire sprinklers. The seventh is a feedwater or condensate line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. The eighth is a feedwater or condensate line break that actuates approximately 100 fire sprinklers.

3.4 Quantification of Internal Flooding Initiating Event Frequencies

Quantification of the initiating event frequency for each of the eight events discussed above is performed in the following sections. Described within each section is the source of data used for system break frequency determination and how that data was used to calculate the initiating event frequency.

3.4.1 Service Water-Initiated Flooding Events

To determine the frequency of service water-initiated flooding events, the frequency of pipe breaks is calculated using the methodology presented in EPRI TR 102266, "Pipe Failure Study Update", April 1993 [REPORT02]. Newer data sources that can be used to determine internal flooding initiating event frequency values have recently been published, i.e., EPRI TR 1012302, "Pipe Rupture Frequencies for Internal Flooding Probabilistic Risk Assessments (PRAs)," [REPORT04]. However, service water initiating event frequency values calculated using the data and methodology of [REPORT04] are not expected to be significantly different from those calculated using [REPORT02]. Generally, it is expected that lower initiating event frequency values will result if calculated using [REPORT04] instead of [REPORT02]. In addition, the pipe segment data needed to calculate initiating event frequency values using the methodology of [REPORT02] is already available. However, a significant effort would be needed to determine the pipe length data needed to employ the methodology of [REPORT04]. In addition, service water-initiated flooding events have been shown in prior, scoping studies to be a small contribution to overall risk from turbine building floods.

Therefore, the frequency of service water-initiated flooding events will be calculated using the methodology presented in [REPORT02].

Using that methodology, pipe breaks are categorized as large, medium, and small. A break in a large pipe will not always be categorized as large. There is a probability that a large pipe will

have a break in the medium or small category. Similarly, a medium pipe may have a break in the small category. When determining the frequency of breaks that result in the different categories, the recommended values from [REPORT02] will be used to determine the probability of equivalent break sizes.

The frequency for failure of components such as valves and heat exchangers is calculated using data from Eide, S.A. et al., "Component External Leakage and Rupture Frequency Estimates", EGG-SSRE-9639 [REPORT03]. The following table gives the component rupture frequencies from [REPORT03] that are used in this analysis:

Component Rupture Frequencies

Component Type	Rupture/Leakage	Rate (/hr)
Valve	Leakage	1.0E-08
	non-PCS Rupture[1]	4.0E-10
	PCS Rupture	1.0E-10
Pump	Leakage	3.0E-08
	non-PCS Rupture	1.2E-09
	PCS Rupture	3.0E-10
Flange	Leakage	1.0E-08
	Rupture	1.0E-10
Heat Exchanger Tube Side	Leakage	1.0E-07
	non-PCS Rupture	4.0E-09
	PCS Rupture	1.0E-09
Heat Exchanger Shell Side	Leakage	1.0E-08
	non-PCS Rupture	4.0E-10
	PCS Rupture	1.0E-10
Tank	Leakage	1.0E-08
	non-PCS Rupture	4.0E-10
	PCS Rupture	1.0E-10

[1] PCS = Primary Cooling System

It was assumed that the rupture of valves, pump casings, and other components have the same conditional probability of small, medium, large ruptures as for piping.

The initiating event frequency for service water-initiated flooding events in the turbine building will consider breaks in all pipes with a nominal size greater than four inches. Service water pipes and components are tabulated by size in [NB01]. As shown in Appendix F of [NB01], service water piping in the turbine is either four inches or smaller or six inches or greater. Twenty-seven pipe segments and nine valves were identified in the six-inch-or-larger category.

It will be assumed that large-bore piping breaks with an equivalent break diameter in the medium (two-to-six-inch) category are not large enough to be of concern because breaks that size in large-

bore piping have a sufficiently low flow rate to allow more time for recovery and, therefore, are not included in the total frequency of service water flooding events. Therefore, the frequency of large service water initiated flooding events in the Turbine Building was calculated to be:

$F_{SW} = F_{SWPipe} + F_{SWValve}$

F_{SW} = ((27 pipe segments) * (1.39E-10 / pipe segment-hour) + (9 valves) * (4.0E-10 / valve-hour)) * 0.5 conditional probability of a large break [REPORT02]

F_{SW} = (3.75E-09 / hour + 3.6E-09 / hour) * 0.5

F_{SW} = 3.78E-09 / hour

F_{SW} = 3.22E-05 per year.

The contribution of maintenance-induced flooding events is considered negligible for several reasons. First, the maintenance event must be such that the event breaches the service water system pressure boundary but still permits operation of the plant and the turbine building header. Actions such as cleaning heat exchanger water boxes could be performed. However, most valves in the systems could not be breached without securing the entire header. Therefore, the frequency of maintenance events is expected to be small. Second, the isolation valves for the service water-cooled heat exchangers are all manual valves located near the component being serviced. Should a breach of an unisolated component occur, the maintenance personnel would be able to quickly isolate the leak.

3.4.2 Circulating Water Inlet Line-Initiated Flooding Events

Flooding from the circulating water system inlet lines could occur due to three causes, failure of the expansion joints, rupture of the piping and components in the system, or maintenance errors. The frequency of failure of expansion joints is documented in Attachment 2 which provides a failure frequency of 3.7E-06 per year per expansion joint. With four inlet expansion joints, the total frequency of expansion joint failures is calculated to be:

$F_{CWINExp}$ = 1.48E-05 per year.

As with service water-initiated flooding events, the frequency of system breaks (excluding expansion joint breaks) is calculated using the methodology of [REPORT02]. Use of this methodology over the newer methodology recently published in [REPORT04] is judged to be acceptable for the same reasons explained in Section 3.4.1.

Circulating water pipes and components are tabulated in [NB01]. As shown in Appendix F of [NB01], circulating water inlet piping contains ten pipe segments and four valves. Therefore, the

frequency of large circulating water inlet-initiated pipe rupture events was calculated to be:

$F_{CWINPipe} = F_{CWPINipe} + F_{CWINValve}$

$F_{CWINPipe}$ = ((10 pipe segments) * (1.39E-10 / pipe segment-hour) + (4 valves) * (4.0E-10 / valve-hour)) * 0.5 conditional probability of a large break [REPORT02]

$F_{CWINPipe}$ = (1.39E-09 / hour + 1.60E-09 / hour) * 0.5

$F_{CWINPipe}$ = 1.49E-09 / hour

$F_{CWINPipe}$ = 1.31E-05 per year.

A flooding event could be initiated during maintenance operations if the following conditions exist or events occur. First, operation of at least one circulating water pump must continue through the maintenance event. This would be expected for power operations. Second, the circulating water system pressure boundary must be breached. A breach would be expected for events such as cleaning water boxes. Third, a failure must occur so as to breach the isolation boundary from the circulating water inlet header to the maintenance opening. Isolation failures are described in more detail below.

Only breaks greater than six inches equivalent diameter are considered because the circulating water system operates at a very low pressure and the flow rate from breaks less than six inches would be expected to allow a significant time period for operators to isolate the break. The only isolation failures that would be of concern are the condenser inlet isolation valves. These motor-operated valves are controlled from local push button stations. During the maintenance event, the valve would be closed, the breaker opened, and then the open breaker and valve hand wheel would be danger tagged. In addition, the push button station would be caution tagged. Therefore, inadvertent opening of the valve would require that the danger tags be disregarded. Then the valve must be manually opened sufficiently to allow flow to endanger turbine building equipment. Since the valves are located just below the water box inlets, it is unlikely that an operator would open a valve without noticing that water was being released. Similarly, if maintenance is attempted on an unisolated water box, then the operators would be expected to notice flow from the system as the pressure boundary is being unbolted. When leakage occurs, the operators can be expected to secure the area and investigate. Random failures of the valve disk are considered negligible. Therefore, flooding events initiated by maintenance on the circulating water system are considered negligible contributors to the overall initiating event frequency and are neglected.

The total frequency of large breaks in the circulating system inlet piping is the sum of the frequency of expansion joint ruptures and the frequency of large pipe ruptures, or,

$F_{CWIN} = F_{CWINExp} + F_{CWINPipe}$.

F_{CWIN} = 1.48E-05 per year + 1.31E-05 per year

F_{CWIN} = 2.79E-05 per year.

3.4.3 Circulating Water Outlet Line-Initiated Flooding Events

Flooding from the circulating water system outlet lines could occur due to three causes, failure of the expansion joints, rupture of the piping in the system, or maintenance errors. Failure of expansion joints used the information from Attachment 2 that provided a failure frequency of 3.7E-06 per year per expansion joint. With four outlet expansion joints, the total frequency of expansion joint failures is calculated to be:

$F_{CWOUTExp}$ = 1.48E-05 per year.

As with service water-initiated flooding events, the frequency of system breaks (excluding expansion joint breaks) is calculated using the methodology of [REPORT02]. Use of this methodology over the newer methodology recently published in [REPORT04] is judged to be acceptable for the same reasons explained in Section 3.4.1.

Circulating water pipes and components are tabulated in [NB01]. As shown in Appendix F of [NB01], circulating water outlet piping contains eight pipe segments but no components other than the expansion joints discussed above. Therefore, the frequency of large circulating water outlet-initiated pipe rupture events was calculated to be:

$F_{CWOUTPipe}$ = ((8 pipe segments) * (1.39E-10 / pipe segment-hour)) * 0.5 conditional probability of a large break [REPORT02]

$F_{CWOUTPipe}$ = (1.11E-09 / hour) * 0.5

$F_{CWINPipe}$ = 4.87E-06 per year.

A flooding event could be initiated during maintenance operations if the following conditions exist or events occur. First, operation of at least one circulating water pump must continue through the maintenance event. This would be expected for power operations. Second, the circulating water system pressure boundary must be breached. A breach would be expected for events such as cleaning water boxes. Third, a failure must occur so as to breach the isolation boundary from the circulating water inlet header to the maintenance opening. Isolation failures are described in more detail below.

Only breaks greater than six inches equivalent diameter are considered because the circulating water system operates at a very low pressure and the flow rate from breaks less than six inches

would be expected to allow a significant time period for operators to isolate the break. The only isolation failures that would be of concern are the condenser inlet isolation valves. These motor-operated valves are controlled from local push button stations. During the maintenance event, the valve would be closed, the breaker opened, and then the open breaker and valve hand wheel would be danger tagged. In addition, the push button station would be caution tagged. Therefore, inadvertent opening of the valve would require that the danger tags be disregarded. Then the valve must be manually opened sufficiently to allow flow to endanger turbine building equipment. Since the valves are located just below the water box inlets, it is unlikely that an operator would open a valve without noticing that water was being released. Similarly, if maintenance is attempted on an unisolated water box, then the operators would be expected to notice flow from the system as the pressure boundary is being unbolted. When leakage occurs, the operators can be expected to secure the area and investigate. Random failures of the valve disk are considered negligible. Therefore, flooding events initiated by maintenance on the circulating water system are considered negligible contributors to the overall initiating event frequency and are neglected.

The total frequency of large breaks in the circulating system outlet piping is the sum of the frequency of expansion joint ruptures and the frequency of large pipe ruptures, or,

$F_{CWOUT} = F_{CWOUTExp} + F_{CWOUTPipe}$.

F_{CWIN} = 1.48E-05 per year + 4.87E-06 per year

F_{CWIN} = 1.97E-05 per year.

3.4.4 Random Breaks in Fire Protection Water Piping

As with service water-initiated flooding events, the frequency of system breaks is calculated using the methodology of [REPORT02]. Use of this methodology over the newer methodology recently published in [REPORT04] is judged to be acceptable for the same reasons explained in Section 3.4.1.

The initiating event frequency for random breaks in the fire protection water system considers breaks in all pipes with a nominal size greater than four inches. Piping drawings for the fire protection water system were reviewed and piping and components that are located in the turbine building and that cause a flooding event of concern were tabulated by pipe size. The piping tabulation in Addendum 2 identified 40 piping segments, 20 valves, and 26 flanges with a nominal size greater than four inches. Assuming that fire protection water piping is classified in the "other safety related" category used in [REPORT02], the frequency of fire protection water-initiated flooding events is calculated to be:

$F_{FPR} = F_{FPPipe} + F_{FPValve} + F_{FPFlange}$

F_{FPR} = ((40 pipe segments) * (1.39E-10 / pipe segment-hour) + (20 valves) * (4.0E-10 / valve-hour) + (26 Flanges) * (1.0E-10 / flange-hour)) * 0.5 conditional probability of a large break [REPORT02]

F_{FPR} = (5.56E-09 / hour + 8.00E-09 / hour + 2.6E-09 / hour) * 0.5

F_{FPR} = 8.08E-09 / hour

F_{FPR} = 7.08E-05 per year.

It will be assumed that large-bore piping breaks with an equivalent break diameter in the two-to-six-inch category are not large enough to be of concern because breaks that size in large-bore piping have a sufficiently low flow rate to allow more time for recovery and are not included in the total frequency of fire protection water flooding events.

The contribution of maintenance-induced flooding events is considered negligible for several reasons. First, the maintenance event must be such that the event breaches the fire protection water system pressure boundary but still allows the system to be pressurized. There are very few large-bore components that would permit such maintenance. Potentially, certain deluge valves could be breached. Next, the maintenance must be such that the breach would allow flooding to continue undetected for a significant time period following any operator error that resulted in an inadvertent breach. For deluge valves in the fire protection system, their associated isolation valve is immediately adjacent to the valve. Therefore, should a breach of an unisolated component occur, the maintenance personnel would be able to quickly isolate the leak. For these reasons, the frequency of maintenance events to the fire protection flooding initiating event frequency is considered negligible.

3.4.5 Steam Line Breaks Causing Large Fire Protection System Actuations

The first step in determining the frequency of steam line breaks that cause large fire protection system actuations is to determine the length and location of the steam pipes of concern. Piping layout drawings were reviewed and dimensions indicated on them were used to determine the length of steam pipes that are of concern to turbine building flooding events. Details of the pipe length data are listed in Addendum 3 Summing the lengths of high-pressure main steam piping located on the mezzanine and basement levels gives a total of 884.6 linear feet of piping. Summing the lengths of extraction steam piping located o the mezzanine and basement levels gives a total of 176.5 linear feet of piping. Summing the lengths of lower-pressure steam piping located on the mezzanine and basement levels gives a total of 621.7 linear feet of piping. All other steam piping was located either on the operating deck or in the Auxiliary Building. (Note all of the steam piping tabulated is at least 6-inch diameter, and therefore of sufficient size to have the break flow required for a large fire protection actuation.)

Because not all high-energy line breaks would result in a turbine building flooding event, a separate analysis was performed to determine the frequency for steam line breaks of interest. This separate analysis uses the data of [REPORT04] and is documented in [REPORT05]. Refer to [REPORT05], which is included as Attachment 3, for details of the calculations. From that analysis, the frequency of steam line breaks (including failures of valves, flanges, etc.) that result in large fire protection system actuations, F_{SLBL}, is:

F_{SLBL} = 2.53E-04 per year

3.4.6 Steam Line Breaks Causing Intermediate Fire Protection System Actuations

Calculation of the frequency of this event is performed in [REPORT05] using the pipe length data described in Section 3.4.5 for large steam line breaks. From [REPORT05], the frequency of steam line breaks (including failures of valves, flanges, etc.) that result in intermediate fire protection system actuations, F_{SLBM}, is:

F_{SLBM} = 1.87E-05 per year

3.4.7 Feedwater and Condensate Line Breaks Causing Large Fire Protection System Actuations

As discussed in Section 3.3.3, this event includes any break with an equivalent diameter greater than two inches in piping downstream of the 15 feedwater heaters and any break with an equivalent diameter greater than six inches between the 14 and 15 feedwater heaters.

The first step in determining the frequency of feedwater and condensate line breaks that cause large fire protection system actuations is to determine the length and location of the pipes of concern. Piping layout drawings were reviewed and dimensions indicated on them were used to determine the length of feedwater and condensate pipes that are of concern to turbine building flooding events. Details of the pipe length data are listed in Addendum 3. Summing the lengths of feedwater piping downstream of the 15 feedwater heaters gives a total of 331.56 linear feet of piping. Summing the lengths of feedwater and condensate piping located between the 14 and 15 feedwater heaters gives a total of 696.65 linear feet of piping. (Note all of the feedwater and condensate piping tabulated is at least 12-inch diameter, and therefore of sufficient size to have the break flow required for a large fire protection actuation.)

Because not all high-energy line breaks would result in a turbine building flooding event, a separate analysis was performed to determine the frequency for feedwater and condensate line breaks of interest. This separate analysis uses the data of [REPORT04] and is documented in [REPORT05]. Refer to [REPORT05], which is included as Attachment 3, for details of the calculations. From that analysis, the frequency of feedwater and condensate line breaks (including failures of valves, pumps, heat exchangers, etc.) that result in large fire protection system actuations, F_{FLBL}, is:

F_{FLBL} = 1.35E-04 per year

3.4.8 Feedwater and Condensate Line Breaks Causing Intermediate Fire Protection System Actuations

As discussed in Section 3.3.3, this event includes any break with an equivalent diameter between two and six inches between the 14 and 15 feedwater heaters. Identification and tabulation of the pipe lengths is described above.

Because not all high-energy line breaks would result in a turbine building flooding event, a separate analysis was performed to determine the frequency for feedwater and condensate line breaks of interest. This separate analysis uses the data of [REPORT04] and is documented in [REPORT05]. Refer to [REPORT05], which is included as Attachment 3, for details of the calculations. From that analysis, the frequency of feedwater and condensate line breaks (including failures of valves, pumps, heat exchangers, etc.) that result in large fire protection system actuations, F_{FLBM}, is:

F_{FLBM} =4.69E-05 per year

4.0 SUMMARY

For the analysis of internal flooding caused by pipe and component failures in the turbine building that potential threaten equipment in safeguards alley, eight initiating events have been identified and their associated frequency values quantified. These events are summarized in the table below.

Event	Consequence	Frequency (per year)
Random Service Water Break	Releases a large flow of Service Water to the Turbine Building	3.22E-05
Circulating Water Inlet Piping Break	Releases 58,000 gallons per minute to the Turbine Building	2.79E-05
Circulating Water Outlet Piping Break	Releases 14,000 gallons per minute to the Turbine Building	1.97E-05
Random Fire Protection Water Break	Releases full flow from both fire water pumps to the Turbine Building	7.08E-05
Large Steam	Actuates enough fire sprinklers that full fire protection water	2.53E-04

Event	Consequence	Frequency (per year)
Line Break	flow is released to the Turbine Building	
Intermediate Steam Line Break	Actuates 100 fire sprinklers that release fire protection water flow is released to the Turbine Building	1.87E-05
Large Feedwater or Condensate Line Break	Actuates enough fire sprinklers that full fire protection water flow is released to the Turbine Building	1.35E-04
Intermediate Feedwater or Condensate Line Break	Actuates 100 fire sprinklers that release fire protection water flow is released to the Turbine Building	4.69E-05

5.0 REFERENCES

[CALC01] X-K-204-1696, Revised 4/5/1972.

[CALC02] [redacted]

[CALC03] MPR Report 2823, "Past Operability Evaluation of Electrical Equipment Due To Flooding in Kewaunee Nuclear Power Plant," Revision 2.

[CALC05] "Results of Probability Analyses of Disc Rupture and Missile Generation," CT-24108, Revision 0, August 1980, Westinghouse Electric Corporation.

[CALC06] MPR Calculation 0064-0509-DEC-03, Revision 0, "Turbine Building HELB Fire Protection Actuation Analysis."

[CALC07] Stevenson & Associates Calculation CAL-002: Evaluation of CST and RMST Wind Load.

[CALC08] PRA Application 05-13: Core Damage Frequency due to Tornadoes Damaging Condensate Storage Tanks

[CALC09] "Tornado Missile Risk Analysis for Kewaunee Nuclear Plant," July 2005, Applied Research Associates, Inc.

[CALC10] MPR Calculation 0064-0011-SPK-1, Revision 1, "Postulated Leaks Through Circulating Water Expansion Joint."

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[MAN01] "CRANE Technical Paper No. 410, Flow of Fluids Through Valves, Fittings, and Pipe", CRANE CO., 1988.

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[PROC02] A-MDS-30, Miscellaneous Drains and Sumps Abnormal Operation," Revision N, 3/5/2002.

[REPORT01] KPS System Description, "Fire Protection System," Rev. 2.

[REPORT02] Electric Power Research Institute, EPRI TR 102266, "Pipe Failure Study Update," April 1993.

[REPORT03] Eide, S.A. et al., 1991, "Component External Leakage and Rupture Frequency Estimates", EGG-SSRE-9639, INEL, November 1991.

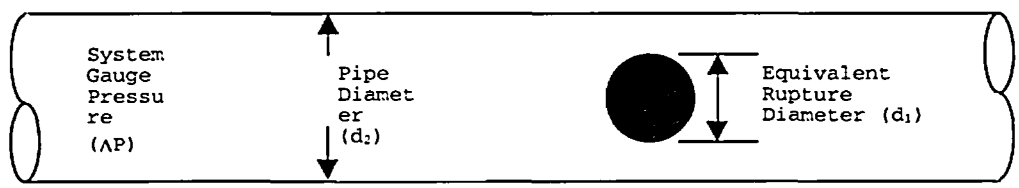
[REPORT04] Electric Power Research Institute, EPRI TR 1012302, "Pipe Rupture Frequencies for Internal Flooding Probabilistic Risk Assessments (PRAs)," September, 2005.

[REPORT05] Fleming, K.N. et al, "High Energy Line Break Initiating Event Frequencies for the Kewaunee PRA", October 2005.

[REPORT06] KPS System Description, "Service Water System," Rev. 3.

ADDENDUM 1, SERVICE WATER AND FIRE PROTECTION SYSTEM PIPING LEAK RATE CALCULATION

Infinite flood sources, such as Service Water and Fire Protection system, have been analyzed to determine the equivalent size of a pipe rupture that will potentially overwhelm the drainage capacity of a designated flood area. The analysis was performed using an Excel spreadsheet that calculates the flow equations listed below to determine flow rates from various rupture sizes in various diameter pipes.



Calculating the volumetric flow rate can be done by applying the following equation:

$$q_{ft^3/sec} = C * A * \sqrt{\frac{2g * 144 * \Delta P}{\rho}}$$ [MAN01], Eqn. 2.23

or expressed in Gallons per Minute (GPM)

$$Q_{GPM} = \left(448.8 \frac{GPM}{ft^3/Sec}\right) * (C * A) * \sqrt{\frac{2g * 144 * \Delta P}{\rho}}$$

Where:

ΔP = System Gauge Pressure (psig)
A = Equivalent Rupture Area (ft^2)
C = Flow Coefficient (dimensionless)
ρ = Density of Water (lb/ft^3)
g = Gravity (32.17 ft/sec^2)

The Flow Coefficient (C) for an orifice is calculated using the equation

$$C = \frac{C_d}{\sqrt{(1 - \beta^4)}}$$ [MAN01], Page A-20

As stated in [MAN01], Table 3.10, the Discharge Coefficient (C_d) for a sharp-edged orifice is 0.62.

The ratio of small to large diameter in an orifice (β) is defined as:

$$\beta = \frac{(d_1)}{(d_2)}$$ [MAN01], Page A-20

For calculation of the flow rates from a ruptured Service Water System, the following constants are used:

Piping Inside Diameters

1" Standard Schedule 40 Pipe:	1.049"	[MAN01], Page B-16
2" Standard Schedule 40 Pipe:	2.067"	[MAN01], Page B-16
4" Standard Schedule 40 Pipe:	4.026"	[MAN01], Page B-16
6" Standard Schedule 40 Pipe:	6.065"	[MAN01], Page B-16

Pressure

Normal Service Water System Pressure (ΔP): 90-100 psig [REPORT06]

Density

Water Density at 54°F:	62.39 lb/ft3	[MAN01], Page A-6
Water Density at 74°F*:	62.27 lb/ft3	[MAN01], Page A-6

For calculation of the flow rates from a ruptured Fire Protection System, the following constants are used:

Pressure

Fire Protection System Pressure (ΔP) (standby): 128-143 psig [REPORT01]

Density

Water Density at 85°F: 62.17 lb/ft3 [MAN01], Page A-6

The table below shows the resultant flow rates for various rupture sizes in pipes with diameters 1 inch, 2 inch, 4 inch, and 6 inch for the service water and fire protection system pipes. The calculations used to develop the table used a pressure of 108 psig which is representative of the average pressure expected in both the service water and fire protection water systems. Since the flowrate is a function of the square route of the pressure, any differences on pressure have a minor impact on the overall results.

Table A1-1: Fire Protection System Piping Rupture Flow Rates (Pressure = 108 psig @ 85°F)

Pipe Inside Diameter (in)	Pipe Cross-Sectional Area (ft^2)	Equivalent Rupture Diameter (in)	Equivalent Rupture Area (ft^2)	Diameter Ratio Beta Factor (β)	Flow Coefficient (C)	Rupture Flow Rate (q) (ft^3/sec)	Rupture Flow Rate Q (GPM)
1 (ID = 1.049)	0.0060	0.50	0.0014	0.4766	0.6366	0.1101	49.4270
		0.75	0.0031	0.7150	0.7214	0.2808	126.0101
2 (ID = 2.067)	0.0233	0.50	0.0014	0.2419	0.6211	0.1074	48.2171
		0.75	0.0031	0.3628	0.6254	0.2434	109.2536
		0.90	0.0044	0.4354	0.6315	0.3539	158.8363
		1.00	0.0055	0.4838	0.6377	0.4413	198.0387
		1.50	0.0123	0.7257	0.7293	1.1355	509.6005
4 (ID = 4.026)	0.0884	0.50	0.0014	0.1242	0.6201	0.1073	48.1402
		0.75	0.0031	0.1863	0.6204	0.2415	108.3678
		0.90	0.0044	0.2235	0.6208	0.3479	156.1508
		1.00	0.0055	0.2484	0.6212	0.4298	192.9053
		1.50	0.0123	0.3726	0.6261	0.9747	437.4454
		2.00	0.0218	0.4968	0.6398	1.7708	794.7316
		3.00	0.0491	0.7452	0.7455	4.6425	2083.5477
6 (ID = 6.065)	0.2006	0.50	0.0014	0.0824	0.6200	0.1073	48.1356
		0.75	0.0031	0.1237	0.6201	0.2413	108.3152
		0.90	0.0044	0.1484	0.6202	0.3476	155.9935
		1.00	0.0055	0.1649	0.6202	0.4292	192.6091
		1.50	0.0123	0.2473	0.6212	0.9671	434.0229
		2.00	0.0218	0.3298	0.6237	1.7263	774.7457
		3.00	0.0491	0.4946	0.6394	3.9821	1787.1590
		4.00	0.0873	0.6595	0.6885	7.6230	3421.2024
		5.00	0.1364	0.8244	0.8452	14.6210	6561.8827

ADDENDUM 2, FIRE PROTECTION PIPE SEGMENT TABULATION

Table A2-1: Turbine Building Fire Protection Water Piping

Piping ID	Diameter	ID => 6" Large Pipe				2" <= ID < 6" Medium Pipe				0.5" <= ID < 2" Small Pipe			
		From	To	Valves	Flanges	From	To	Valves	Flanges	From	To	Valves	Flanges
TU-1	10	Wall	T to FP 5-3										
TU-2	10	T to FP 5-3	T to FP 5-2										
TU-3	10	T to FP 5-2	T to FP 5-4										
TU-4	10	T to FP 5-4	T to FP 28-2										
TU-5	10	T to FP 28-2	T to FP 5-5										
TU-6	10	T to FP 5-5	T to FP 5-6										
TU-7	10	T to FP 5-6	FP 1-1										
TU-8	10	T at FP 1-1 North to Turbine Building Wall	T to FP 15-1										
TU-9	10	T at FP 1-1 South to T at FP 22-1	T at FP 22-1										
TU-10	10	T to FP 22-1	T to FP 5-11										
TU-11	10	T to FP 5-11	T to FP 28-1										
TU-12	10	T to FP 28-1	T to FP 3-6										
TU-13	10	T to FP 3-6	T to FP 3-5										
TU-14	10	T to FP 3-5	T to FP 3-4										
TU-15	10	T to FP 3-4	T to FP 3-3										
TU-16	10	T to FP 3-3	T to FP 3-2										
TU-17	10	T to FP 3-2	10 to 6-inch reducer to FP 3-1										
TU-18	2.5					T to FP 5-3	FP 5-3	1	2				
TU-19	2.5					FP 5-3	T to hose connection lines						
TU-20	1.5									T to hose connection lines	Up to FP 90-14	1	
TU-21	1.5									T to hose connection lines	down to FP 90-7	1	
TU-22	2.5					T to FP 5-2	FP 5-2	1	2				
TU-23	2.5					FP 5-2	T to FP 90-4						
TU-24	1.5									T to FP 90-4	Down to FP 90-4	1	
TU-25	2.5					T to FP 90-4	Up to T to FP 90-13						
TU-26	1.5									T to FP 90-13	FP 90-13	1	
TU-27	1.5									T to FP 90-13	Up to FP 90-3		
TU-28	2.5					T to FP 5-4	FP 5-4	1	2				
TU-29	2.5					FP 5-4	Strainer and Deluge Valve	2	4				
TU-30	8	T to FP 28-2	FP 28-2	1	2								
TU-31	4					FP 28-2	FP 56-1						

Table A2-1: Turbine Building Fire Protection Water Piping

Piping ID	Diameter	ID => 6" Large Pipe				2" <= ID < 6" Medium Pipe				0.5" <= ID < 2" Small Pipe			
		From	To	Valves	Flanges	From	To	Valves	Flanges	From	To	Valves	Flanges
TU-32	4					FP 56-1	Wall to TSC						
TU-33	8	FP 28-2	T to Mezzanine Sprinkler Isolation Valve										
TU-34	6	T to Mezzanine Sprinkler Isolation Valve	Basement Sprinkler Isolation Valve										
TU-35	2.5					T to FP 5-5	FP 5-5	1	2				
TU-36	2.5					FP 5-5	Reducing T						
TU-37	1.5									Reducing T	FP 90-9	1	
TU-38	2.5					Reducing T	FP 90-15	1					
TU-39	1.5									FP 90-15	FP-91-5	1	
TU-40	2.5					T to FP 5-6	FP 5-6	1	2				
TU-41	2.5					FP 5-6	T to FP 90-10						
TU-42	2.5					T to FP 90-10	T to FP 90-16	1					
TU-43	1.5									T to FP 90-16	Hose Station 21		
TU-44	1.5									T to FP 90-10	FP 90-10		
TU-45	2									T to FP 22-1	FP 22-1	1	
TU-46	2.5					T to FP 5-11	FP 5-11	1	2				
TU-47	2.5					FP 5-11	T to Hose Station 10						
TU-48	1.5									T to Hose Station 10	Hose Station 10	1	
TU-49	1.5									T to Hose Station 10	Hose Station 16	1	
TU-50	1.5									FP 5-11	Hose Station 1	1	
TU-51	8	T to FP 28-1	FP 28-1	1	2								
TU-52	8	FP 28-1	T to Sprinkler Branch Lines										
TU-53	6	T to Sprinkler Branch Lines	Basement Sprinkler Isolation Valve										
TU-54	6	T to FP 3-6	FP 19-6	2	2								
TU-55	6	T to FP 3-5	FP 19-5	2	2								
TU-56	6	T to FP 3-4	FP 19-4	2	2								
TU-57	6	T to FP 3-3	FP 19-3	2	2								
TU-58	6	T to FP 3-2	FP 19-2	2	2								
TU-59	6	Elbow to FP 3-1	FP 19-1	2	2								
TU-60	2.5					T to FP 5-12	FP 5-12	1	2				
TU-61	2.5					FP 5-12	T to FP 90-2						

Table A2-1: Turbine Building Fire Protection Water Piping

Piping ID	Diameter	ID => 6" Large Pipe				2" <= ID < 6" Medium Pipe				0.5" <= ID < 2" Small Pipe			
		From	To	Valves	Flanges	From	To	Valves	Flanges	From	To	Valves	Flanges
TU-62	2.5					T to FP 90-2	T to FP 90-12 and FP 90-17						
TU-63	1.5									T to FP 90-12 and FP 90-17	FP 90-12	1	
TU-64	1.5									T to FP 90-2	FP 90-2	1	
TU-65	6									T to FP 90-17	FP 90-17	1	
TU-66	6	T to Mezzanine Sprinkler Isolation Valve Line TU-33)	T at column 8 that splits to 3-inch header and 5-inch header	2	3								
TU-67	5	T at column 8 that splits to 3-inch header and 5-inch header	Riser										
TU-68	5	Riser	T and Riser labeled Q										
TU-69	5	T and Riser labeled Q	T and riser to branch 317										
TU-70	5	T and riser to branch 317	Riser labeled K										
TU-71	5	Riser labeled K	Riser labeled G										
TU-72	6	Basement Sprinkler Isolation Valve	T to lines 21 and 15	2	3								
TU-73	6	T to lines 21 and 15	T to Riser labeled J										
TU-74	6	Basement Sprinkler Isolation Valve (line TU-53)	T to riser labeled S	2	3								
TU-75	10	T to FP 15-1	T to FP 5-10										
TU-76	10	T to FP 5-10	Wall		1								
TU-77	3					T to FP 5-10	Wall	1	4				
TU-78	2.5					T to FP 5-10	FP 23-1	3	4				
78	Totals	40		20	26	22		15	26	16		13	0

ADDENDUM 3, HIGH-ENERGY LINE PIPE LENGTH TABULATIONS

Table A3-1: High-Pressure Main Steam Piping

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
MAIN STEAM PIPING LOCATED IN THE AUXILIARY BUILDING (ALL LEVELS)								
"A" Train								
Aux	M-238	622'-0"	30	A3 - "1A" Train MS Piping from MSIV MS1A to 90° Bend		Horiz.	7.63	5N-6S, N-M
Aux	M-238	622'-0"	30	A3 - "1A" Train MS Piping from 90° Bend to 90° Bend		Horiz.	16.52	6S, M
Aux	M-238, -240	622'-0" to 639'-6"	30	A3 - "1A" Train MS Piping from 90° Bend to Floor Penetration at 639'-6"	"15-15"	Vert.	17.50	6S, M
Aux	M-238	639'-6" to 664'-11 7/16"	30	A3 - "1A" Train MS Piping from Floor Penetration at 639'-6" to 90° Bend		Vert.	27.45	6S, M
Aux	M-238	664'-11 7/16"	30	A3 - "1A" Train MS Piping from 90° Bend to 40° Bend		Horiz.	29.43	6S-6, M-L
Aux	M-238	664'-4 3/4"	30	B4 - "1A" Train MS Piping from 40° Bend to 90° Bend		Horiz.	98.43	6, L-H
Aux	M-238	664'-4 3/4"	30	E4 - "1A" Train MS Piping from 90° Bend to 90° Bend		Horiz.	34.52	6-7, H
Aux	M-238, -240	664'-3" to 652'-11 3/4"	30	E4 - "1A" Train MS Piping from 90° Bend to 90° Bend	"16-16"	Vert.	11.27	7, H
Aux	M-238, -240	652'-11 3/4"	30	E5 - "1A" Train MS Piping from 90° Bend to Turbine Building Wall Penetration (Oper. Deck Level)	"16-16"	Horiz.	58.99	7, H-G
"B" Train								
Aux	M-238	620'-0"	30	F2 - "1B" Train MS Piping from MSIV MS1B to 90° Bend		Horiz.	35.92	4, HE-G
Aux	M-238	620'-0"	30	G2 - "1B" Train MS Piping from 90° Bend to 90° Bend		Horiz.	31.46	4-5, G
Aux	M-238	620'-0"	30	G2 - "1B" Train MS Piping from 90° Bend to Turbine Building Wall Penetration (Mez. Level)		Horiz.	5.49	5, G
				Linear FT on 622'+ Level			277.59	
				Linear FT on 622' - Level			97.02	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			374.61	

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (In)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
MAIN STEAM PIPING LOCATED IN THE TURBINE BUILDING OPERATING DECK AND MEZZANINE LEVELS (30 INCH PIPE)								
"A" Train								
TB	M-984-1	Oper Deck	30	E8 - "1A" Train MS Piping Through TB Wall (Approx 660' elev.) 90° Elbow Through Pipe Chase to TB Mez.		Vert.	28.19	7-8, G-F
TB	M-984-1	Mez.	30	F8 - "1A" Train MS Piping From Oper. Deck Opening Thru Mez. 90° Elbow to 90° Towards HP Turbine		Horiz.	73.04	7-8, G-C
TB	M-984-1	Mez.	30	H6 - "1A" Train MS Piping From Mez. 90° Elbow to Oper. Deck. Penetration Towards HP Turbine		Vert.	9.42	7-8, D-C
TB	M-984-1	Mez.	30	H6 - "1A" Train MS Piping From Oper. Deck. Penetration Towards HP Turbine to 90° Elbow		Vert.	4.75	7-8, D-C
TB	M-984-1	Oper Deck	30	H6 - "1A" Train MS Piping From 90° Elbow at Oper. Deck. Penetration Towards HP Turbine Stop Valve Inlet Connection		Horiz.	16.06	7-8, D-C
TB	X-K-101-30	Oper Deck	30	"1A" MS Piping From Valve MS-3A to Oper. Deck Floor Penetration (U-PIPE)		Vert.	4.06	6-7,D-C
TB	X-K-101-30	Mez.	30	"1A" MS Piping From Oper. Deck Floor Penetration to 90° Elbow		Vert.	19.50	6-7,D-C
TB	X-K-101-30	Mez.	30	"1A" MS Piping From 90° Elbow to 90° Elbow		Horiz.	5.75	6-7,D-C
TB	X-K-101-30	Mez.	30	"1A" MS Piping From 90° Elbow to HP Turbine		Vert.	13.30	6-7,D-C
"B" Train								
TB	M-985-1, -2	Mez.	30	D8/D9 - "1B" Train MS Piping Thru TB Wall into Mez. Level to 90° Elbow to Oper. Deck		Horiz.	117.08	5-8, G-D
TB	M-985-2	Mez.	30	D1 - "1B" Train MS Piping From 90° Elbow in the Mez. to Oper. Deck Penetration		Vert.	4.00	7-8, E-D

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (In)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-985-2	Oper Deck	30	C7 - "1B" Train MS Piping From Oper. Deck Penetration to 90° Elbow		Vert.	10.33	7-8, E-D
TB	M-985-2	Oper Deck	30	C7 - "1B" Train MS Piping From 90° Elbow at Oper. Deck. Penetration Towards HP Turbine Stop Valve Inlet Connection		Horiz.	13.69	7-8, E-D
TB	X-K-101-30	Oper Deck	30	"1B" MS Piping From Valve MS-3A to Oper. Deck Floor Penetration (U-PIPE)		Vert.	4.06	6-7,E-D
TB	X-K-101-30	Mez.	30	"1B" MS Piping From Oper. Deck Floor Penetration to 90° Elbow		Vert.	19.50	6-7,E-D
TB	X-K-101-30	Mez.	30	"1B" MS Piping From 90° Elbow to 90° Elbow		Horiz.	5.75	6-7,E-D
TB	X-K-101-30	Mez.	30	"1B" MS Piping From 90° Elbow to HP Turbine		Vert.	13.30	6-7,E-D
						Linear FT on Oper. Deck	**76.39**	
						Linear FT on Mez. Level	**285.39**	
						Linear FT on Basement Level	**0.00**	
						Total Length (Linear FT)	**361.78**	
MAIN STEAM PIPING (STEAM DUMP) LOCATED IN THE TURBINE BUILDING OPERATING DECK AND MEZZANINE LEVELS (18 INCH PIPE)								
"1A" Train								
TB	M-239	Oper Deck	18	A6 - "1A" Train Steam Dump Piping from Tee with 30" MS Line To 90° Elbow Bend	"8-8"	Horiz.	3.68	7-8, F-G
TB	M-239	Oper Deck	18	A6 - "1A" Train Steam Dump Piping 90° Elbow Bend Thru Oper. Deck Floor to Mez.	"8-8"	Vert.	2.97	7-8, F-G
TB	M-239	Mez.	18	A6 - "1A" Train Steam Dump Piping From Oper. Deck Floor to Mez. Level 90° Elbow Bend	"8-8"	Vert.	4.10	7-8, F-G
TB	M-239	Mez.	18	A6 - "1A" Train MS Steam Dump Piping From 90° Elbow Bend to 90° Elbow Bend		Horiz.	13.55	7-8, F-G

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-239	Mez.	18	A6 - "1A" Train Steam Dump Piping From 90° Bend Thru 30° Down Angle Towards "7" Line	"8-8"	Angle	5.17	7-8, F-G
TB	M-239	Mez.	18	A6 - "1A" Train Steam Dump Piping From End of 30° Down Angle To 90° Elbow Bend		Horiz.	35.38	6-7, F-G
TB	M-239, -240	Mez.	18	B4 - "1A" Train Steam Dump Piping From 90° Bend to Capped End	"19-19"	Horiz.	15.17	5-6, F-G
"B" Train								
TB	M-239	Mez.	18	A3 - "1B" Train Steam Dump Piping from Tee in 30" MS Line 45° Elbow Bend at "5" Line		Horiz.	4.96	5-4, F-G
TB	M-239, -241	Mez.	18	D8 - "1B" Train Steam Dump Piping from 45° Elbow Bend to 45° Elbow Bend	"25-25"	Angle	3.18	5-4, F-G
TB	M-239	Mez.	18	A3 - "1B" Train Steam Dump Piping from 45° Elbow Bend to 90° Elbow Bend		Horiz.	14.40	4-5, F-G
TB	M-239, -241	Mez.	18	A3 - "1B" Train Steam Dump Piping from 90° Thru a 45° Declined Angle to 45° Elbow Bend	"20-20"	Angle	3.03	4-5, F-G
TB	M-239	Mez.	18	A3 - "1B" Train Steam Dump Piping from 45° Elbow Bend to Capped End		Horiz.	18.17	4-5, E-F
				Linear FT on Oper. Deck			6.65	
				Linear FT on Mez. Level			117.11	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			123.76	
MAIN STEAM PIPING (STEAM DUMP) LOCATED IN THE TURBINE BUILDING OPERATING DECK AND MEZZANINE LEVELS (8 INCH PIPE)								
"A" Train - 8" MS LINE FROM 18" STEAM DUMP 1A (Valves SD1-1, SD2-1, FCV-484A)								
TB	M-239, -240	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (1 of 3) From 18" Main Header to Capped Tee	"19-19"	Vert.	12.00	5-6, E-F
TB	M-239, -240	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (1 of 3) From 8" Tee to 16"x8" Reducer	"19-19"	Horiz.	7.50	5-6, E-F

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
"A" Train 8" MS LINE FROM 18" STEAM DUMP 1A (Valves SD1-3, SD2-3, FCV-484B)								
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping From 18" Main Header to 90° Elbow (2 of 3)	"22-22"	Horiz.	2.08	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow	"22-22"	Vert.	3.63	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow	"22-22"	Horiz.	1.67	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow	"22-22"	Vert.	7.87	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to Tee in 16" Line	"22-22"	Horiz.	16.67	5-6, E-F
"A" Train 8" MS LINE FROM 18" STEAM DUMP 1A (Valves SD1-2, SD2-2, FCV-484C)								
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping From 18" Main Header to 90° Elbow (3 of 3)	"22-22"	Horiz.	3.75	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"22-22"	Vert.	2.21	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"22-22"	Horiz.	2.25	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"22-22"	Vert.	9.29	5-6, E-F
TB	M-239, -241	Mez.	8	B4 - "1A" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to Tee in 16" Line	"22-22"	Horiz.	18.83	5-6, E-F
"B" Train 8" MS LINE FROM 18" STEAM DUMP 1B (Valves SD1-4, SD2-4, FCV-484D)								
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (1 of 3) From 18" Main Header to 90° Elbow	"20-20" "18-18"	Vert.	2.00	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (1 of 3) From 90° Elbow Thru 180° Return to 90° Elbow	"18-18"	Horiz.	22.00	3-5, E-F

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (1 of 3) From 90° Elbow at 45° Declined Angle to 45° Elbow	"20-20"	Angle	0.00	(FT included in 9.15 below) 4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (1 of 3) From 45° Elbow to Capped Tee	"20-20"	Vert.	9.15	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (1 of 3) From 8" Tee to 16"x8" Reducer	"20-20"	Horiz.	9.00	4-5, E-F
"B" Train 8" MS LINE FROM 18" STEAM DUMP 1B (Valves SD1-5, SD2-5, FCV-484E)								
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 18" Main Header to 90° Elbow	"21-21"	Vert.	1.83	4-5, E-F
TB	M-239	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow		Horiz.	3.58	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow	"21-21"	Vert.	4.13	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow Thru 180° Bend to 90° Elbow	"21-21"	Horiz.	30.13	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	2.50	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow Thru SD1-5 to 90° Elbow	"21-21"	Vert.	7.69	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow Thru FCV-484E and SD2-5 to 90° Elbow	"21-21"	Horiz.	6.17	4-5, E-F
TB	M-239	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (2 of 3) From 90° Elbow to Tee in 16" Line		Horiz.	3.50	4-5, E-F
"B" Train 8" MS LINE FROM 18" STEAM DUMP 1B (Valves SD1-6, SD2-6, FCV-484E)								
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 18" Main Header to 90° Elbow	"21-21"	Vert.	3.00	4-5, E-F

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	10.45	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Vert.	7.58	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	7.13	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	7.25	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	11.83	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to 90° Elbow	"21-21"	Horiz.	4.00	4-5, E-F
TB	M-239, -241	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow Thru Valve SD1-6 to 90° Elbow	"21-21"	Vert.	6.08	4-5, E-F
TB	M-239	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow Thru Valves FCV-484F and SD2-6 to 90° Elbow		Horiz.	6.17	4-5, E-F
TB	M-239	Mez.	8	B3 - "1B" Train 8" Steam Dump Piping (3 of 3) From 90° Elbow to Tee in 16" Line		Horiz.	5.75	4-5, E-F
8" MS LINE FROM 30" MS HEADER "1A" TO MOISTURE SEPARATORS/REHEATERS A1 AND A2								
TB	M-239	Mez.	8	C6 - "1A" Train 8" Steam Line From 30" Main Header to 90° Elbow	"5-5" "5A-5A"	Horiz.	7.42	D-C, 7-8
TB	M-239	Mez.	8	C6 - "1A" Train 8" Steam Line From 90° Elbow to 90° Elbow	"5A-5A"	Vert.	2.29	D-C, 7-8
TB	M-239	Mez.	8	C6 - "1A" Train 8" Steam Line From 90° Elbow to 90° Elbow		Horiz.	14.50	B-C, 7-8
TB	M-239	Mez.	8	C6/D6 - "1A" Train 8" Steam Line From 90° Elbow to 8"x4" Reducer	"6-6"	Horiz.	99.00	B-C, 8-4
				Linear FT on Oper. Deck			**0.00**	
				Linear FT on Mez. Level			**381.87**	
				Linear FT on Basement Level			**0.00**	

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
					Total Length (Linear FT)		381.87	
MAIN STEAM PIPING (TO MSRs) LOCATED IN THE TURBINE BUILDING OPERATING DECK AND MEZZANINE LEVELS (6 INCH PIPE)								
6" MS LINE FROM 18" STEAM DUMP HEADER 1A TO MOISTURE SEPARATORS/REHEATERS B1								
TB	M-239, -240	Mez.	6	B4 - "1A" Train 6" Steam Line from 18" Steam Dump to 90° Elbow	"17-17"	Horiz.	12.25	5-7, F-E
TB	M-239, -240	Mez.	6	B4/B5 - "1A" Train 6" Steam Line from 90° Elbow to Oper. Deck Level Penetration	"17-17"	Vert.	6.75	5-7, F-E
TB	M-239, -240	Oper Deck	6	B4/B5 - "1A" Train 6" Steam Line from Oper. Deck Level Penetration to 90° Elbow	"17-17"	Vert.	2.00	5-7, F-E
TB	M-203, -239, -240	Oper Deck	6	B4/B5 - "1A" Train 6" Steam Line from 90° Elbow Thru Valves (MS200B1, MS201B1) to 90° Elbow	"17-17"	Horiz.	7.65	5-7, F-E
TB	M-239, -240	Oper Deck	6	B4/B5 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow	"17-17"	Vert.	8.34	5-7, F-E
TB	M-239, -240	Oper Deck	6	B5 - "1A" Train 6" Steam Line from 90° Elbow Thru Orifice to 90° Elbow	"17-17"	Horiz.	11.50	5-7, F-E
TB	M-239, -240	Oper Deck	6	B5 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow	"17-17"	Horiz.	6.75	5-7, F-E
TB	M-239, -240	Oper Deck	6	B5 - "1A" Train 6" Steam Line from 90° Elbow to Moisture Sep/Reheater B1	"17-17"	Angle	2.00	5-7, F-E
6" MS LINE FROM 18" STEAM DUMP HEADER 1B TO MOISTURE SEPARATORS/REHEATERS B2								
TB	M-239, -240	Mez.	6	B3 - "1B" Train 6" Steam Line from 18" Steam Dump to 90° Elbow	"18-18"	Vert.	3.08	5-3, F-E
TB	M-239, -240	Mez.	6	B2/B3 - "1B" Train 6" Steam Line from 90° Elbow to 90° Elbow	"18-18"	Horiz.	12.63	5-3, F-E
TB	M-239, -240	Mez.	6	B2/B3 - "1B" Train 6" Steam Line from 90° Elbow to Oper. Deck Level Penetration	"18-18"	Vert.	3.25	5-3, F-E
TB	M-239, -240	Oper Deck	6	B2/B3 - "1B" Train 6" Steam Line from Oper. Deck Level Penetration to 90° Elbow	"18-18"	Vert.	2.00	5-3, F-E

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-239, -240	Oper Deck	6	B2/B3 - "1B" Train 6" Steam Line from 90° Elbow Thru Valves (MS200B2, MS201B2) to 90° Elbow	"18-18"	Horiz.	7.65	5-3, F-E
TB	M-239, -240	Oper Deck	6	B2/B3 - "1B" Train 6" Steam Line from 90° Elbow to 90° Elbow	"18-18"	Vert.	8.34	5-3, F-E
TB	M-239, -240	Oper Deck	6	B2 - "1B" Train 6" Steam Line from 90° Elbow Thru Orifice to 90° Elbow	"18-18"	Horiz.	11.50	5-3, F-E
TB	M-239	Oper Deck	6	B2 - "1B" Train 6" Steam Line from 90° Elbow to 90° Elbow		Horiz.	6.75	5-3, F-E
TB	M-239, -240	Oper Deck	6	B2 - "1B" Train 6" Steam Line from 90° Elbow to Moisture Sep/Reheater B2	"18-18"	Angle	2.50	5-3, F-E
6" MS LINE FROM 8" STEAM HEADER 'A' TO MOISTURE SEPARATORS/REHEATERS A1								
TB	M-239	Mez.	6	D4/E4 - "1A" Train 6" Steam Line from 8" Steam Supply Line to Oper. Deck Penetration	"9-9"	Vert.	5.19	6-7, B-C
TB	M-239	Oper Deck	6	D4/E4 - "1A" Train 6" Steam Line from Oper. Deck Penetration to 90° Elbow	"9-9"	Horiz.	2.00	6-7, B-C
TB	M-239	Oper Deck	6	D5/E5 - "1A" Train 6" Steam Line from 90° Elbow Thru Valves (MS200A1, MS201A1) to 90° Elbow	"9-9"	Horiz.	7.65	6-7, B-C
TB	M-239	Oper Deck	6	D5/E5 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow	"9-9"	Vert.	8.34	6-7, B-C
TB	M-239	Oper Deck	6	D5/E5 - "1A" Train 6" Steam Line from 90° Elbow Thru Orifice to 90° Elbow	"9-9"	Horiz.	11.50	6-7, B-C
TB	M-239	Oper Deck	6	D5/E5 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow		Horiz.	6.75	6-7, B-C
TB	M-239	Oper Deck	6	D5/E5 - "1A" Train 6" Steam Line from 90° Elbow to Moisture Sep/Reheater A1	"9-9"	Angle	2.50	6-7, B-C
6" MS LINE FROM 8" STEAM HEADER 'A' TO MOISTURE SEPARATORS/REHEATERS A2								
TB	M-239	Mez.	6	D2/E2 - "1A" Train 6" Steam Line from 8" Steam Supply Line to Oper. Deck Penetration	"6-6"	Vert.	5.52	4-3, B-C

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from Oper. Deck Penetration to 90° Elbow	"6-6"	Horiz.	2.00	4-3, B-C
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from 90° Elbow Thru Valves (MS200A2, MS201A2) to 90° Elbow	"6-6"	Horiz.	7.65	4-3, B-C
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow	"6-6"	Vert.	8.34	4-3, B-C
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from 90° Elbow Thru Orifice to 90° Elbow	"6-6"	Horiz.	11.50	4-3, B-C
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from 90° Elbow to 90° Elbow		Horiz.	6.75	4-3, B-C
TB	M-239	Oper Deck	6	D2/E2 - "1A" Train 6" Steam Line from 90° Elbow to Moisture Sep/Reheater A2	"6-6"	Angle	2.50	4-3, B-C
				Linear FT on Oper. Deck			**154.46**	
				Linear FT on Mez. Level			**48.67**	
				Linear FT on Basement Level			**0.00**	
				Total Length (Linear FT)			**203.13**	
MAIN STEAM HEADER "1A"/"1B" EQUAILIZING LINE (20" PIPE)								
TB	M-985-2	Mez.	20	B6 - Equalizing Line Between Main "A" and "B" Steam Headers		Horiz.	42.25	7-8, F-E
				Linear FT on Oper. Deck			**0.00**	
				Linear FT on Mez. Level			**42.25**	
				Linear FT on Basement Level			**0.00**	
				Total Length (Linear FT)			**42.25**	
STEAM LINE SECTION FROM 16"X8" REDUCER FROM 8" STEAM DUMP LINES TO 16" NOZZLE (16" PIPE)								
TRAIN "1A" MS LINE FROM 16"X8" REDUCER FROM 8" STEAM DUMP LINES TO 16" NOZZLE (16" PIPE)								
TB	M-239, -240	Mez.	16	B4/C4 - "1A" Train 16" Steam Line From 16"x8" Reducer to Low Pressure Turbine	"19-19"	Horiz.	4.67	5-6, E
TRAIN "1B" MS LINE FROM 16"X8" REDUCER FROM 8" STEAM DUMP LINES TO 16" NOZZLE (16" PIPE)								
TB	M-239, -240	Mez.	16	B3/C3 - "1B" Train 16" Steam Line From 16"x8" Reducer to Low Pressure Turbine	"19-19"	Horiz.	4.67	4-5, E

Table A3-1: High-Pressure Main Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
				Linear FT on Oper. Deck			0.00	
				Linear FT on Mez. Level			9.34	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			9.34	

Table A3-2: Extraction Steam Piping

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
HP TURBINE STEAM SUPPLY TO HIGH PRESSURE FEEDWATER HEATERS 15A/15B								
BLEED STEAM HEADER TO FEEDWATER HEATERS 15A/15B								
TB	M-1258	Mez.	12	B11 - Bleed Steam Piping From Turbine Shell Insulation to 90° Elbow		Vert.	6.27	6-7, D
TB	M-1258	Mez.	12	B11/A10 - Bleed Steam Piping From 90° Elbow to 45° Declined Angle Bend		Horiz.	18.98	6-7, D-E
TB	M-1258	Mez.	12	A10 - Bleed Steam Piping From 45° Declined Angle Bend to 16"x12" 90° Reducing Elbow		Angle	3.67	6-7, E
TB	M-1258	Mez.	16	A10/E3 - Bleed Steam Piping From 16"x12" 90° Reducing Elbow to 90° Elbow		Horiz.	71.09	7-4, E
TB	M-1258	Mez.	16	E3/D2 - Bleed Steam Piping From 90° Elbow to 16"X10" 90° Reducing Elbow		Horiz.	23.80	4, E-F
TB	M-1258	Mez.	12	C11 - Bleed Steam Piping From Turbine Shell Insulation to 90° Elbow		Vert.	2.83	6-7, D
TB	M-1258	Mez.	12	C11/C10 - Bleed Steam Piping From 90° Elbow to 90° Elbow		Horiz.	8.04	6-7, E-D
TB	M-1258	Mez.	12	C10 - Bleed Steam Piping From 90° Elbow to 90° Elbow		Vert.	4.58	6-7, E-D
TB	M-1258	Mez.	12	C10 - Bleed Steam Piping From 90° Elbow to 45° Declined Angle Bend		Horiz.	7.50	6-7, E-D
TB	M-1258	Mez.	12	C9 - Bleed Steam Piping From 45° Declined Angle Bend to 45° Angle Bend		Angle	3.67	6-7, E-D
TB	M-1258	Mez.	12	C9 - Bleed Steam Piping From 45° Angle Bend to 45° Angle Bend		Horiz.	4.85	6-7, E
TB	M-1258	Mez.	12	C9 - Bleed Steam Piping From 45° Angle Bend to 45° 16"x12" Lateral Reducer		Horiz.	3.54	6-7, E
STEAM TO FOR FEEDWATER HEATER 15A								
TB	M-1258	Mez.	10	D1/E1 - Bleed Steam Piping From 16"X16"X10" Tee to 12"x10" 90° Reducing Elbow		Horiz.	6.96	4, E-F

Table A3-2: Extraction Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-1258	Mez.	12	E1 - Bleed Steam Piping From 12"x10" 90° Reducing Elbow Top of FD WTR HTR 15A		Vert.	2.00	4, E-F
STEAM TO FOR FEEDWATER HEATER 15B								
TB	M-1258	Mez.	10	D2 - Bleed Steam Piping From 16"X16"X10" Tee to 12"x10" 90° Reducing Elbow		Horiz.	6.69	4-F
TB	M-1258	Mez.	12	E2 - Bleed Steam Piping From 12"x10" 90° Reducing Elbow Top of FD WTR HTR 15B		Vert.	2.00	4-F
						Linear FT on Oper. Deck	0.00	
						Linear FT on Mez. Level	176.46	
						Linear FT on Basement Level	0.00	
						Total Length (Linear FT)	176.46	

Table A3-3: Lower-Pressure Steam Piping

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
HP TURBINE STEAM SUPPLY TO HIGH PRESSURE FEEDWATER HEATERS 14A/14B								
REHEAT STEAM FROM REHEAT STEAM CROSSUNDER PIPE TO FOR FEEDWATER HEATER 14A/14B								
TB	M-242	Mez.	16	E7 - Reheat Steam From 30" Crossunder Piping to 90° Elbow		Horiz.	1.75	6, D
TB	M-242, -423	Mez.	16	E7 - Reheat Steam From 90° Elbow to 90° Elbow	"C-C"	Vert.	20.73	6-7, D-E
TB	M-242, -423	Mez.	16	E7 - Reheat Steam From 90° Elbow to 45° Angle Bend Into 24" Reheat Steam Header		Horiz.	5.66	6-7, D-E
TB	M-242	Mez.	16	F8 - Reheat Steam From 30" Crossunder Piping to 90° Elbow		Horiz.	1.75	6-7, D
TB	M-242, -423	Mez.	16	F8 - Reheat Steam From 90° Elbow to 24"x16" 90° Reducing Elbow	"C-C"	Vert.	20.73	6-7, D
TB	M-242	Mez.	24	F8 - Reheat Steam From 24"x16" 90° Reducing Elbow to 90° Elbow		Horiz.	28.50	6-7, D-E
TB	M-242	Mez.	24	D8 - Reheat Steam From 90° Elbow to 90° Elbow		Horiz.	14.33	6-7, E
TB	M-242	Mez.	24	D9 - Reheat Steam From 90° Elbow to 90° Elbow		Horiz.	6.00	7, E
TB	M-242, -423	Mez.	24	D9/C9 - Reheat Steam From 90° Elbow to 90° Elbow	"C-C"	Vert.	14.21	7, E-F
TB	M-242, -423	Mez.	24	D9/C9 - Reheat Steam From 90° Elbow to 24"x16" 90° Reducing Elbow For FD WTR HTR 14B	"C-C"	Horiz.	14.92	7, E-F
STEAM TO FOR FEEDWATER HEATER 14A (16" PIPE)								
TB	M-242	Mez.	16	C9 - Reheat Steam from 24"x24"x16" Tee to 90° Elbow		Horiz.	9.17	6-7, E-F
TB	M-242, -423	Mez.	16	C8 - Reheat Steam from 90° Elbow To FD WTR HTR 14A	"C-C"	Vert.	2.00	6-7, E-F
STEAM TO FOR FEEDWATER HEATER 14B (16" PIPE)								
TB	M-242	Mez.	16	B9 - Reheat Steam from 24"x16" 90° Reducing Elbow to 90° Elbow For FD WTR HTR 14B		Horiz.	9.17	6-7, F

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (In)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-242, -423	Mez.	16	B8 - Reheat Steam from 90° Elbow To FD WTR HTR 14B	"C-C"	Angle	2.15	6-7, F
				Linear FT on Oper. Deck			0.00	
				Linear FT on Mez. Level			151.07	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			151.07	
HEATING STEAM FROM FEEDWATER HEATERS 14A/14B 24" STEAM SUPPLY LINE (10" PIPE)								
HEATING STEAM FROM 24" REHEAT STEAM (10" PIPE)								
TB	M-242, -423	Mez.	10	C9 - Heating Steam from 24" Reheat Steam Line Tee to 90° Elbow	"C-C"	Vert.	7.10	7, E-F
TB	M-242	Mez.	10	C9 - Heating Steam From 90° Elbow to 90° Elbow		Horiz.	4.00	7, E-F
TB	M-242	Mez.	10	C9 - Heating Steam From 90° Elbow to 45° Bend		Horiz.	6.04	7, E-F
TB	M-242	Mez.	10	C8 - Heating Steam From 45° Bend to 45° Bend		Horiz.	9.90	7-6, F
TB	M-242	Mez.	10	B8 - Heating Steam From 45° Bend to 90° Declined Elbow		Horiz.	47.00	7-5, F
TB	M-242, -423	Mez.	10	B4 - Heating Steam From 90° Declined Elbow to 90° Elbow	"C-C"	Angle	8.44	5, F-G
TB	M-242	Mez.	10	B4 - Heating Steam From 90° Elbow to 60° Bend		Horiz.	56.50	5-3, F-G
TB	M-242	Mez.	10	B1 - Heating Steam From 60° Bend to 90° Elbow		Horiz.	9.50	3, F-G
TB	M-242, -423	Mez.	10	A1 - Heating Steam From 90° Elbow to Mez. Floor Penetration	"J-J"	Vert.	11.02	3, G
TB	M-242, -423	Basement	10	A1 - Heating Steam From Mez. Floor Penetration to 90° Elbow	"J-J"	Vert.	4.81	3, G
TB	M-242, -423	Basement	10	A1 - Heating Steam From 90° Elbow to 90° Elbow	"J-J"	Horiz.	20.25	3-2, G
TB	M-423	Basement	10	H4 - Heating Steam From 90° Elbow to Aux. Bld Wall Pen.		Horiz.	10.00	3-2, G-GG
				Linear FT on Oper. Deck			0.00	

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (In)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
				Linear FT on Mez. Level			159.50	
				Linear FT on Basement Level			35.06	
				Total Length (Linear FT)			194.56	
MAIN STEAM CROSSUNDER PIPING (30" PIPE)								
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "A" MSRs - FRONT PIPE								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "A" MSRs - Front Pipe) from HP Turbine to 90° Elbow		Vert.	10.56	6-7, C-D
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "A" MSRs - REAR PIPE								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "A" MSRs - Rear Pipe) from HP Turbine to 90° Elbow		Vert.	10.56	6-7, C-D
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "A" MSRs - Rear Pipe) from 90° Elbow to 90° Elbow		Horiz.	8.86	6-7, C-D
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "A" MSRs - Rear Pipe) from 90° Elbow to 42" Crossunder Piping to "A" MSRs		Horiz.	8.54	6-7, C-D
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "A" MSRs - HEADER PIPE								
TB	XK-101-30, XK-101-33	Mez.	30, 42	Reheat Steam Crossunder Piping (to "A" MSRs - Header) from 30" 90° Elbow Thru 42"x30" Reducer to 42" 90° Elbow		Horiz.	25.00	7-5, C-B
TB	XK-101-30, XK-101-33	Mez.	30, 42	Reheat Steam Crossunder Piping (to "A" MSRs - Header) from 42" 90° Elbow Thru 42"x30" Reducer to 30" 90° Elbow		Horiz.	53.38	7-5, C-B
STEAM CROSSUNDER PIPING TO MSR 1A								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Piping to MSR "1A" from 42" Crossunder Header to Oper. Deck Floor Penetration		Vert.	10.56	5, B-C
TB	XK-101-30, XK-101-33	Oper Deck	30	Reheat Steam Piping to MSR "1A" from Oper. Deck Floor Penetration to 30" 90° Elbow		Vert.	4.75	5, B-C

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	XK-101-30, XK-101-33	Oper Deck	30	Reheat Steam Piping from 30" 90° Elbow to MSR "1A"		Horiz.	11.75	5, B-C
STEAM CROSSUNDER PIPING TO MSR 2A								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Piping to MSR "2A" from 42" Crossunder Header to Oper. Deck Floor Penetration		Vert.	10.56	5, B-C
TB	XK-101-30, XK-101-33	Oper Deck	30	Reheat Steam Piping to MSR "2A" from Oper. Deck Floor Penetration to 30" 90° Elbow		Vert.	4.75	5, B-C
TB	XK-101-30, XK-101-33	Oper Deck	30	Reheat Steam Piping from 30" 90° Elbow to MSR "2A"		Horiz.	11.75	5, B-C
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "B" MSRS - FRONT PIPE								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "B" MSRs - Front Pipe) from HP Turbine to 90° Elbow		Vert.	10.56	6-7, D-E
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "B" MSRS - REAR PIPE								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "B" MSRs - Rear Pipe) from HP Turbine to 90° Elbow		Vert.	10.56	6-7, D-E
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "B" MSRs - Rear Pipe) from 90° Elbow to 90° Elbow		Horiz.	8.86	6-7, D-E
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Crossunder Piping (to "B" MSRs - Rear Pipe) from 90° Elbow to 42" Crossunder Piping to "B" MSRs		Horiz.	8.54	6-7, D-E
STEAM CROSSUNDER PIPING FROM HP TURBINE TO "B" MSRS - HEADER PIPE								
TB	XK-101-30, XK-101-33	Mez.	30, 42	Reheat Steam Crossunder Piping (to "A" MSRs - Header) from 30" 90° Elbow Thru 42"x30" Reducer to 42" 90° Elbow		Horiz.	25.00	7-5, E-F

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	XK-101-30, XK-101-33	Mez.	30, 42	Reheat Steam Crossunder Piping (to "B" MSRs - Header) from 42" 90° Elbow Thru 42"x30" Reducer to 30" 90° Elbow		Horiz.	53.38	7-5, E-F
STEAM CROSSUNDER PIPING TO MSR 1B								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Piping to MSR "1B" from 42" Crossunder Header to Oper. Deck Floor Penetration		Vert.	10.56	5, E-F
TB	XK-101-30, XK-101-33	Oper. Deck	30	Reheat Steam Piping to MSR "1B" from Oper. Deck Floor Penetration to 30" 90° Elbow		Vert.	4.75	5, E-F
TB	XK-101-30, XK-101-33	Oper. Deck	30	Reheat Steam Piping from 30" 90° Elbow to MSR "1B"		Horiz.	11.75	5, E-F
STEAM CROSSUNDER PIPING TO MSR 2B								
TB	XK-101-30, XK-101-33	Mez.	30	Reheat Steam Piping to MSR "2B" from 42" Crossunder Header to Oper. Deck Floor Penetration		Vert.	10.56	5, E-F
TB	XK-101-30, XK-101-33	Oper. Deck	30	Reheat Steam Piping to MSR "2B" from Oper. Deck Floor Penetration to 30" 90° Elbow		Vert.	4.75	5, E-F
TB	XK-101-30, XK-101-33	Oper. Deck	30	Reheat Steam Piping from 30" 90° Elbow to MSR "2B"		Horiz.	11.75	5, E-F
				Linear FT on Oper. Deck			66.00	
				Linear FT on Mez. Level			276.04	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			342.04	
STEAM CROSSOVER PIPING FROM MOISTURE SEPARATORS 1A/1B/2A/2B TO LOW PRESSURE TURBINE (30" PIPE)								
STEAM CROSSOVER PIPING FROM MSR 1A								
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from MSR 1A to 90° Elbow		Vert.	13.42	6, B-C
TB	X-K-101-30, X-K-	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to 90° Elbow		Horiz.	12.00	6-5, B-C

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
	101-33							
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to Bend into LP Turbine #1		Horiz.	27.50	6-5, B-D
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from Bend into LP Turbine #1 to Common Inlet		Vert.	3.50	6-5, D
STEAM CROSSOVER PIPING FROM MSR 1B								
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from MSR 1B to 90° Elbow		Vert.	13.42	6, E-F
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to 90° Elbow		Horiz.	12.00	6-5, E-F
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to Bend into LP Turbine #1		Horiz.	27.50	6-5, E-D
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from Bend into LP Turbine #1 to Common Inlet		Vert.	3.50	6-5, D
STEAM CROSSOVER PIPING FROM MSR 2A								
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from MSR 2A to 90° Elbow		Vert.	13.42	4, B-C
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to 90° Elbow		Horiz.	12.00	4-5, B-C
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to Bend into LP Turbine #2		Horiz.	27.50	4-5, B-D
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from Bend into LP Turbine #2 to Common Inlet		Vert.	3.50	4-5, D
STEAM CROSSOVER PIPING FROM MSR 2B								

Table A3-3: Lower-Pressure Steam Piping (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from MSR 2B to 90° Elbow		Vert.	13.42	4, E-F
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to 90° Elbow		Horiz.	12.00	4-5, E-F
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from 90° Elbow to Bend into LP Turbine #2		Horiz.	27.50	4-5, E-D
TB	X-K-101-30, X-K-101-33	Oper. Deck	30	Steam Crossover Piping from Bend into LP Turbine #2 to Common Inlet		Vert.	3.50	4-5, D
				Linear FT on Oper. Deck			225.68	
				Linear FT on Mez. Level			0.00	
				Linear FT on Basement Level			0.00	
				Total Length (Linear FT)			225.68	

Table A3-4: Piping Upstream of 15 Feedwater Heaters

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
CONDENSATE PIPING LOCATED BETWEEN HEATERS 14 AND MAIN FEEDWATER PUMPS								
TB	M-245	Basement	12	B10 - 12-inch bypass header centerline of valve C20-1 to elbow that angles down to main 20-inch header	D-D, E-E	Horiz.	16.75	7-7, F-F
TB	M-245	Basement	12	B10 - 12-inch bypass header centerline of valve C20-1 angling down to main 20-inch header	D-D, E-E	Horiz.	5.23	7-7, F-F
TB	M-245	Mezzanine	16	B10 - Horizontal distance from outlet of heater 14A to centerline of vertical pipe down	D-D, E-E	Horiz.	2.00	7-7, F-F
TB	M-246	Basement	16	C4 - 16-inch header piping down from outlet of heater 14A to mezzanine floor level	D-D	Vert.	3.67	7-7, F-F
TB	M-246	Mezzanine	16	C4 - 16-inch header piping down from mezzanine floor level to centerline of header	D-D	Vert.	5.50	7-7, F-F
TB	M-245	Basement	14	B10 - Centerline of vertical pipe down from heater 14A outlet to inlet of main 20-inch header	D-D, E-E	Horiz.	9.50	7-7, F-F
TB	M-245	Mezzanine	16	B10 - Horizontal distance from outlet of heater 14B to centerline of vertical pipe down	D-D, E-E	Horiz.	2.00	7-7, F-F
TB	M-246	Mezzanine	16	C4 - 16-inch header piping down from outlet of heater 14B to mezzanine floor level	D-D	Vert.	3.67	7-7, F-F
TB	M-246	Basement	16	C4 - 16-inch header piping down from mezzanine floor level to centerline of header	D-D	Vert.	5.50	7-7, F-F
TB	M-245	Basement	14	B10 - Centerline of vertical pipe down from heater 14B outlet to 90 degree elbow to the east	D-D, E-E	Horiz.	9.50	7-7, F-F
TB	M-245	Basement	14	B10 - Header pipe east from centerline of C15-2 to 20-inch header	D-D, E-E	Horiz.	12.25	7-7, F-F
TB	M-245	Basement	20	B10 - Header pipe east from reducer east to centerline of main 20-inch header south	D-D, E-E	Horiz.	8.25	7-7, F-F

Table A3-4: Piping Upstream of 15 Feedwater Heaters (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-245	Basement	12	B10 - 12-inch bypass header from centerline of valve C9-1 south to beginning of pipe bend	D-D, E-E	Horiz.	8.00	7-7, F-F
TB	M-245	Basement	12	B10 - 12-inch bypass header the beginning of pipe bend angling to the 14-inch header	D-D, E-E	Horiz.	7.78	7-7, F-F
TB	M-245	Basement	20	B10 - 20-inch header south toward feedwater pumps to reducer	E-E	Horiz.	36.50	7-6, F-F
TB	M-246	Basement	16	D6 - 16-inch header piping down from main header to main feedwater pump 1A inlet	F-F	Vert.	6.25	6-6, F-F
TB	M-246	Basement	16	B8 - 16-inch pipe west to main feedwater pump 1A suction	F-F	Horiz.	16.92	6-6, F-F
TB	M-246	Basement	16	B8 - 16-inch pipe south to main feedwater pump 1A suction	F-F	Horiz.	4.00	6-6, F-F
TB	M-246	Basement	16	D6 - 16-inch header piping down into main feedwater pump 1A inlet	F-F	Vert.	2.00	6-6, F-F
TB	M-245	Basement	16	B8 - 16-inch header south from reducer toward main feedwater pump 1B to 90 degree elbow down	G-G	Horiz.	39.00	6-4, F-F
TB	M-246	Basement	16	E12 - 16-inch header piping down from main header	G-G	Vert.	12.50	4-4, F-F
TB	M-245	Basement	16	B6 - 16-inch header south from vertical pipe down to 90 degree elbow up	G-G	Horiz.	10.00	4-4, F-F
TB	M-246	Basement	16	E11 - 16-inch header piping up from main header	G-G	Vert.	6.25	4-4, F-F
TB	M-245	Basement	16	B5 - 16-inch pipe west to main feedwater pump 1B suction	H-H	Horiz.	18.92	4-4, F-F
TB	M-246	Basement	16	D6 - 16-inch header piping down into main feedwater pump 1B inlet	H-H	Vert.	2.00	4-4, F-F
TB	M-252	Basement	12	B10 - Horizontal distance from the discharge of heater drain pump 1A east to 90 degree elbow up	Q-Q	Horiz.	1.93	7-7, F-F

Table A3-4: Piping Upstream of 15 Feedwater Heaters (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-252	Basement	12	B10 - Horizontal distance from the discharge of heater drain pump 1B east to 90 degree elbow up	Q-Q	Horiz.	1.93	7-7, F-F
TB	M-253	Basement	12	B10 - Vertical distance from centerline of heater drain pump 1A discharge to 14-inch line	Q-Q	Vert.	7.15	7-7, F-F
TB	M-253	Basement	12	B10 - Vertical distance from centerline of heater drain pump 1B discharge to 14-inch line	Q-Q	Vert.	7.15	7-7, F-F
TB	M-252	Basement	14	B10 - Horizontal distance from the discharge of heater drain pump 1A south to 90 degree elbow turning to the east	Q-Q	Horiz.	19.75	7-6, F-F
TB	M-252	Basement	14	B10 - Horizontal distance from centerline of 14-inch pump discharge header east to 90 degree elbow up	Q-Q	Horiz.	5.52	6-6, F-F
TB	M-253	Basement	14	B10 - Vertical distance from centerline of 14-inch pump header to centerline of 20-inch feedwater header	Q-Q	Vert.	6.19	6-6, F-F
TB	M-252	Basement	20	B10 - Horizontal distance from the centerline of heater drain tank to the discharge of heater drain pump 1A	Q-Q	Horiz.	13.46	7-7, F-F
TB	M-252	Basement	20	B10 - Horizontal distance from the centerline of heater drain tank to the discharge of heater drain pump 1B	Q-Q	Horiz.	13.46	6-6, F-F
TB	M-253	Basement	20	B10 - Vertical distance from heater drain tank outlet to centerline of heater drain pump 1A inlet	Q-Q	Vert.	4.00	7-7, F-F
TB	M-253	Basement	20	B10 - Vertical distance from heater drain tank outlet to centerline of heater drain pump 1B inlet	Q-Q	Vert.	4.00	7-7, F-F
						Linear FT on Basement	**325.31**	
						Linear FT on Mez. Level	**13.17**	
						Total Length (Linear FT)	**338.48**	
PIPING LOCATED BETWEEN MAIN FEEDWATER PUMPS AND 15 HEATERS								

Table A3-4: Piping Upstream of 15 Feedwater Heaters (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-249	Basement	16	B3 - Main feedwater pump 1A outlet up to 90 degree elbow to the east	E-E	Vert.	9.25	6-6, F-F
TB	M-247	Basement	16	C5 - Horizontal distance from centerline pump 1A discharge east to 90 degree elbow to the north	E-E	Horiz.	4.00	6-6, F-F
TB	M-247	Basement	16	C5 - Horizontal distance north on pump 1A discharge piping	E-E	Horiz.	9.50	6-6, F-F
TB	M-247	Basement	16	C6 - Horizontal distance west on pump 1A discharge piping	E-E	Horiz.	12.25	6-6, F-F
TB	M-247	Basement	16	C6 - Horizontal distance south on pump 1A discharge piping	E-E	Horiz.	19.50	6-5, F-F
TB	M-247	Basement	16	C6 - Horizontal distance east on pump 1A discharge piping to 90 degree elbow angling down to the south	E-E	Horiz.	16.00	5-5, F-F
TB	M-247	Basement	16	D5 - Pump 1A discharge piping south toward 15 feedwater heaters	E-E	Horiz.	42.88	5-4, F-F
TB	M-247	Basement	16	D2 - Pump 1A discharge piping angling 45 degrees to 22-inch header	G-G	Horiz.	6.36	4-4, F-F
TB	M-249	Basement	16	B6 - Main feedwater pump 1B outlet up to 90 degree elbow to the west	F-F	Vert.	6.50	4-4, F-F
TB	M-247	Basement	16	C3 - Horizontal distance from centerline pump 1B discharge west to 90 degree elbow angling up and to the north	F-F	Horiz.	8.75	4-4, F-G
TB	M-249	Basement	16	B6 - Horizontal distance for the pipe angling up from the 90 degree elbow to the centerline of valve F2-2	F-F	Horiz.	5.50	4-4, G-G
TB	M-247	Basement	16	C3 - Horizontal run of Pump 1B discharge piping north through valve F2-2	F-F	Horiz.	18.53	4-5, G-G
TB	M-247	Basement	16	C4 - Horizontal run of Pump 1B discharge piping downstream of valve F2-2 to the east	F-F	Horiz.	6.00	5-5, G-G
TB	M-247	Basement	16	C4 - Horizontal run of Pump 1B discharge piping north	F-F	Horiz.	7.71	5-5, G-G

Table A3-4: Piping Upstream of 15 Feedwater Heaters (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (In)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-247	Basement	16	C4 - Horizontal run of Pump 1B discharge piping east to the elbow angling down	E-E	Horiz.	13.50	5-5, G-F
TB	M-249	Basement	16	B6 - Main feedwater pump 1B discharge piping down to header towards 15 feedwater heaters	E-E	Vert.	2.67	5-5, F-F
TB	M-247	Basement	16	B6 - Main feedwater pump 1B discharge piping south towards 15 feedwater heaters up to the reducer	G-G	Horiz.	41.60	5-4, F-F
TB	M-247	Basement	22	B2 - 22-inch header for main feedwater discharge piping from reducer to T ant 15 heaters	G-G	Horiz.	7.79	4-4, F-F
TB	M-247	Basement	22	D2 - Centerline of T in 22-inch header east to reducing elbow	G-G	Horiz.	8.50	3-3, F-F
TB	M-247	Basement	16	D2 - From centerline of reducing elbow south through valve F3-1 to 90 degree reducing elbow to the west	G-G	Horiz.	17.04	3-3, F-F
TB	M-247	Basement	20	D2 - Straightline distance north through the two 90 degree elbows toward the 15A heater	G-G	Horiz.	5.00	3-3, F-F
TB	M-247	Basement	20	D2 - 20-inch piping north toward heater 15A	G-G	Horiz.	13.29	3-3, F-F
TB	M-249	Basement	20	C12 - Vertical piping from 20-inch horizontal pipe up to mezzanine floor toward heater 15A	H-H	Vert.	5.92	3-3, F-F
TB	M-249	Basement	20	C12 - Vertical piping from mezzanine floor to heater 15A inlet	H-H	Vert.	1.52	3-3, F-F
TB	M-249	Basement	14	F1 - Vertical 14-inch bypass piping from 20-inch horizontal pipe up to mezzanine floor toward heater 15A	H-H	Vert.	5.92	3-3, F-F
TB	M-249	Mez.	14	CF1 - Vertical piping from mezzanine floor to valve F11-1 inlet	H-H	Vert.	1.50	3-3, F-F
TB	M-247	Basement	22	D2 - Centerline of T in 22-inch header west to reducing elbow	G-G	Horiz.	11.00	3-3, F-F

Table A3-4: Piping Upstream of 15 Feedwater Heaters (cont.)

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-247	Basement	16	C2 - From centerline of reducing elbow south through valve F3-2 to 90 degree reducing elbow to the east	G-G	Horiz.	17.04	3-3, F-F
TB	M-247	Basement	20	C2 - Straightline distance south through the two 90 degree elbows toward the 15B heater	G-G	Horiz.	5.00	3-3, F-F
TB	M-247	Basement	20	C2 - 20-inch piping north toward heater 15B	G-G	Horiz.	13.29	3-3, F-F
TB	M-249	Basement	20	C12 - Vertical piping from 20-inch horizontal pipe up to mezzanine floor toward heater 15A	H-H	Vert.	5.92	3-3, F-F
TB	M-249	Basement	20	C12 - Vertical piping from mezzanine floor to heater 15A inlet	H-H	Vert.	1.52	3-3, F-F
TB	M-249	Basement	14	F1 - Vertical 14-inch bypass piping from 20-inch horizontal pipe up to mezzanine floor toward heater 15A	H-H	Vert.	5.92	3-3, F-F
TB	M-249	Mez.	14	CF1 - Vertical piping from mezzanine floor to valve F11-1 inlet	H-H	Vert.	1.50	3-3, F-F
				Linear FT on Basement			355.17	
				Linear FT on Mez. Level			3.00	
				Total Length (Linear FT)			358.17	

Table A3-5: Piping Downstream of 15 Feedwater Heaters

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
PIPING LOCATED BETWEEN 15 HEATERS AND FW-7A AND FW-7B IN TURBINE BUILDING								
TB	M-249	Mez.	18	B9 - Outlet of heater 15A up to 90 degree elbow to the south	G-G, H-H	Vert.	7.04	F-F, 3-3
TB	M-247	Mez.	18	D2 - Horizontal piping running to the south from the outlet of heater 15A	G-G, H-H	Horiz.	9.63	F-F, 3-3
TB	M-247	Mez.	18	D2 - Horizontal distance east through the 90 degree elbows on heater 15A outlet piping	G-G, H-H	Horiz.	5.00	F-F, 3-3
TB	M-247	Mez.	18	D2 - Horizontal distance north to the reducing elbow to the west	G-G, H-H	Horiz.	13.38	F-F, 3-3
TB	M-247	Mez.	22	D2 - Horizontal distance from the reducing elbow west toward turbine building wall to elbow up	G-G, H-H	Horiz.	28.16	F-G, 3-3
TB	M-249	Mez.	14	F1 - Heater 15A bypass line from F11-1 to 18-inch pipe on heater outlet	G-G	Vert.	12.54	F-F, 3-3
TB	M-249	Mez.	18	B9 - Outlet of heater 15B up to 90 degree elbow to the south	G-G, H-H	Vert.	7.04	F-F, 3-3
TB	M-247	Mez.	18	C2 - Horizontal piping running to the south from the outlet of heater 15B	G-G, H-H	Horiz.	9.63	F-F, 3-3
TB	M-247	Mez.	18	C2 - Horizontal distance east through the 90 degree elbows on heater 15B outlet piping	G-G, H-H	Horiz.	7.00	F-F, 3-3
TB	M-247	Mez.	18	D2 - Horizontal distance north from elbow to intersection of 45 degree pipe to 22-inch header	G-G, H-H	Horiz.	6.38	F-F, 3-3
TB	M-247	Mez.	18	D2 - Horizontal distance northwest of heater 51B outlet piping angling at 45 degrees into 22-inch header	G-G, H-H	Horiz.	9.90	F-F, 3-3
TB	M-249	Mez.	14	A1 - Heater 15B bypass line from F11-2 to 90 degree elbow angling toward 22-inch header	G-G	Vert.	12.54	F-F, 3-3
TB	M-247	Mez.	14	C2 - Horizontal distance northwest of heater 15B bypass piping angling at 45 degrees into 22-inch header	G-G, H-H	Horiz.	3.36	F-F, 3-3

INTERNAL FLOODING – Initiating Events Analysis for Turbine Building Floods

BLDG	Dwg. No.	Building Level	Nom. Dia. (in)	Drawing Coordinates/Description	Detail Section	Horiz./Vert. /Angle	Pipe Length (Linear FT)	Quad #,Letter (floor plan quads)
TB	M-249	Mez.	24	B8 - Vertical distance from centerline of 22-inch header to operating deck. Assumes that all pipe is 24 inches from elbow on	G-G	Vert.	7.95	G-G, 3-3
TB	M-249	Oper.	24	B8 - Vertical distance from operating deck to 90 degree elbow into auxiliary building. Assumes that all pipe is 24 inches from elbow on	G-G	Vert.	11.00	G-G, 3-3
TB	M-247	Oper.	24	C2 - Horizontal distance north from T in vertical 24-inch header	G-G	Horiz.	4.42	G-G, 3-3
TB	M-247	Oper.	24	A2 - Vertical distance from centerline of line 224 to 90 degree elbow angling out from wall	A-A	Vert.	10.25	G-G, 3-3
TB	M-247	Oper.	24	C2 - Horizontal distance of pipe angling out 45 degrees from wall to header	G-G	Horiz.	7.42	G-G, 3-4
TB	M-247	Oper.	24	C2 - Horizontal distance north to elbow up	G-G	Horiz.	41.92	G-G, 4-5
TB	M-247	Oper.	24	B5 - Vertical distance from centerline of header through valve V38-8 to the 90 degree elbow to the south	N/A	Vert.	11.08	G-G, 5-5
TB	M-247	Oper.	22	C2 - Horizontal distance from centerline of valve F38-8 south to elbow down	G-G	Horiz.	64.77	G-G, 5-3
TB	M-249	Oper.	22	B8 - Vertical distance from centerline of header to centerline of valve V38-9	N/A	Vert.	19.42	G-G, 3-3
TB	M-247	Oper.	22	C2 - Horizontal distance from centerline of header pipe down to the reducing elbow turning west	G-G	Horiz.	12.50	G-G, 3-3
TB	M-247	Oper.	22	C2 - Horizontal distance from centerline of F38-9 into header T downstream of F38-7	G-G	Horiz.	5.25	G-G, 3-3
TB	M-247	Oper.	22	C2 - Horizontal distance from centerline of F38-7 to auxiliary building wall	G-G	Horiz.	4.00	G-G, 3-3
				Linear FT on Oper. Deck			192.03	
				Linear FT on Mez. Level			139.53	
				Total Length (Linear FT)			331.56	

Appendix A

Initiating Events

Attachment 1 – Turbine Sump Alarm History

Turbine Building Sump Alarm History

Prepared by: [signature] George E Baldwin
Signature | Print Name

10/18/05
Date

Reviewed by: [signature] JEFFREY T. STAFFORD
Signature | Print Name

10-18-05
Date

Turbine Building Sump Alarm History

Annunciator 47033-P, *Miscellaneous Sump Level High,* represents three sumps, the Screenhouse sump (SER point 1593), Turbine Building sump (SER point 1594), and the Waste Area sump (SER point 1595). In review of the Sequence Event Recorder (SER) output from January 2003 through April 2005 (28 months), Annunciator 47033-P actuated on 70 days. This represents an alarm on the average of once every 12 days. There are periods of close to 2 months without an alarm and short periods with daily alarms. Alarms are frequently less than 1 minute and clear when operator acknowledges the annunciator. Of the 156 annunciator activations, 103 were at power. The annunciator was active for 1100 minutes with three times greater than 1 hour. The activations at-power average length of time was 11 minute but the three longer times account for 572 minutes. The average time, excluding the three long periods, is approximately 5 minutes per alarm. With the infrequency and length of time of the annunciator, the operators would respond in a timely fashion with concern if the alarm does not immediately clear.

Date	SER Point	IN	Out	Note
27-Feb-03	1594	0758	0758	
	1594	0758	0800	
	1594	0836	0836	
	1594	0836	0837	
	1594	0837	0840	
	1594	0840	0840	
	1594	0840	0845	
20-Mar-03	1593	1443	1443	
	1593	1443	1443	
	1593	1443	1443	
	1593	1443	1443	
	1593	1443	1443	
25-Mar-03	1594	0931	0932	
26-Mar-03	1594	0619	0619	
	1594	0619	0619	
	1594	0619	0619	
15-Apr-03	1593	1340	1343	First during Outage
20-Apr-03	1593	0903	1046	
06-May-03	1594	2328	0102	Day change
07-May-03	1594	0102	0154	
	1594	0102	0102	
	1594	0154	0154	
	1594	0154	0154	
	1594	0204	0230	
	1594	1633	2119	
08-May-03	1594	1239	1631	Day change
10-May-03	1594	1304	1311	Last during Outage
17-May-03	1593	0819	0824	

Date	SER Point	IN	Out	Note
	1593	1859	1902	
18-May-03	1593	0039	0042	
15-Jun-03	1593	1129	1132	
	1593	2243	2246	
07-Jul-03	1593	0102	0104	
	1594	0953	0953	
22-Jul-03	1593	2244	2249	
23-Jul-03	1593	1309	1312	
24-Jul-03	1593	0549	0550	
27-Jul-03	1593	1819	1821	
29-Jul-03	1593	2100	2103	
30-Jul-03	1593	0521	0524	
20-Sep-03	1593	0512	0518	
	1593	1419	1423	
	1593	1729	1933	
25-Sep-03	1594	2113	2145	
	1594	2145	2149	
02-Oct-03	1594	1340	1340	
03-Dec-03	1593	1141	1143	
04-Dec-03	1594	0220	0220	
08-Dec-03	1593	0136	0141	
	1594	0326	0326	
09-Dec-03	1594	0144	0144	
	1593	0437	0441	
12-Dec-03	1593	0913	0916	
16-Dec-03	1593	2208	2212	
18-Dec-03	1593	0018	0021	
22-Dec-03	1594	1241	1241	
25-Dec-03	1593	1136	1138	

Date	SER Point	IN	Out	Note
28-Dec-03	1593	1400	1402	
	1593	1412	1415	
	1593	1724	1726	
29-Dec-03	1593	1243	1246	
	1593	2246	2249	
31-Dec-03	1593	1509	1513	
01-Jan-04	1593	0632	0635	
	1593	0924	0926	
10-Jan-04	1593	1723	1727	
13-Jan-04	1593	0341	0344	
13-Jan-04	1593	0645	0649	
	1593	2118	2121	
15-Jan-04	1593	1828	1832	First during Outage
	1593	1939	1943	
16-Jan-04	1593	0149	0153	
	1593	0533	0537	
	1593	1257	1300	
	1593	1412	1415	
28-Jan-04	1593	1245	2349	
	1593	2145	2148	
29-Jan-04	1593	0312	0318	
	1594	2256	2300	
	1594	2300	0038	Day change
30-Jan-04	1594	0038	0039	Last during Outage
	1594	0039	0039	
	1594	0039	0132	
31-Jan-04	1594	0303	0314	
	1594	0359	0406	
	1594	0508	0516	
	1593	0559	0603	
	1594	0802	0810	
01-Feb-04	1593	1647	1650	
02-Feb-04	1593	0053	0057	
	1593	0236	0240	
	1593	0921	0924	
	1593	1209	1213	
	1593	1430	1435	
	1593	1550	1556	
01-Mar-04	1594	1246	1251	
02-Mar-04	1594	0753	0753	
	1594	0759	0800	
	1594	0759	0759	
	1594	0946	0946	
	1594	0947	0947	
	1594	0947	0954	
02-Mar-04 Cont	1594	0955	1007	
	1594	1043	1043	

Date	SER Point	IN	Out	Note
	1594	1043	1044	
	1594	1107	1107	
	1594	1129	1132	
	1594	1152	1152	
	1594	1154	1154	
	1594	1156	1159	
	1594	1304	1304	
	1594	1311	1311	
	1594	1311	1311	
14-Jun-04	1594	0833	0833	
18-Jun-04	1593	0832	0832	
16-Aug-04	1594	1230	1230	
	1594	1230	1230	
	1594	1230	1230	
	1594	1230	1230	
	1594	1230	1230	
20-Sep-04	1594	1346	1414	
01-Oct-04	1594	1333	1633	
	1594	1655	1655	
	1594	1718	1758	
20-Oct-04	1593	2237	2332	First during Outage
02-Nov-04	1594	1209	1210	
	1594	1210	1213	
	1594	1313	1314	
	1594	1314	1314	
	1594	1314	1314	
	1594	1314	1332	
	1594	1314	1314	
	1594	1332	1421	
04-Nov-04	1594	1405	1405	
06-Dec-04	1594	0537	0610	Last during Outage
09-Feb-05	1595	1043	1044	
	1595	1044	1044	
	1595	1044	1044	
	1595	1049	1049	
	1595	1117	1117	
	1595	1117	1117	
23-Feb-05	1593	2157	2158	First during Outage
	1593	2157	2157	
10-Mar-05	1593	0827	0834	SERIES
13-Mar-05	1594	1101	1104	
14-Mar-05	1594	0808	0808	
17-Mar-05	1593	0925	0925	
	1593	1018	1018	
22-Mar-05	1593	1739	1743	

Date	SER Point	IN	Out	Note
02-Apr-05	1594	1451	1457	
03-Apr-05	1594	0626	0650	
04-Apr-05	1594	1225	1236	
05-Apr-05	1594	0629	0644	
06-Apr-05	1594	0616	0634	
09-Apr-05	1594	1546	1547	
	1594	1550	1550	

Appendix A

Initiating Events

Attachment 2 – Circulation Water Expansion Joint Rupture Frequency

Circulation Water Expansion Joint Rupture Frequency

Owner's Acceptance: THOMAS G HOOK — Signature

THOMAS G. HOOK — Print Name

10/27/2005 — Date

Kewaunee Power Station

Calculation MSE-KPS-05-01

Circulation Water Expansion Joint Rupture Frequency

Revision 0

Effective Date: October 2005

Prepared by Maracor Software & Engineering, Inc.

Prepared By: D. M. Jones, Maracor — Date: 10-25-05

Reviewed By: J. R. Sharpe, Maracor — Date: 10/25/05

Approved By: R. J. Dremel, Maracor — Date: 10/25/05

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List of Attachments

1.0 Purpose

The purpose of this calculation is to determine a failure rate for circulating water expansion joint failures resulting in a major flood, which is applicable to Kewaunee Power Stations (KPS).

2.0 Analysis

The technical approach used to determine the appropriate failure rate consists of the following steps:

- Review the historical industry data for expansion joint failures.
- Review industry failure data calculations for expansion joints.
- Determine the applicability of industry data to the KPS expansion joints
- Calculate an appropriate failure rate for circulating water expansion joint failures resulting in a major flood at KPS.

Each of these steps is described in the following subsections.

2.1 Industry History for Expansion Joint Failure

The EPRI Expansion Joint Maintenance Guide [REPORT01] tabulates the results of an industry survey on expansion joint experience, including failures (leak or rupture) of rubber/fabric expansion joints which occurred between the years 1977 and 2000. That data identified 31 failures of rubber expansion joints at 22 units, consisting of:

- 14 failures of condensate system expansion joints
- 7 failures of service water expansion joints
- 2 failures of circulating water expansion joints
- 2 failures of condenser expansion joints
- 6 failures of other expansion joints (cooling water, screen wash, feedwater, etc.)

In addition, the Guide noted that while rubber expansion joints are highly susceptible to the leak failure mechanism, they are only moderately susceptible to rupture or deformation, and have low susceptibility to cracking, wall thinning, pinhole leak, linear tearing or cracking, material degradation, tearing or corrosion. Of the 31 rubber expansion joint failures identified, 42% were a crack resulting in a leak, 23% were a rupture, and the remainder had other failure modes.

In many cases (46%) the cause of the failure (e.g., age, degradation, fatigue, water hammer, etc.) was unknown. However, surveys and interviews with manufacturers identified that the most common causes of failure for rubber expansion joints are:

- Misalignment of the piping system at the time of installation causing excessive movement and stress fatigue.
- Improper application of the expansion joint material (e.g., fluid incompatibility).
- Design inadequacies (e.g., increased operating temperature, increased levels of abrasive particulates).

2.2 Industry Average Circulating Water Expansion Joint Failure Rate

The EPRI report on Pipe Rupture Frequencies for Internal Flooding PRAs [REPORT02] developed a mean flood failure rate for circulating water expansion joints greater than 24-inch diameter that result in a major flood:

Major flood due to failure of circulation water expansion joint = 1.48E-05/component-reactor year

The failure rate for a major flood due to circulating water expansion joint failure considered the two circulating water expansion joint failures identified in REPORT01:

- LaSalle Unit 1, a 108-inch circulating water pump expansion joint failed due to water hammer in the Lake Screen House on May 31, 1985, resulting in a 2000-gpm flood (LER 50-373/1985-045).
- Comanche Peak Unit 1, a rubber expansion joint on the circulation pump discharge failed on June 6, 1993, resulting in six feet of water in the circulating discharge room. The expansion joint failed under vacuum when the pump was stopped, and was attributed to normal aging. This failure resulted in leakage but not a catastrophic rupture [CORRESP01].

In addition, two other circulating water expansion joint failures that occurred between the years 2000 and 2004 were also identified, for a total of 33 failures of rubber expansion joints:

- Catawba Unit 1, minor leakage of a circulating water rubber expansion joint occurred in 2001 (IR 50-413/2001-02).
- Catawba Unit 2, minor leakage of a circulating water rubber expansion joint occurred in 2001 (IR 50-413/2001-02) [CORRESP02].

Although only one of these four circulating water expansion joint failure events resulted in significant leakage, in order to have a sufficient sample of events [CORRESP03] all four were included in the REPORT02 calculation of the failure rate for a major flood due to major structural failure of a circulating water expansion joint. In addition, no differentiation was made for differences in expansion joint material, event failure mechanisms or causes, or plant in-service and leak inspection programs, in order to provide an average failure rate. Therefore, the average developed in REPORT02 may not be directly applicable to a specific plant.

2.3 Applicability of Average Circulating Water Expansion Joint Failure Rate to KPS

The KPS circulating water inlet expansion joints are approximately 20 years old. The outlet expansion joints are original plant components. Both the inlet and outlet expansion joints are scheduled to be replaced in 2006. The inlet expansion joints were examined by an engineer from (Garlock) and the following observations made [REPORT03]:

> "Very little foreign matter was evident inside this pipe after draining the system. Normal silt and minute particulate was visible on top of the valve. Around the circumference, both the upper portion of the joint and the top of the arch showed little wear and few signs of mechanical abrasion. The residue that settled in the arch was light and silty, easily removed with a rag and water. The entire body of the joint felt firm but not brittle, revealing no vertical cracks. A fine network of surface cracks was evident on the body of the joint, which is to be expected given the age of the elastomer. These cracks are only on the surface and do not penetrate to the depth of the fabric reinforcing plies, and will not lead to premature failure. The bottom portion of the joint showed some larger particulate attached to the top edge of the pipe and settling in a layer between the edge of the pipe and the body of the joint. This particulate edge was sharp, with a long and narrow configuration, measuring approximately .0625" wide, by .25" long, by .125" deep. In several areas, the particulate had gathered together in a small cluster of 5 or 6 pieces. When scraped away, a rust colored mark was exposed on the elastomer surface, beneath the foreign matter. In two of these instances, the area underneath was slightly soft to the touch. These areas measured about .5" wide. The sponginess was slight and no breaks were evident in the fabric plies underneath the rubber. The integrity of the joint does not appear to be compromised as a result of this condition.
>
> Based on this evaluation . . . there appears to be no reason to take these joints out of service prior to the planned replacement in March 2006. All visible wear corresponds to the normal aging of elastomers and exposure to a high velocity flow rate with minimal movement requirements."

An additional evaluation of the KPS circulating water expansion joints provided the following observations [REPORT04]:

- The normal design pressure for circulating water expansion joints of the size installed in the turbine building is 40 psig. The design head of the KPS circulating water pumps is about 12 psig.
- The affects of aging were reviewed and the following conclusions were reached:
    - Ozone – after about 19 years, ozone could generate a crack approximately ½-inch deep. The 2005 inspection report for the expansion joints [REPORT03] presents evidence of minor cracking typical with the aging process associated with elastomeric expansion joints. Cracks as deep as ½-inch would be visible and would not be considered minor. Therefore, significant degradation of the joints due to ozone exposure has not occurred.

- Ultraviolet Radiation – The KPS circulating water expansion joints are in relatively low-temperature service and are indoors. They are not exposed to sunlight or other sources of ultraviolet light. The inspection report indicated no surface crazing and no high levels of oxidized rubber. Thus, ultraviolet radiation damage is not a factor in aging of the KPS circulating water expansion joints.
- Temperature-Related Aging Effects – In general, the expansion joints, assumed for the evaluation to be natural rubber (which is conservative), would perform their function for about 40 years based on the test results cited in the evaluation.

- Seismic Events – Failures of the expansion joints due to seismic events were found to not be credible.
- Stress and Load – The anticipated loading of the expansion joint is well below the capacity of the material.

The KPS circulating water piping expansion joint evaluation [REPORT04] concluded that for potential failure mechanisms, the KPS circulating water expansion joints would not have experienced gross failure or degradation during past operation. In fact, the evaluations suggest the remaining useful life of the joints is likely to be 10 to 20 years. Therefore, the evaluations described above suggest that there is no evidence to conclude that a rupture of the KPS circulating water expansion joints is more likely than industry data indicates. Indeed, the evidence seems to suggest that the failure rate for Kewaunee would be less than the industry average.

2.4 Calculation of a Circulating Water Expansion Joint Failure Rate for KPS

As described previously, the EPRI Expansion Joint Maintenance Guide [REPORT01] notes that only 23% of the rubber expansion joint failures identified in the industry data for all systems are ruptures. In addition, of the events considered in the EPRI report "Pipe Rupture Frequencies for Internal Flooding PRAs" [REPORT02] to develop a mean flood failure rate for circulating water expansion joints greater than 24-inch diameter causing a major flood, only 25% (i.e., one of the four events identified between 1977 and 2004) were significant leaks or rupture.

Inspections and evaluations of the KPS circulating water expansion joints [REPORT03, REPORT04] indicate that the expansion joints would not have experienced gross failure or degradation during past operation, and that the remaining useful life of the expansion joints is likely to be 10 to 20 years.

These findings demonstrate the KPS circulating water expansion joints have not degraded from either misapplication of the expansion joint or poor installation of the expansion joint, the common expansion joint failure mechanisms. Based on these considerations, the portion of KPS circulating water expansion joint failures that could occur due to rupture is judged to be consistent with the industry data in REPORT01 and REPORT02, and a reduction factor of 25% (based on only one of four events resulting in a significant leakage or rupture) can be applied to the average industry failure rate:

Major flood due to rupture of KPS circulation water expansion joint =
1.48E-05/component-reactor year * 0.25 = **3.7E-06/expansion joint-reactor year**

Discussion with the author of REPORT02 confirms that this a reasonable approach to determine a circulating water expansion joint rupture frequency applicable to KPS [CORRESP03].

To further confirm that use of a 25% reduction factor is appropriate, a circulating water expansion joint rupture frequency is calculated using the method from REPORT02, with only the one event between 1977 and 2004 that resulted in significant leakage or rupture as the posterior evidence.

The model for relating failure rates and rupture frequencies used in REPORT02 is as follows:

$$\rho_{ijx} = \sum_{k=1}^{M} \rho_{ijkx} = \sum_{k=1}^{M} \lambda_{ijk} P_{ijk}\{R_x|F\}$$

Where:

ρ_{ijx}	=	total rupture frequency of rupture size x for pipe size i in system j
ρ_{ijkx}	=	rupture frequency of rupture size x for pipe of size i in system j due to damage mechanism k
λ_{ijk}	=	failure rate of pipe of size i in system j due to damage mechanism k
$P_{ik}\{R_x|F\}$	=	conditional probability of rupture size x given failure for pipe size i in system j and damage mechanism k
M	=	Number of different damage mechanisms

In general, a point estimate of the frequency of pipe failures, λ_{ijk}, is given by the following expression:

$$\lambda_{ijk} = \frac{n_{ijk}}{f_{ijk} N_{ij} T_{ij}}$$

Where

n_{ijk}	=	the number of failures (cracks, wall thinning, leaks and ruptures) events for pipe size i in system j due to damage mechanism k
T_{ij}	=	the total time over which failure events were collected for pipe size i in system j
N_{ij}	=	the number of components that provided the observed pipe failures for size i in system j
f_{ijk}	=	the fraction of number of components of size i in system j that are susceptible to failure from damage mechanism k for conditional failure rates given susceptibility to damage mechanism k, 1 for unconditional failure rates

For internal flooding we seek unconditional failure rates and therefore combine these equations under the condition f_{ijk} =1 to obtain the following expression for the point estimate of the rupture frequency.

$$\rho_{ijx} = \sum_{k=1}^{M} \rho_{ijkx} = \sum_{k=1}^{M} \lambda_{ijk} P_{ik}\{R_x|F\} = \sum_{k=1}^{M} \frac{n_{ijk}}{N_{ij}T_{ij}} P_{ik}\{R_x|F\}$$

In the development of Bayes' uncertainty distributions for these parameters, prior distributions are developed for the parameters λ_{ijk} and $P_{ik}\{R/F\}$ and these prior distributions are updated using the evidence from the failure and exposure data as in standard Bayes' updating.

The Bayes' prior failure rate used in REPORT02 for circulating water expansion joints is based on the Oconee PRA (NSAC-60) which documents a failure rate of 2.5E-04 per expansion joint per year. This information is used as our prior state of knowledge and interpreted as a lognormal mean with a range factor of 100.

The parameters for the Beta distribution representing $P\{R|F\}$ are calculated as follows:

$$\text{Alpha} = \frac{E(1-E)}{E[-1+\exp(\ln RF/t95)^{**}2)]} - E$$

$$\text{Beta} = \frac{\text{Alpha}(1-E)}{E}$$

Where:

E	=	Prior mean
RF	=	Prior range or error factor
t95	=	95th percentile standard normal variant = 1.644853875

Therefore,

$$\text{Alpha} = \frac{2.5E\text{-}04\ (1 - 2.5E\text{-}04)}{2.5E\text{-}04\ [-1+\exp(\ln 100/1.644853875)^{**}2)]} - 2.5E\text{-}04 = 1.443E\text{-}04$$

$$\text{Beta} = \frac{1.443E\text{-}04\ (1 - 2.5E\text{-}04)}{2.5E\text{-}04} = 5.770E\text{-}01$$

The posterior mean and error factor for $P\{R|F\}$ are then determined from the Beta distribution as follows:

$$\text{Mean} = \frac{\text{Alpha} + k}{\text{Alpha} + \text{Beta} + n}$$

Where:

k	=	Number of major structural failures (evidence)
n	=	Number of demands (total other failures)

The posterior evidence for major structural failures used to update $P\{R|F\}$ consists of one major structural failure (as opposed to four included in REPORT02) out of the 33 total rubber expansion joint failures. It is also assumed that the prior evidence consisted of one major structural failure out of the two total rubber expansion joint failures. Then, k and n are calculated as:

k = 1 prior + 1 posterior = 2 major structural failures
n = 1 prior + (33 -1 posterior) = 33 other failures

The updated conditional probability of major structural failure given a rubber expansion joint failure ($P\{R|F\}$) is then:

$$\text{Mean} = \frac{1.443\text{E-04} + 2}{1.443\text{E-04} + 5.770\text{E-01} + 33} = 5.957\text{E-02}$$

The exposure term used in REPORT02 is calculated as (U.S. LWR Critical Reactor Years) * (Total Number of Circulating Water Expansion Joints per Plant) = 2899 * 12 = 34,788 Circulating Water Expansion Joint Years.

The total rupture frequency for a circulating water expansion joints is then calculated as

$$\rho = \frac{n}{N\,T} P\{R\,|F\}$$

Where

n	=	number of major structural failures (called "k" above) = 2
T	=	total time over which failure events were collected = 2899 reactor critical years
N	=	number of components that provided the failures = 12
$P\{R\|F\}$	=	conditional probability of rupture given failure = 5.957E-02

The resulting frequency of a major flood due to rupture of a circulating water expansion joint is then:

$$\rho = \frac{2}{12 * 2899} * (5.957\text{E-02}) = \mathbf{3.43E\text{-}06\ /\ expansion\ joint - reactor\ year}$$

The close agreement with the circulating water expansion joint rupture frequency calculated previously (3.7E-05/expansion joint-reactor year) confirms that use of a 25% reduction factor is appropriate and conservative.

3.0 Conclusion

Industry historical data for expansion joint failures and calculations of average expansion joint failure rates based on industry data were reviewed to determine if an average industry failure rate for expansion joint rupture was applicable to Kewaunee Power Station. The industry average failure rate for circulating water expansion joint rupture (1.48E-05 per expansion joint per reactor-year) was based on four industry circulating water expansion joint failure events that occurred between 1977 and 2004, although only one of these four events was a major structural failure that resulted in significant leakage or rupture. Similarly, historical data for all rubber expansion joint failures indicates that only 23% of the failures are ruptures.

The findings from inspection and evaluation of the KPS circulating water expansion joints demonstrate the KPS circulating water expansion joints have not degraded from either misapplication or poor installation of the expansion joint, and suggest that the failure rate would be less than the industry average. Therefore, the portion of KPS circulating water expansion joint failures that could occur due to rupture is judged to be 25% of the industry average failure rate, or **3.7E-06 per expansion joint per reactor-year.** The 25% reduction factor was confirmed to be appropriate and conservative by calculating the circulating water expansion joint rupture frequency using only the one industry event that resulted in major structural failure.

4.0 References

[REPORT01] Tulay, M., "EPRI Expansion Joint Maintenance", EPRI 1008035, Charlotte, NC, 2003.

[REPORT02] Fleming, K and Lydell, B., "Pipe Rupture Frequencies for Internal Flooding PRAs", Karl N. Fleming Consulting Services, prepared for EPRI, Encinitas, CA, 2005.

[REPORT03] Garlock On Site Internal Inspection of Expansion Joints, Julie Benzer, Garlock Sealing Technologies, March 11, 2005. (Attachment 1)

[REPORT04] Kinsey, S., "Circulating Water Piping Expansion Joint Evaluation", MPR Associates Inc., Alexandria, VA, 2005.

[CORRESP01] Electronic mail from Dan Tirsun, Comanche Peak, 254-897-0865, October 6, 2005. (Attachment 2)

[CORRESP02] Phone conversation with Dave Kawl, 803-831-4174, Catawba, October 4, 2005. (Attachment 3)

[CORRESP03] Phone conversation with Bengt Lydell, 520-883-4335, October 20, 2005. (Attachment 4)

Attachment 1

Expansion Joint Inspection

Garlock
SEALING TECHNOLOGIES®

EXPANSION JOINT DEPARTMENT

Kewaunee Nuclear Station
Attn: Dale Franson
Phone: 920-388-8267

March 11, 2005

Re: Garlock On Site Internal Inspection
Expansion Joints

Dear Mr. Franson,

On Wednesday, March 2, 2005 - Internal inspection was conducted by Garlock Area Manager, Carolyn Connolly, at Kewaunee Nuclear Station on Condenser Inlet expansion joints A1 and B2. External inspection was performed in January 2005 and results were conveyed to Kewaunee.

Expansion Joint Description: 72" Sleeve Type, Single Arch, installed and approximately 20 years old. The expansion joint is installed indoors.

System Parameters were advised to be as follows:

Operating Pressure:	10 PSI
Operating Temperature:	33 to 80 degrees F with flux in temperature occurring gradually.
Operational Flow Rate:	100,000 GPM (constant)

Internal Inspection Results:

Unit A1 -

Very little foreign matter was evident inside this pipe after draining the system. Normal silt and minute particulate was visible on top of the valve. Around the circumference, both the upper portion of the joint and the top of the arch showed little wear and few signs of mechanical abrasion. The residue that settled in the arch was light and silty, easily removed with a rag and water. The entire body of the joint felt firm but not brittle, revealing no vertical cracks. A fine network of surface cracks was evident on the body of the joint, which is to be expected given the age of the elastomer. These cracks are only on the surface and do not penetrate to the depth of the fabric reinforcing plies, and will not lead to premature failure. The bottom portion of the joint showed some larger particulate attached to the top edge of the pipe and settling in a layer between the edge of

the pipe and the body of the joint. This particulate edge was sharp, with a long and narrow configuration, measuring approximately .0625" wide, by .25" long, by .125" deep. In several areas, the particulate had gathered together in a small cluster of 5 or 6 pieces. When scraped away, a rust colored mark was exposed on the elastomer surface, beneath the foreign matter. In two of these instances, the area underneath was slightly soft to the touch. These areas measured about .5" wide. The sponginess was slight and no breaks were evident in the fabric plies underneath the rubber. The integrity of the joint does not appear to be compromised as a result of this condition.

Unit B2: Similar in wear to Unit A1 was noted. However, more foreign matter was noted inside the pipe of this unit, including small fish and rocks approximately 2" in diameter. A number of rocks had become embedded in the condenser tube sheet and another half dozen were noted on top of the valve. However, the joint appeared to be in good condition. As with Unit A1, the body of the arch and the upper portion of the joint appeared flawless. The bottom portion, where the joint flange met the pipe, showed the same type of foreign matter noted in Unit 1. In addition, there were two areas that showed some additional wear. These areas were approximately 3 inches long, by 1 inch wide. In these sections, the elastomer bulged upward in a subtle but noticeable manner. Closer inspection revealed these were likely to be variances in the overall configuration, as a result of the original manufacturing process. They were not bubbles in the elastomer, which would typically indicate delamination between the fabric and rubber plies.

Based on this evaluation, in addition to the external inspection already completed, there appears to be no reason to take these joints out of service prior to the planned replacement in March 2006. All visible wear corresponds to the normal aging of elastomers and exposure to a high velocity flow rate with minimal movement requirements.

If additional information or further discussion is necessary, please feel free to contact me.

Thank You,

Julie Benzer
Product Manager
Garlock-Expansion Joints

Attachment 2

Record of Electronic Mail

From: IMCEANOTES-Dan+20Tirsun_ENERGY_TXU+40TXUE+40TXUB@txu.com
Sent: Thursday, October 06, 2005 6:27 AM
To: ejorgenson@maracor.com
Subject: Re: Expansion Joint Failures - Historical Events

Sorry about the delay, but we don't have that kind of details from that far back. At least from what we can quickly dig up and as we are starting our down power to begin the fall outage, we just are not going to get a lot of support for someone else digging through historical/archived files.

All I can tell you is that neither of the leaks caused a trip. The 98 event did not cause a down power and the expansion joints were replaced during the outage. The earlier one as you stated caused a load reduction. Again no one seems to remember a catastrophic failure, but the leak must have been large enough or there was a concern that it could become larger so they shut down the pump for repairs. From what I've been told the expansion joints are metallic type and there have been several minor weld repairs done on them in the past.

Sorry I could not have been of more help.

Dan

Eric Jorgenson <ejorgenson@maracor.com>
10/05/2005 02:26 PM
To: Dan Tirsun/ENERGY/TXU@TXUE
Subject: Expansion Joint Failures - Historical Events

Hi Dan and Russ – I've spoken with you this week and last week about obtaining specific information regarding expansion joint failure events at Comanche Peak. I'd like to determine leak size, expansion joint composition, if possible. The events are shown below. Would you please respond by noon on Thursday if possible? I have a deadline that is quickly approaching. Thanks!

1. Comanche Peak 1 – 1998 - Circulating Water pump expansion joint ruptured because of normal aging.
2. Comanche Peak 1 – 6/6/1993 - Load reduction due to circulating pump 1-02 expansion joint failure.

Eric Jorgenson
Maracor Software & Engineering
PO Box 20176, Seattle, WA 98102-1176
Courier: 304 11th Ave E, Seattle, WA 98102
Phone: 206-709-4068
Fax: 206-709-4067

Attachment 3

Record of Telephone Conversation

Originator: Eric Jorgenson, Maracor Software & Engineering, Inc.
Phone: 206-709-4068

Participant: Dave Kaul, Catawba Nuclear Station
Phone: 803-831-4174

Date: Monday, October 24, 2005
Time: 8:00 am PDT

Topic: Catawba historical experience with expansion joint failures

Discussion:

Catawba 1, June 12, 1993 event. Dave recalls that this event involved a catastrophic rupture of a metal expansion joint inside the main condenser. No leakage outside of the condenser occurred.

Catawba 2, October 21, 2001 event. Dave indicated that this event involved leakage in a 10-foot diameter rubber condenser cooling water (equivalent to circulating water) expansion joint. Leakage rate was approximately 10-20 gpm. The root cause was attributed to aging and the large dimension of the joint (significant loads are placed on larger joints). The expansion joints are rubber with polyester reinforcement. The joints were placed in service in 1985 and have never been replaced. An internal seal was installed on the leaking joint and returned to service.

Neither Catawba unit has experience an expansion joint failure event that resulted in significant leakage, based on Dave's knowledge of the plants.

Attachment 4

Record of Telephone Conversation

Originator: Diane M. Jones, Maracor Software & Engineering, Inc.
Phone: 515-221-0096

Participant: Bengt O. Y. Lydell
Phone: 520-883-4335

Date: Thursday, October 20, 2005
Time: 3:30 pm CDT

Topic: Calculation of circulating water expansion joint failure rates in report he co-authored for EPRI ("Pipe Rupture Frequencies for Internal Flooding PRAs")

Discussion:

Diane: The EPRI Expansion Joint Maintenance Guide says that only 23% of the rubber expansion joint failures identified in the industry data for all systems are ruptures. In their (Bengt and Karl Fleming) report, of the 4 events considered to develop a mean flood failure rate for circulating water expansion joints causing a major flood, only one (25%) was a significant leak or rupture.

So would it be acceptable to reduce the frequency they calculated (1.48E-5) by a factor of 25% to apply to ruptures that result in large floods at Kewaunee?

Bengt: Yes, for lack of anything better that would be a reasonable approach without overstepping.

A basic problem is that many plants have a proactive periodic replacement program for their expansion joints and others don't, they may just do visible inspections. The amount of documentation on this is very poor, so it is hard to know what impact the programs have.

Diane: Since only one of the four circulating water expansion joint failure events resulted in significant leakage why were all four included in their calculation of the failure rate for major structural failures of circulating water expansion joints that result in a large flood. Was it to get a significant number of failures for sample size for the Bayesian?

Bengt: Yes, for lack of any other reason it was to have enough data.

Appendix A

Initiating Events

Attachment 3 – High Energy Line Break Report

High Energy Line Break Report

Owner Acceptance: THOMAS G HOOK | THOMAS G. HOOK
Signature | Print Name

10/27/2005
Date

HIGH ENERGY LINE BREAK INITIATING EVENT FREQUENCIES FOR THE KEWAUNEE PRA

Final Report

Prepared for

Dominion Energy
Kewaunee Power Station

By

Karl N. Fleming
Bengt O.Y. Lydell

In Cooperation with
Maracor Software & Engineering, Inc.

Karl N. Fleming Consulting Services LLC
A California Limited Liability Company
616 Sereno View Road
Encinitas, CA 92024
United States of America

October, 2005

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1. INTRODUCTION

1.1 *Purpose*

The purpose of this report is to document the derivation of initiating event frequencies that will be used as input to the turbine building internal flooding risk assessment at Dominion Energy's Kewaunee Power Station. Specifically, initiating event frequency values associated with ruptures of high-energy lines that in turn cause actuation of fire protection systems will be determined. This work was performed via Subcontract to Maracor Software Engineering, Inc. on behalf of Dominion Energy's Kewaunee Power Station. This report is intended to be an integral part of the overall turbine building internal flooding initiating events analysis.

1.2 *Scope*

The scope of work covered in this report includes:

- Development of pipe failure rates and rupture frequencies for high energy piping (i.e. piping with water or steam above saturation temperature) in PWR plants including the following systems:
  - o steam, including high pressure, low pressure, and extraction steam systems
  - o feedwater system, including feedwater heaters and drain systems
  - o condensate system
- Development of point estimates and probability uncertainty distributions for all parameters subject to data uncertainties
- Calculation of Kewaunee HELB initiating event frequencies including point estimates and probability uncertainty distributions based on information provided by Kewaunee and Maracor on initiating event success criteria and piping lengths

1.3 *Objectives*

The objective is to perform a state of the art data analysis that is consistent with the applicable requirements of ASME PRA Standard Capability Category II for initiating event frequency development. Consistent with this objective, the report is intended to provide a traceable basis for the calculations so that the results could be independently reproduced from the information provided.

1.4 *Report Guide*

A major part of this report is devoted to the development of a set of failure rates and rupture frequencies for use in the turbine building HELB-initiated internal flooding initiating event development. The technical approach to developing these failure rates and rupture frequencies

is summarized in Section 2. In Section 3 the HELB-initiated internal flooding initiating event models for the Kewaunee PRA are described including the success criteria for screening pipe locations and break sizes that apply to each event. The details of the development of the break sizes and locations for these events and break sizes are provided in Section 3.2 in the turbine building internal flooding initiating events analysis, into which this report is to be integrated. The information in Section 3 of this report is based on information in Section 3.2 of the main report and was provided to the authors by Kewaunee and Maracor. The development of failure rates and rupture frequencies for this model using the methodology of Section 2 is documented in Section 4. The results for the initiating event frequencies including point estimates and uncertainty distributions are summarized in Section 5. Section 6 lists the references used as inputs to the data development and methodology. Supporting details are provided in the Appendices.

2. TECHNICAL APPROACH

2.1 *Overview*

The model used to estimate pipe break frequencies for the initiating event models in this calculation is the same as that used in a recent EPRI report on internal flooding initiating event frequencies [1], and similar to that used in recent NRC studies regarding loss of coolant accident (LOCA) initiating event frequencies [2] [3]. The source of pipe failure and exposure data used to quantify the failure rates used in these models is known as "PIPExp-2004" [4]. A summary of this database is provided in Appendix A.

2.2 *Uncertainty Treatment*

Uncertainties in these failure rates were quantified using a Bayes' methodology that was developed in the EPRI RI-ISI program [5] and approved by the NRC for use in applied RI-ISI evaluations [6]. An independent review of this pipe failure rate uncertainty treatment was performed to support the NRC Safety Evaluation and results of this favorable review are provided in Reference [7]. An earlier EPRI report [8] developed a set of pipe failure rates for use in the EPRI RI-ISI applications which was also approved and independently reviewed in References [6] and [7]. These earlier failure rate estimates were derived from a pipe failure database that had been developed in Reference [10]. During subsequent work in applying these estimates in applied RI-ISI evaluation, a significant number of data classification errors in the original data source [10] were identified and improved estimates of the exposure population became available. These factors, as discussed more fully in Reference [9], were the prime motivation to switch to the more comprehensive and validated "PIPExp-2004" database when Reference [1], was developed. The most recent NRC sponsored work on LOCA frequencies [3] is also based in part on the "PIPExp-2004" database.

2.3 *Pipe Rupture Model*

The model used for relating failure rates and rupture frequencies uses the following simple model that is widely used in piping reliability assessment and was used in recent updates of recommended Loss of Coolant Accident frequencies [6]. The failure modes included in the estimation of failure rates include leaks and ruptures and, in some cases, cracks may also be included depending on the application. The model is expressed in the following equation:

$$\rho_{ijx} = \sum_{k=1}^{M} \rho_{ijkx} = \sum_{k=1}^{M} \lambda_{ijk} P_{ijk}\{R_x|F\} \qquad (2.1)$$

Where:

ρ_{ijx}	=	total rupture frequency of rupture size x for pipe size i in system j
ρ_{ijkx}	=	rupture frequency of rupture size x for pipe of size i in system j due to damage mechanism k
λ_{ijk}	=	failure rate of pipe of size i in system j due to damage mechanism k

$P_{ik}\{R_x\|F\}$	=	conditional probability of rupture size x given failure for pipe size i in system j and damage mechanism k
M	=	Number of different damage mechanisms

In general, a point estimate of the frequency of pipe failures, λ_{ijk}, is given by the following expression:

$$\lambda_{ijk} = \frac{n_{ijk}}{f_{ijk} N_{ij} T_{ij}} \tag{2.2}$$

Where

n_{ijk}	=	the number of failures (cracks, wall thinning, leaks and ruptures) events for pipe size i in system j due to damage mechanism k
T_{ij}	=	the total time over which failure events were collected for pipe size i in system j
N_{ij}	=	the number of components that provided the observed pipe failures for size i in system j
f_{ijk}	=	the fraction of number of components of size i in system j that are susceptible to failure from damage mechanism k for conditional failure rates given susceptibility to damage mechanism k, 1 for unconditional failure rates

Note that all failure modes that result in pipe repair are included in the failure rate and that all failures thus defined are regarded as precursors to rupture. The events counted as ruptures are based on a specific definition of rupture which is application specific. For internal flooding and HELB applications, we seek unconditional failure rates and hence we can combine these equations under the condition: $f_{ijk}=1$ to obtain the following expression for the point estimate of the rupture frequency.

$$\rho_{ijx} = \sum_{k=1}^{M} \rho_{ijkx} = \sum_{k=1}^{M} \lambda_{ijk} P_{ik}\{R_x|F\} = \sum_{k=1}^{M} \frac{n_{ijk}}{N_{ij}T_{ij}} P_{ik}\{R_x|F\} \tag{2.3}$$

In the development of Bayes' uncertainty distributions for these parameters, prior distributions are developed for the parameters λ_{ijk} and $P_{ik}\{R/F\}$ and these prior distributions are updated using the evidence from the failure and exposure data as in standard Bayes' updating. The exposure terms (denominator of the fractions on the right hand side of Equation (2.3) also have uncertainty as these terms must be estimated for the entire nuclear industry that provides the number of failures for the failure rate estimation. This uncertainty is treated in this process by adopting three hypotheses about the values of the exposure terms which requires three Bayes updates for each failure rate. The resulting posterior distributions for each parameter on the right hand side of Equation (2.3) are then combined using Monte Carlo sampling to obtain uncertainty distributions for the pipe rupture frequencies. A picture of this process is shown in Figure 2-1. This flow chart shows the full treatment of uncertainty needed for the RISI formulation in Equation (2.2). For the internal flooding and HELB formulation of Equation (2.3) the damage mechanism susceptibility fractions (f_{ijk}) do not come into play. The specific way in which this flow chart is applied is discussed in Section 4 for each system and failure mode.

In Reference [1] rupture frequencies were developed for three rupture sizes that were selected to support internal flooding analysis. These sizes include water sprays with flood rates of up to 100 gpm, flooding with flood rates of 100 to 2000 gpm, and major flooding with flood rates greater than 2000 gpm. For the Kewaunee HELB-initiated internal flooding models, a somewhat different rupture size model had to be developed as the criteria for producing the consequences of interest are based on specific rupture sizes that were determined in a deterministic calculation, based on the energy required to activate fire protection system sprinklers.

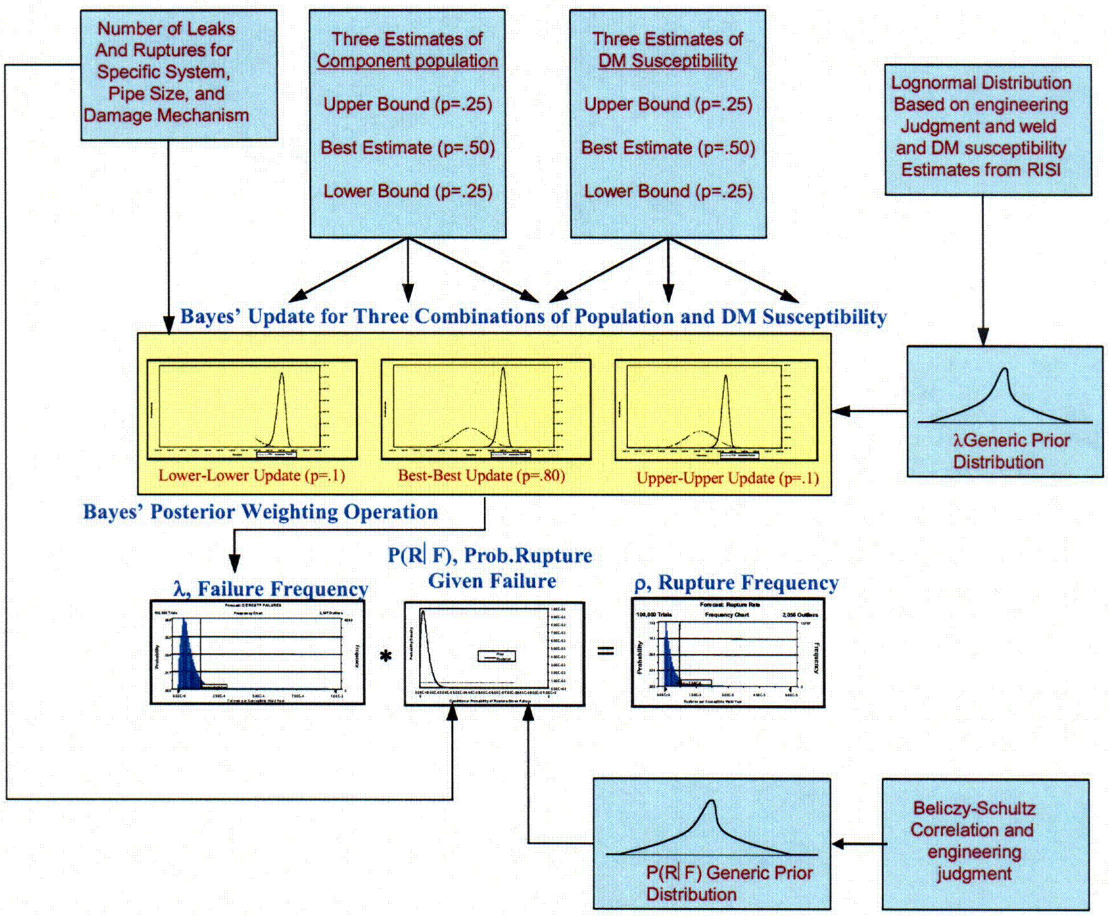

Figure 2-1 Flow Chart for Bayes' Estimates of System, Size, and Damage Mechanism Specific Pipe Failure Rates (λ) and Rupture Frequencies (ρ)

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2.4 Definition of Pipe Failure Rate Cases

To support the baseline calculations and some sensitivity calculations that were selected to develop risk management insights, a set of 24 analysis cases were devised as shown in Table 2-1. The variables used to define these cases include the piping system, rupture size, and data screening assumptions.

A failure rate and a rupture frequency had to be developed for each case and, hence, a total of 48 parameter distributions were developed. As discussed more fully in Section 4, the dominant failure mechanism in HELB piping is flow accelerated corrosion (FAC). The piping systems were put into 4 major categories based on their general susceptibility to FAC. The systems in the HELB category that are susceptible to FAC include the feedwater and condensate systems and the steam systems with relatively wet steam conditions with carbon steel pipe. Based on insights from service experience and the piping design parameters, the high-pressure steam piping between the steam generators and the inlet of the high pressure turbine is generally not susceptible to FAC. The reasons for this include the use of thick walled pipe, dry steam conditions, and relatively straight bend free runs of pipe. In the PIPExp database there have been no instances of FAC in this part of the main steam system. Hence the high-pressure steam piping is set aside as one category so that the remaining categories represent the FAC sensitive pipe. The FAC sensitive pipe was further broken down into 3 categories based on the relative susceptibility to FAC; two categories for steam and one for feedwater and condensate. The two steam categories in include the low-pressure steam pipe downstream of the HP turbine outlet and the extraction steam.

For each of the four system categories described in the preceding paragraphs, rupture frequencies were developed for two rupture size cases: Ruptures with equivalent break sizes between 2-inches and 6-inches diameter, and ruptures with equivalent break sizes greater than 6-inches in diameter. The estimation of the rupture frequencies for each of these break size cases required the estimation of two parameters: a failure rate and a conditional probability that the break would be in the specified size range. The failure rate for each break size range is different because only pipes with a pipe diameter of at least 6-inches can produce a break size greater than 6-inches, whereas pipes as small as 2-inches in diameter can produce break sizes of 2-inches and greater. To support the estimation of these parameters, separate queries of the pipe failure database had to be made for pipe failures (cracks, leaks, wall-thinning, and ruptures) and ruptures in the prescribed break size ranges. Then, these queries had to be matched up against the appropriate estimate of the pipe component population exposure terms. The parameter estimation for these failure rates and conditional rupture probabilities is documented in Section 4.

Consideration was given to the development of system-specific failure rates and rupture frequencies separately for the feedwater system and for the condensate system as was performed in Reference [1] for the internal flooding application. It was decided to develop a composite set of failure rates and rupture frequencies for both systems combined for several reasons: One is that there are inconsistencies in the way in which system boundaries are established between feedwater and condensate that would give rise to inconsistencies between how the data was classified and how it is applied to Kewaunee.

Second, there are a variety of different operating conditions within the condensate system and the feedwater system that give rise to different susceptibilities to the predominant damage mechanism, flow accelerated corrosion. For example there are normally several stages of

feedwater heating in the condensate and additional stages in the feedwater system. Feedwater drains and heater and main feedwater and condensate lines have much different conditions.

Third, there is no noticeable trend in the failure and rupture service experience between the two systems. And finally, breaking up the data into separate systems reduces the statistical quality of each data cell, i.e. would subdivide the data cells too finely so that the frequency of events within each data cell are statistically insignificant.

Based on what was learned in this study, the authors plan to issue a revision to Reference [1] to replace the system specific rates in that reference with a composite set of rates for the feedwater and condensate systems.

Based on the success criteria discussed in Section 3, for each set of failure rates, two rupture modes had to be distinguished: those with equivalent break sizes between 2" and 6" and those with break sizes in excess of 6 inches. Depending on the location of the pipe break either or both of these rupture modes may contribute to a specific HELB-initiated internal flooding initiating event, as discussed more fully in Section 3. Separate conditional rupture probability models had to be developed to distinguish these cases.

Table 2-1 Pipe Failure Rate Analysis Cases

Case	System	Pipe Size	Data Screening Assumptions
KNPP01	FWC	≥ 2 inch	Post-1988 data only
KNPP02	FWC	> 6 inch	Post-1988 data only
KNPP03	FWC	≥ 2 inch	Data up to 1988 only
KNPP04	FWC	> 6 inch	Data up to 1988 only
KNPP05	FWC	≥ 2 inch	FAC events removed
KNPP06	FWC	> 6 inch	FAC events removed
KNPP07	Extraction Steam	≥ 2 inch	Post-1988 data only
KNPP08	Extraction Steam	> 6 inch	Post-1988 data only
KNPP09	Extraction Steam	≥ 2 inch	Data up to 1988 only
KNPP10	Extraction Steam	> 6 inch	Data up to 1988 only
KNPP11	Extraction Steam	≥ 2 inch	FAC events removed
KNPP12	Extraction Steam	> 6 inch	FAC events removed
KNPP13	Low Pressure Steam	≥ 2 inch	Post-1988 data only
KNPP14	Low Pressure Steam	> 6 inch	Post-1988 data only
KNPP15	Low Pressure Steam	≥ 2 inch	Data up to 1988 only
KNPP16	Low Pressure Steam	> 6 inch	Data up to 1988 only
KNPP17	Low Pressure Steam	≥ 2 inch	FAC events removed
KNPP18	Low Pressure Steam	> 6 inch	FAC events removed
KNPP19	High Pressure Steam	≥ 2 inch	Post-1988 data only
KNPP20	High Pressure Steam	> 6 inch	Post-1988 data only
KNPP21	High Pressure Steam	≥ 2 inch	Data up to 1988 only
KNPP22	High Pressure Steam	> 6 inch	Data up to 1988 only
KNPP23	High Pressure Steam	≥ 2 inch	FAC events removed
KNPP24	High Pressure Steam	> 6 inch	FAC events removed

A review of the piping service data as discussed more fully in Section 4 reveals a significant improvement in piping system performance around 1988. It is reasonable to assume that this trend in performance is due to industry and NRC efforts to improve plant performance in general, and in particular to address flow accelerated corrosion in augmented inspection, repair and replacement programs. For the base case analysis only the service data since 1988 was used to calculate the failure rates as this data is viewed to be representative of current industry practice in managing piping system performance. As a contrast, the second case considered only the service data up to and including 1988. A third case was defined by screening out all the FAC related pipe failures. The purpose of the three cases was to understand the importance of the prevailing failure mechanism for experienced high energy line breaks.

Failure rates were specialized for the wet and dry steam systems, and for the feedwater and condensate systems, by specializing the data analysis for the failure rates. The data from the FAC sensitive steam, feedwater, and condensate systems were combined for the purposes of estimating the conditional rupture size probabilities. The justification for this is that essentially all the pipe ruptures in these systems are due to FAC and occur in similar carbon steel pipes. The system-specific factors that influence the rupture frequencies are judged to be adequately reflected in the specialized failure rates. The conditional probability of rupture size is viewed to be primarily related to properties of the pipe material and the damage mechanism and less related to the property of the system. The piping system materials for all the FAC sensitive piping are very similar. This is consistent with the data treatment in References [1], [3], and [8].

In summary, the piping failure rates and rupture frequencies developed in this study were quantified to address 4 different pipe system categories, 2 break size categories, and 3 data screening assumptions, giving rise to 24 data analysis cases. For each case, a pipe failure rate covering all failure modes, and a rupture frequency covering a specific break size range was developed and hence 48 parameters were developed.

3. KEWAUNEE HELB-INITIATED INTERNAL FLOODING INITIATING EVENTS

3.1 *Definition of Breaks*

Quantification of the HELB-initiated internal flood initiating event frequency values is performed for each initiating event defined in the turbine building internal flooding initiating events analysis. A summary of the HELB-related initiating events is provided below.

3.1.1 Steam Line Breaks

For steam line breaks, two HELB-initiated internal flooding initiating events are analyzed. The first is a steam line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. This event includes any break upstream of the turbine throttle valves below the operating deck with an equivalent diameter less than nine inches but greater than two inches, any break in the extraction steam line greater than six inches, and any break in a line after exiting the high-pressure turbine with an equivalent diameter of six inches or greater.

The second event is a steam line break that actuates approximately 100 sprinklers. The Turbine Building HELB models show that 100 sprinklers are representative of moderate releases. This event includes breaks in the extraction steam lines with an equivalent break size between two and six inches, and breaks in a line after exiting the high-pressure turbine and having an equivalent diameter of two to six inches.

3.1.2 Feedwater and Condensate Line Breaks

For feedwater and condensate line breaks, two HELB-initiated internal flooding initiating events are analyzed. The first is a feedwater or condensate line break that actuates enough fire sprinklers to result in full flow from both fire pumps to the Turbine Building. This event includes any between the fourth and fifth feedwater heaters with an equivalent diameter of greater than six inches or any break downstream of the fifth feedwater heaters with an equivalent diameter greater than two inches.

The second event is a feedwater or condensate line break that actuates approximately 100 sprinklers. The Turbine Building HELB models show that 100 sprinklers are representative of moderate releases. This event includes breaks in the lines between the fourth and fifth feedwater heaters with an equivalent diameter between two and six inches.

3.2 *Break Frequency Calculations*

3.2.1 Steam Line Breaks Causing Large Fire Protection System Actuations

This analysis will use the pipe length values determined in the turbine building internal flooding initiating events analysis. For steam piping located upstream of the turbine throttle valve, a total of 884.6 linear feet of piping were identified on the mezzanine and basement levels. For extraction steam, a total of 176.5 linear feet of piping was identified on the mezzanine and basement levels. For steam lines after the exit of the high-pressure turbine, a total of 621.7 linear feet of piping was identified on the mezzanine and basement levels. All other steam piping was located either on the operating deck or in the Auxiliary Building.

For piping located upstream of the turbine throttle valve, the frequency of pipe ruptures includes all failures with an equivalent diameter of greater than two inches. The frequency of failures in steam piping upstream of the turbine throttle valve, F_{HPS}, can be calculated as follows:

$$F_{HPS} = L_{HPS}(\rho_{KNPP19} + \rho_{KNPP20}) = L_{HPS}(\lambda_{KNPP19}P\{2-6|F\} + \lambda_{KNPP20}P\{>6|F\}) \quad (3.1)$$

Where:

L_X = Length of pipe in system X

ρ_j = Pipe Rupture Frequency for Case j (see Table 2-1)

λ_j = Pipe Failure Rate for Case j (see Table 2-1)

$P\{2-6|F\}$ = Conditional probability of pipe rupture of size 2" to 6" given pipe failure in pipe ≥ 2 inch in size

$P\{>6|F\})$ = Conditional probability of pipe rupture of size > 6" given pipe failure in a pipe > 6 inch in size

The systems and cases are defined in Table 2-1.

The above equation uses the pipe modeling methodology of Reference [1] in which all the failure modes of the metallic system pressure boundary components are averaged into a pipe system failure rate per linear foot of pipe. Since all the pressure boundary failure modes were included in the data analysis, there is no need to add separate terms to the equations to account for such components as valves, heat exchangers, pump bodies, and metallic expansion joints. This approach is also justified by the fact that

most of the experienced pipe failures occur in pipes or where pipes are welded to other pipes or piping components.

For extraction steam piping, the frequency of pipe ruptures includes all failures with an equivalent diameter of greater than six inches. The frequency of failures in the extraction steam piping can be calculated as follows:

$$F_{ES} = L_{ES}\rho_{KNPP08} = L_{ES}(\lambda_{KNPP08}P\{>6|F\} \quad (3.2)$$

For steam piping after the exit of the high-pressure turbine, the frequency of pipe ruptures includes all failures with an equivalent diameter of greater than six inches. The frequency of failures in this piping can be calculated as follows:

$$F_{RSL} = L_{RS}\rho_{KNPP14} = L_{RS}(\lambda_{KNPP14}P\{>6|F\} \quad (3.3)$$

The total frequency for steam line breaks that actuate enough fire protection sprinklers to result in full system flow to the turbine building is the sum of the three values calculated above or:

$$F_{SLBL} = F_{HPS} + F_{ES} + F_{RS} \quad (3.4)$$

3.2.2 Steam Line Breaks Causing Intermediate Fire Protection System Actuations

Calculation of the frequency of this event is performed as shown in Section 3.2.1 for large steam line breaks. Pipe length data also are identified in that section.

For extraction steam piping, the frequency of pipe ruptures includes failures with an equivalent diameter of between two and six inches. The frequency of failures in the extraction steam piping can be calculated as follows:

$$F_{ESM} = L_{ES}\rho_{KNPP07} = L_{ES}\lambda_{KNPP07}P\{2-6|F\} \quad (3.5)$$

For steam piping after the exit of the high-pressure turbine, the frequency of pipe ruptures includes all failures with an equivalent diameter of between two and six inches. The frequency of failures in this piping can be calculated as follows:

$$F_{RSM} = L_{RS}\rho_{KNPP13} = L_{RS}\lambda_{KNPP13}P\{2-6|F\} \quad (3.6)$$

The total frequency for steam line breaks that actuate approximately 100 fire protection sprinklers is the sum of the two values calculated above or:

$$F_{SLBM} = F_{ESM} + F_{RSM} \quad (3.7)$$

3.2.3 Feedwater and Condensate Line Breaks Causing Large Fire Protection System Actuations

This analysis will use the pipe length values determined in the turbine building internal flooding initiating events analysis. As discussed in Section 3.1.1, this event includes any break with an equivalent diameter greater than two inches in piping downstream of the 15 feedwater heaters and any break with an equivalent diameter greater than six inches between the 14 and 15 feedwater heaters. For feedwater piping located downstream of the 15 feedwater heaters, a total of 331.56 feet of pipe was identified. For piping between the 14 and 15 feedwater heaters, a total of 696.55 feet of pipe was identified.

The failure frequency for these size breaks in this piping is calculated to be:

$$F_{FL15} = L_{FL15}(\rho_{KNPP01} + \rho_{KNPS02}) = L_{FL15}(\lambda_{KNPP01}P\{2-6|F\} + \lambda_{KNPP02}P\{>6|F\}) \quad (3.8)$$

For piping between the 14 and 15 feedwater heaters, only pipe breaks greater than six-inches equivalent diameter are included. The failure frequency for these size breaks in this piping is calculated to be:

$$F_{FL45L} = L_{FL45}\rho_{KNPP02} = L_{FL45}(\lambda_{KNPP02}P\{>6|F\} \quad (3.9)$$

The frequency of feeedwater and condensate line breaks for this initiating event is the sum of the two values above or:

$$F_{FLBL} = F_{FLB15} + F_{FLB45L} \quad (3.10)$$

3.2.4 Feedwater and Condensate Line Breaks Causing Intermediate Fire Protection System Actuations

Calculation of the frequency of this event is performed as shown in Section 3.2.3. Pipe length data also are identified in that section. As discussed in Section 3.1.2, this event includes any break with an equivalent diameter between two and six inches between the 14 and 15 feedwater heaters. Using that data and the methodology of this report, the failure frequency for these size breaks in this piping is calculated to be:

$$F_{FL45M} = L_{FL45}\rho_{KNPP01} = L_{FL45}\lambda_{KNPP01}P\{2-6|F\} \quad (3.11)$$

3.3 *Model Quantification*

The technical approach to model quantification is to develop uncertainty distributions for each of the parameters defined in this section and then to propagate these distributions through the equations using Monte Carlo simulation, a traditional approach to PRA uncertainty quantification. The development of the pipe failure rate and rupture frequency parameters in these models is documented in Section 4 and the results of the Monte Carlo analysis are provided in Section 5. The pipe length estimates described in the above section were provided to the authors by Maracor and are documented in the main body of the turbine building internal flooding initiating events report of which this analysis will be an attachment. Uncertainty in pipe length estimates is modeled using normal distributions with the estimated pipe lengths taken as the mean values and a standard deviation of 10% of these length estimates.

4. PIPE FAILURE RATES AND RUPTURE FREQUENCIES

4.1 *System Boundaries*

This evaluation is concerned with non-ASME Code piping systems inside the Turbine Building of Pressurized Water Reactor (PWR) plants. The following systems are considered:

- Feedwater & Condensate (FWC) piping: The Condensate piping system extends from the Condenser Hotwell up to and including the Low Pressure Heaters. It also includes the Drains and Vents System piping from the Low Pressure and High Pressure Heaters. The Feedwater piping system boundary considered in this evaluation consists of the piping from the Low Pressure Heaters, the Feedwater pump suction/discharge piping, High Pressure Heater inlet/outlet piping up to the outboard containment isolation valves. Due to comparable susceptibilities to flow accelerated corrosion (FAC) and plant to plant variabilities in how the boundaries between these systems is defined, a composite set of data parameters are developed for FWC piping.
- Steam Extraction piping: In a typical PWR the high pressure portion of the turbine has extraction connections for two stages of feedwater heating. The low pressure portion of the turbine has extraction connections for four stages of feedwater heating.
- Low Pressure Steam piping: In this evaluation, the low pressure steam piping includes piping between the high pressure (HP) and low pressure (LP) turbine stages, including steam cross-over and cross-under piping, and Moisture Separator Reheater (MSR) piping. The MSR piping is also located between the HP and LP turbines and it is used to extract moisture from the steam and reheat the steam to improve the turbine performance.
- HP Steam piping:. In this evaluation the HP steam piping is upstream of the HP turbine throttle valve and extends to the outboard containment isolation valves.

4.2 *Database Screening*

The pipe failure rates and rupture frequencies in this evaluation are derived from service data included in the PIPExp database (Appendix A). The full PIPExp includes on the order of 6,700 data records covering Code Class 1-3 and non-Code piping in commercial light water reactor plants. Input parameters to the pipe failure rate calculation in this evaluation are obtained through database queries that include filters for excluding any non-relevant service data:

- Initial screening on the basis of Code Class and PWR plant system. Retain failure data associated with non-Code piping in Turbine Building including the following systems:
    - Condensate System
    - Extraction steam piping
    - Feedwater heater drain and vent piping

- Main Feedwater (from LP feedwater heaters to outboard containment isolation valves)
- Main Steam (from outboard containment isolation valve to High Pressure turbine steam admission valve, and turbine cross-over/cross-under piping)
- Moisture Separator Reheater piping

- Results of initial screening subjected to additional screening on the basis of nominal pipe size and through-wall flaw size:
- The evaluation considers piping of nominal pipe size (NPS) greater than 2-inch diameter as piping less than 2-inch is not within the scope of the HELB-initiated internal flooding initiating event models described in Section 3.

The service data involving through-wall flaws are reviewed in accordance with the Kewaunee HELB-initiated internal flooding initiating event analysis requirements (i.e., "moderate" versus "major" release). This means that the service data are screened further on the basis of flaw size ('equivalent diameter break size'). The results of this screening step are input to the derivation of posterior Beta distribution parameters for calculation of conditional pipe failure probabilities for 2" to 6" and greater than 6" break sizes.

4.3 *Database Query Results*

The results of the database queries are summarized in charts (Figures 4-1 and 4-2) and tables (Tables 4-1 and 4-2). Flow-accelerated corrosion (FAC) is a predominant degradation mechanism for the systems that are included in the study scope except for the high pressure steam system. Most if not all plant owners have implemented programs to mitigate FAC susceptibilities. These programs include implementing non-destructive examination (NDE) programs, pro-active monitoring of pipe wall wear rates, and replacing the original carbon steel piping with FAC-resistant piping material such as stainless steel, carbon steel clad on the inside diameter with stainless steel, or chrome-molybdenum alloy steel. The purpose of these initial data queries was to identify the appropriate data set to use that represents current industry practice for predicting the initiating event frequencies at Kewaunee. The use of time trend analysis is a requirement of the ASME PRA standard for Capability Category 3 analyses. In addition, evaluating the trending of events avoids important insights in the data that would be missed by simply averaging all the industry experience.

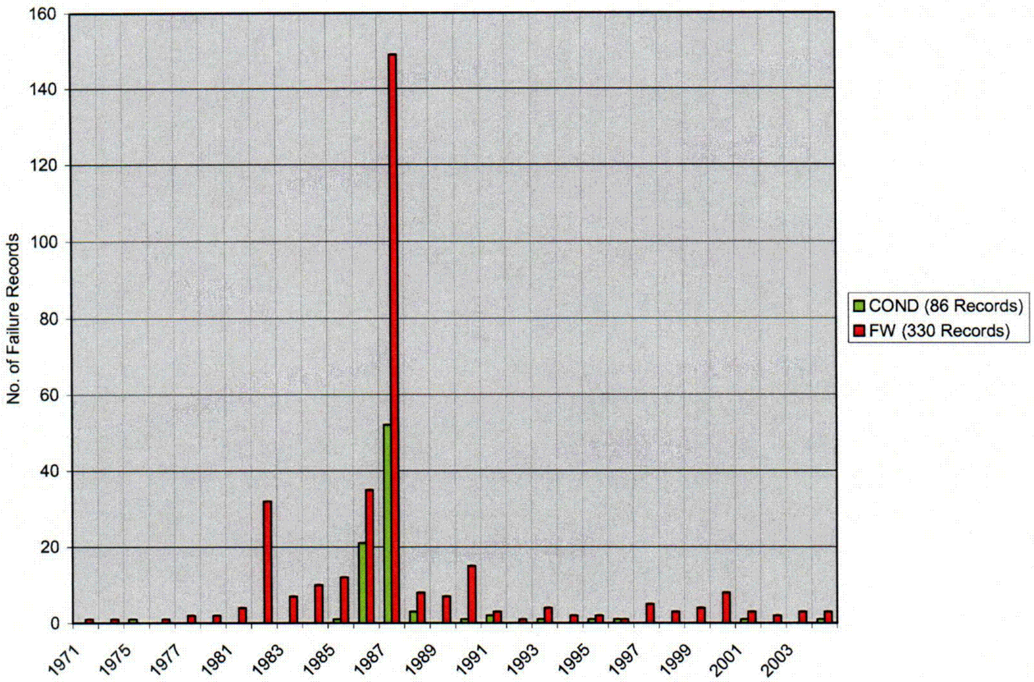

Figure 4-1 PWR Worldwide Experience with non-Code FWC Piping 1970-2004

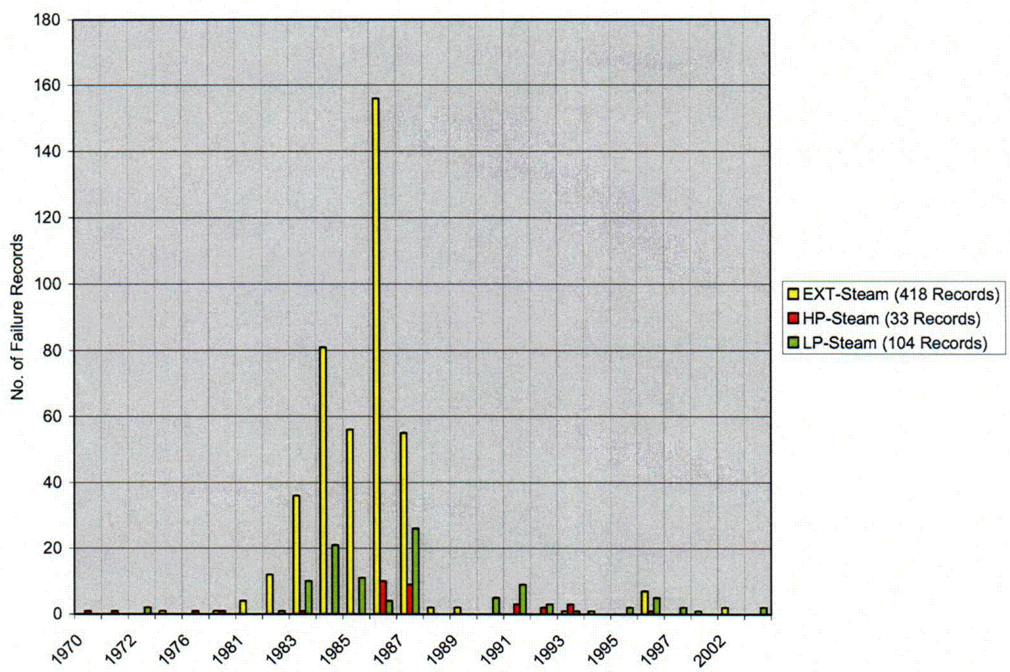

Figure 4-2 PWR Worldwide Experience with non-Code Steam Piping 1970-2004 [1]

C02

The two charts above show a distinctly higher incident rate before 1988. The before/after-1988 trend in Figure 4-1 and 4-2 is accounted for in the quantitative evaluation of the service-data. The service data coverage in PIPExp corresponds to 858 PWR reactor years for the period 01/01/1970 – 12/31/1987 and 1666 PWR reactor years for the period 01/01/1988-12/31/2004. By the *early- to mid-1980's the industry experienced several major failures of non-Code carbon* steel piping (e.g., Trojan in March 1985 and Surry-2 in December 1986) (See References [11] through [14]). In response to these events as well as the industry-wide experience with pipe wall thinning and minor through-wall flaws attributed to FAC.

Tables 4-1 and 4-2 show the same data sets as those included in Figures 4-1 and 4-2 except that the data is organized by failure mode and pipe size to reflect the Kewaunee HELB-initiated internal flooding initiating event analysis requirements. The following failure mode definitions are used:

- Wall thinning; represents cases of severe wall thinning resulting in either weld overlay repair or preemptive replacement of affected piping section or fitting (e.g., elbow, tee).
- Leak; includes pinhole leak, leak or large leak resulting in isolation (where feasible) or manual reactor shutdown to effect repair or replacement.
- Rupture; significant through-wall flaw resulting in moderate or significant steam/water release and prompt manual shutdown or automatic turbine trip/reactor trip.

As will be discussed more fully below, in developing estimates of the conditional rupture size probabilities, a special query is made on the database to identify those ruptures that fit into two size categories: 2" to 6", and greater than 6" equivalent break sizes.

Table 4-1 Service Experience with non-ASME Code FWC Piping

Nominal Pipe Size (NPS) [Inch]	1970-1987				1988-2004			
	Total	**Wall Thinning**	**Leak**	**Rupture**	**Total**	**Wall Thinning**	**Leak**	**Rupture**
2" < NPS ≤ 6"	14	5	6	3	18	7	7	4
NPS > 6"	300	275	17	8	52	30	15	7
Total:	314	280	23	11	70	37	22	11

Notes:

- Service experience in Table 1 derived from 2524 reactor-years of PWR operation worldwide; 858 reactor-years pre-1988 and 1666 reactor-years post-1987
- Failure data includes contributions from FAC (dominant degradation mechanism), vibration-fatigue and water hammer
- The root cause of post-1987 events in many cases is attributed to programmatic errors or weaknesses in the Owner's FAC program
- Appendix A includes information on the coverage and completeness of the PIPExp database

Table 4-2 Service Experience with non-Code Steam Piping

System	Nominal Pipe Size (NPS) [Inch]	1970-1987				1988-2004			
		Total	Wall Thinning	Leak	Rupture	Total	Wall Thinning	Leak	Rupture
EXT-Steam	2" < NPS ≤ 6"	10	0	8	2	9	1	7	1
	NPS > 6"	392	385	4	3	7	2	2	3
LP-Steam	2" < NPS ≤ 6"	14	0	11	3	15	1	10	4
	NPS > 6"	61	60	1	0	14	2	9	3
HP-Steam	NPS > 2"	24	19	3	2	9	1	7	1
	Total:	501	464	27	10	54	7	35	12

Notes:

- 'EXT-Steam' includes HP & LP steam extraction piping. Most of this piping is > NPS6.
- 'LP-Steam' includes piping between the HP and LP turbine stages, including cross-over/under piping and Moisture Separator Reheater piping.
- 'HP-Steam' includes piping upstream of the HP turbine throttle valve.
- Service experience in Table 1 derived from 2524 reactor-years of PWR operation worldwide; 858 reactor-years pre-1988 and 1666 reactor-years post-1987
- Failure data includes contributions from FAC (dominant degradation mechanism), vibration-fatigue and water hammer
- The root cause of post-1987 events in many cases is attributed to programmatic errors or weaknesses in the Owner's FAC program
- Appendix A includes information on the coverage and completeness of the PIPExp database

4.4 *Exposure Term Data*

In pipe failure rate estimation, the exposure term is the product of either the number of components (e.g., fittings, welds) or total length of piping that provides the observed pipe failures and the total time over which failure events are collected. There is variability in the population counts. In part this variability stems from differences across NSSS types and balance of plant design differences, and in part it stems from different piping design and fabrication practices (e.g., use of cold bent piping versus use of welded fittings). Also, design modifications are implemented during the lifetime of a plant to enhance flow conditions, minimize system vibrations, and to improve the access for non-destructive examination (NDE), etc. Table 4-3 summarizes piping population data for the systems covered in the Kewaunee HELB-initiated internal flooding initiating events analysis.

Table 4-3 Piping Population Exposure Data

System / System Group	Linear ft of Piping	Information Source / Comment
FWC (> NPS2)	14,037 ft	EPRI TR-111880, Table A-5; in the failure rate calculation the given length is input as a median value
EXT-Steam	1,500 ft	Entergy Nuclear Northeast (Indian Point-3 FAC program information). In the failure rate calculation the given length is input as a median value.
LP-Steam	622 ft	Dominion Energy; the given length is for KNPP and in the failure rate calculation it is input as a lower bound value
HP-Steam	885 ft	Dominion Energy; the given length is for KNPP and in the failure rate calculation it is input as a lower bound value

4.5 *Conditional Pipe Failure Probability*

For FAC-susceptible piping the likelihood of rapid or unexpected flaw propagation given wall thinning is quite high and can be estimated directly from service data. In the case of pipe materials or systems that are not susceptible to FAC such as the high pressure main steam system at Kewaunee, there are much fewer events from which to derive the conditional rupture probability. In this case the estimation of the likelihood of sudden pipe failure relies on insights from service experience with different piping systems and materials under different loading conditions in combination with engineering judgment and fracture mechanics evaluations.

The likelihood of a through-wall flaw propagating to a significant structural failure is expressed by the conditional failure probability $P_{ik}\{R/F\}$. It is determined from service experience insights and engineering judgment, with the uncertainty treated using the Beta Distribution.

The beta distribution takes on values between 0 and 1 and is defined by two parameters, A and B (some texts refer to these as "Alpha" and "Beta"). It is often used to express the uncertainty in the estimation of dimensionless probabilities such as MGL common cause parameters and failure rates per demand. The mean of the Beta Distribution is given by:

$$Mean = \frac{A}{A+B} \tag{4.1}$$

If A = B = 1, the beta distribution takes on a flat distribution between 0 and 1. If A = B = ½ , the distribution is referred to as a Jeffery's non-informative prior and is a U shaped distribution with peaks at 0 and 1. Expert opinion can be incorporated by selecting *A* and *B* to match up with an expert estimate of the mean probability. For example, to represent an expert estimate of 10^{-2}, A=1 and B=99 can be selected. These abstract parameters *A* and *B* can be associated with the number of failures and the number of successes in examining service data to estimate a failure probability on demand. *A* + *B* represents the number of trials.

The beta distribution has some convenient and useful properties for use in Bayes' updating. A prior distribution can be assigned by selecting the initial parameters for *A* and *B*, denoted as A_{Prior} and B_{Prior}. Then when looking at the service data, if there are *N* failures and *M* successes observed, the Bayes updated or posterior distribution is also a Beta distribution with the following parameters:

$$A = A_{Prior} + N \tag{4.2}$$

$$B = B_{Prior} + M \tag{4.3}$$

The above explains how the Beta distribution is used in this study to estimate conditional rupture probabilities. The priors are selected to represent engineering estimates of the probabilities "prior" to the collection of evidence. Equations (4.2) and (4.3) are used to compute the parameters of the Bayes' updated distribution after applying the results of the data queries to determine N and M. N corresponds to the number of ruptures in the specified size range and M corresponds to the number of pipe failures that do not result in a rupture in the specified size range.

A review of service data provides some insights about the conditional pipe failure probability for different types of piping systems. Figure 4-3 shows the conditional failure probability for different, observed through-wall flow rate threshold values. For comparison the Beliczey-Schulz correlation [15] is re-calibrated for through-wall flow threshold values rather than pipe size; this correlation only applies to Code Class 1 piping. According to Beliczey-Schulz, for 1-inch piping the conditional probability of a major structural failure (MSF) or rupture is on the order of 5.0×10^{-2} (corresponding to a liquid flow rate of about 800 gpm (completely severed pipe), which is well beyond the upper threshold value in Figure 4-3. This information is presented to help justify the prior distribution parameters A and B selected for this analysis.

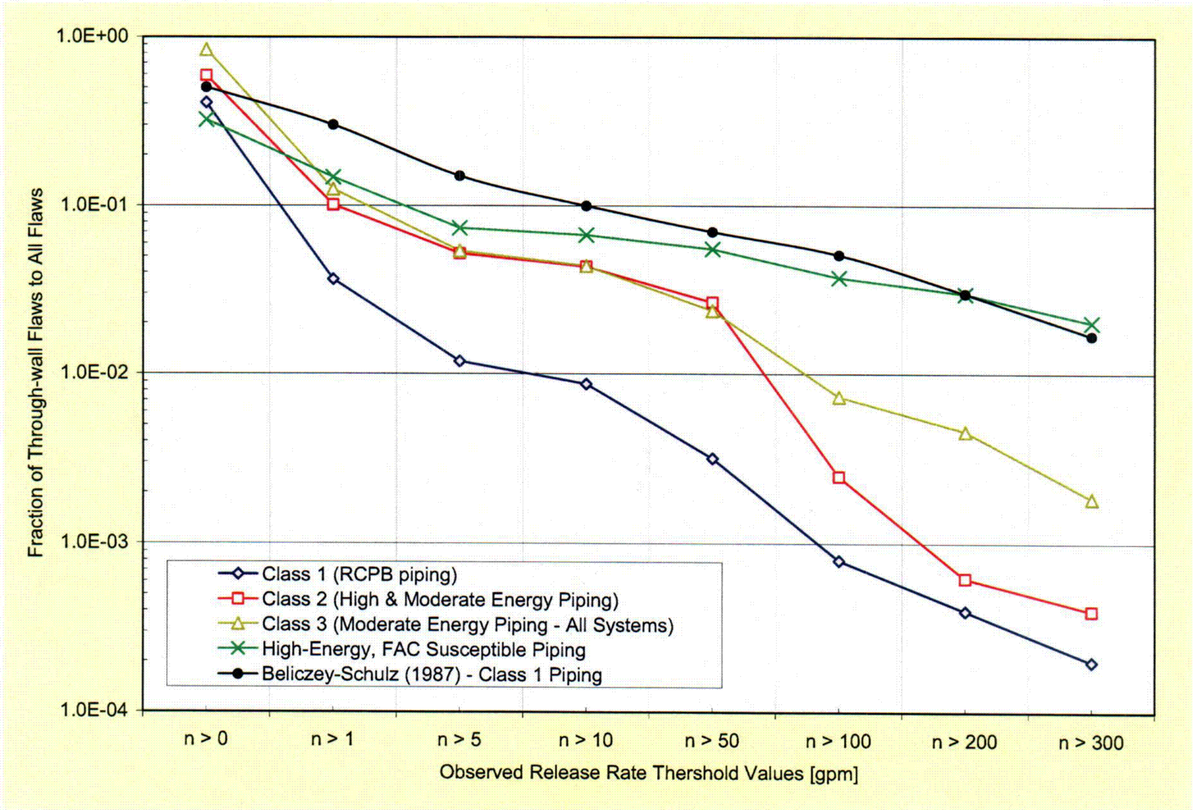

Figure 4-3
Empirical Conditional Probability of Pipe Failure as a Function of Type of Piping System & Through-Wall Flow Rate Threshold Value[1]

The "A" parameter of the Beta Distribution corresponds to a significant consequence (spray, internal flooding or major flooding event) and the "B" parameter corresponds to the remaining failure experience (significant wall thinning or through-wall flaw). The total number of failures in the database is equal to A+B. Table 4-4 is a summary of the prior and posterior Beta Distribution parameters for non-Code FWC and steam piping used in this report. The posterior distribution parameters are derived by performing a Bayes' update of the assumed prior distributions using service data from PIPExp and the conjugate properties of the Beta Distribution.

Part of the information presented in Table 4-4 is the screening of pipe ruptures in different break size ranges in the FAC sensitive piping. The 26 events with equivalent break sizes between 2" and 6" are listed in Table 4-5, and the 33 events with break sizes greater than 6-inches are in Table 4-6.

[1] Plotted in the figure are the conditional probabilities of leak flow rates given pipe failure as estimated by the fraction of the pipe failures in the failure data population with the indicated leak flow rate.

4.6 *Results for Failure Rates and Rupture Frequencies*

Using the methodology described in Section 2, uncertainty distributions were developed for the failure rates and rupture frequencies for each of the analysis cases in Table 2-1. The mean values of these distributions are presented in Table 4-7. The full uncertainty distributions were propagated through the HELB-initiated internal flooding initiating event models that were described in Section 3 and the results are presented in Section 5. Parameters of these distributions are presented in Appendix B.

To support sensitivity calculations that are summarized in Section 5, comparisons were made among the data screening sensitivity cases for each system group that were identified. As seen in Figures 4-4 and 4-5 the results for the case using only data from prior to 1988 before FAC programs became effective would increase by more than an order of magnitude. Stated another way, the failure rates and rupture frequencies based on the service data before 1988 are more than an order of magnitude greater than those considering only data from events after 1988 when the FAC programs were in effect.. Conversely, if all the FAC-related events were precluded by some type of plant change, an order of magnitude reduction in the relevant pipe failure rates and rupture frequencies would be expected.

Table 4-4
Parameters of Posterior Beta Distribution for $P_{Ik}\{R|F\}$ for non-Code FAC-Susceptible High-Energy Piping & non-Code FAC-resistant High-Energy Piping

Analysis Case		Prior Beta Parameters			Posterior Beta Parameters		
Piping Material	Equivalent Break Size (EBS)	Constraint	A_{Prior}	B_{Prior}	A_{Post}	B_{Post}	Mean
Carbon Steel and FAC-susceptible	2" < EBS ≤ 6"	1.0E-2	1	99	27 (1)	1254	2.11E-02
	EBS > 6"	1.0E-2	1	99	34 (2)	1072	3.07E-02
Stainless Steel or FAC-resistant	2" < EBS ≤ 6"	1.0E-3	1	999	10	1062	9.33E-03
	EBS > 6"	1.0E-3	1	999	8	1036	7.66E-03

Notes:

(1) A through-wall flaw of size 2" < EBS ≤ 6" can occur in any FAC-susceptible piping of nominal pipe size (NPS) > 2". The database screening criteria include consideration of NPS and through-wall flaw size.

(2) A through-wall flaw of size EBS > 6" can occur in any FAC-susceptible piping of NPS > 6".

- EBS = Equivalent Break Size
- NPS = Nominal Pipe Size [inch]
- The posterior Beta distribution parameters are obtained from PIPExp database (accounts for service experience applicable to non-Code FWC and steam piping in Light Water Reactors):
  - $B_{Post} = B_{Prior} + (B_{Evidence} - A_{Evidence})$
  - $A_{Evidence}$ = Total number of ruptures in specified size range
  - $B_{Evidence}$ =Total number of failure records =1181 records (carbon steel FWC piping of nominal pipe size greater than 2". There are 1006 records for piping > 6" NPS.
  - $A_{Post\text{-}Large\ Leak} = A_{Prior} + A_{Evidence}$; the evidence is 26 records for which the through-wall defect is sufficient to create a significant outflow of steam/condensate corresponding to 2" < EBS ≤ 6" (Table 4-5).
  - $A_{Post\text{-}MSF} = A_{Prior} + A_{Evidence}$; the evidence is 33 records involving major structural failure of FAC-susceptible piping corresponding to EBS > 6-inch diameter (Table 4-6)
- The Beta distribution parameters for 'stainless steel or FAC resistant case' are obtained by screening out any data record involving degradation or failure caused by FAC. A total of 72 records involve non-FAC failures and of these, 44 records involve piping > NPS6.

Table 4-5 Summary of FAC-Susceptible Piping Rupture Events with Equivalent Break Size Between 2-inch Diameter and 6-Inch Diameter (EBS1)

DATABASE RECORD NO.	EVENT DATE	PLANT NAME	COUNTRY	PLANT TYPE	SYSTEM	SYSTEM GROUP	NOMINAL PIPE SIZE [Inch]
2962	4/22/1995	Almaraz-1	ES	PWR	COND	FWC	6
15272	2/13/2001	Balakovo-2	RU	PWR	FW	FWC	3.2
2907	7/27/1993	Bohunice-3	SK	PWR	MS	STEAM	6
455	9/28/1983	Browns Ferry-1	US	BWR	MSR	STEAM	6
456	11/1/1977	Browns Ferry-3	US	BWR	EXT-Steam	STEAM	6
3722	8/10/1999	Callaway	US	PWR	FW	FWC	6
1166	9/25/1985	Dresden-2	US	BWR	COND	FWC	6
2787	11/17/1986	Fermi-2	US	BWR	FW	FWC	6
1425	4/28/1970	H.B. Robinson-2	US	PWR	MS	STEAM	6
1975	3/1/1977	Hatch-1	US	BWR	COND	FWC	4
1463	9/26/1989	Indian Point-2	US	PWR	MS	STEAM	4
2866	4/3/1987	Indian Point-2	US	PWR	FW	FWC	6
2498	11/24/1993	Kola-4	RU	PWR	MS	STEAM	4
999	1/1/1972	Millstone-1	US	BWR	MS	STEAM	4
494	12/30/1973	Millstone-1	US	BWR	COND	FWC	4
2161	12/31/1990	Millstone-3	US	PWR	MSR	STEAM	6
498	12/31/1990	Millstone-3	US	PWR	MSR	STEAM	6
501	3/19/1983	Oconee-2	US	PWR	MSR	STEAM	3
2949	12/15/1996	Paks-3	HU	PWR	EXT-STEAM	STEAM	6
478	7/29/1986	R.E. Ginna	US	PWR	MS	STEAM	6
850	11/18/1977	Ringhals-2	SE	PWR	FW	FWC	6
607	3/23/1990	Surry-1	US	PWR	MSR	STEAM	4
540	8/7/1972	Surry-1	US	PWR	MSR	STEAM	4
1536	1/9/1982	Trojan	US	PWR	EXT-STEAM	STEAM	6
697	8/1/1983	Zion-1	US	PWR	EXT-STEAM	STEAM	6
2458	7/28/1991	Zion-2	US	PWR	FW	FWC	3

Table 4-6 Summary of FAC-Susceptible Piping Rupture Events with Equivalent Break Size > 6-Inch Diameter (EBS2)

DATABASE RECORD NO.	EVENT DATE	PLANT NAME	COUNTRY	PLANT TYPE	SYSTEM	SYSTEM GROUP	NOMINAL PIPE SIZE [Inch]
2865	12/18/1991	Almaraz-1	ES	PWR	MS	STEAM	8
445	4/18/1989	ANO-2 (Arkansas-2)	US	PWR	MS	STEAM	14
454	9/29/1982	Browns Ferry-1	US	BWR	MS	STEAM	8
453	6/24/1982	Browns Ferry-1	US	BWR	MSR	STEAM	8
15185	8/15/1983	Browns Ferry-1	US	BWR	MS	STEAM	8
462	11/20/1984	Calvert Cliffs-1	US	PWR	EXT-STEAM	STEAM	16
465	1/15/1988	Catawba-1	US	PWR	COND	FWC	8
2912	9/25/1987	Doel-1	BE	PWR	COND	FWC	8
2504	4/10/1993	Fermi-2	US	BWR	EXT-STEAM	STEAM	8
2785	4/21/1997	Fort Calhoun-1	US	PWR	FW	FWC	12
483	4/25/1986	Hatch-2	US	BWR	FW	FWC	20
37	6/27/1985	KMK Mülheim-Kärlich	DE	PWR	FW	FWC	18
2598	12/29/1984	Krsko	SLO	PWR	FW	FWC	14
2446	5/6/1991	Kuosheng-2	TW	BWR	COND	FWC	12
85	5/28/1990	Loviisa-1	FI	PWR	FW	FWC	12
76	2/25/1993	Loviisa-2	FI	PWR	FW	FWC	8
2928	6/14/1996	Maanshan-21	TW	PWR	MS	STEAM	16
20056	8/9/2004	Mihama-3	JP	PWR	FW	FWC	20
1307	11/6/1991	Millstone-2	US	PWR	MSR	STEAM	8
1320	8/8/1995	Millstone-2	US	PWR	Heater-Drain	FWC	8
500	6/23/1982	Oconee-2	US	PWR	EXT-STEAM	STEAM	24
865	1/1/1985	Oconee-2	US	PWR	FW	FWC	10
2701	9/24/1996	Oconee-2	US	PWR	MSR	STEAM	18
504	9/17/1986	Oconee-3	US	PWR	Heater-Drain	FWC	10
976	6/10/1974	Quad Cities-2	US	BWR	FW	FWC	18
2913	1/1/1989	Santa Maria de Garona	ES	BWR	FW	FWC	16
3092	2/9/1980	Santa Maria de Garona	ES	BWR	EXT-STEAM	STEAM	16

DATABASE RECORD NO.	EVENT DATE	PLANT NAME	COUNTRY	PLANT TYPE	SYSTEM	SYSTEM GROUP	NOMINAL PIPE SIZE [Inch]
2278	3/1/1993	Sequoyah-2	US	PWR	MS	STEAM	10
541	10/15/1983	Surry-1	US	PWR	FW	FWC	26
542	12/9/1989	Surry-1	US	PWR	Heater-Drain	FWC	10
595	12/9/1986	Surry-2	US	PWR	FW	FWC	18
545	3/9/1985	Trojan	US	PWR	FW	FWC	14
920	12/2/1971	Turkey Point-3	US	PWR	MS	STEAM	12

Table 4-7 Mean Values of Failure Rate and Rupture Frequency Parameters

Case	Description	Results – Mean Values	
		Failure Rate [1/ft.yr]	Rupture Frequency [1/ft.yr]
KNPP01	FWC, EBS1 with Post-1988 data	3.19E-06	6.72E-08
KNPP02	FWC, EBS2 with Post-1988 data	3.56E-06	1.09E-07
KNPP03	FWC, EBS1 with data through 1988	2.78E-05	5.85E-07
KNPP04	FWC; EBS2 with data through 1988	3.98E-05	1.22E-06
KNPP05	FWC; EBS1 with FAC events screened out	9.21E-07	8.60E-09
KNPP06	FWC; EBS2 with FAC events screened out	8.29E-07	6.35E-09
KNPP07	Steam Extraction piping; EBS1 with Post-1988 data	3.40E-06	7.17E-08
KNPP08	Steam Extraction piping; EBS2 with Post-1988 data	2.58E-06	7.93E-08
KNPP09	Steam Extraction piping; EBS1 with data through 1988	3.32E-04	6.99E-06
KNPP10	Steam Extraction piping; EBS2 with data through 1988	4.86E-04	1.49E-05
KNPP11	Steam Extraction piping; EBS1 with FAC events screened out	1.93E-07	1.80E-09
KNPP12	Steam Extraction piping; EBS2 with FAC events screened out	2.68E-07	2.07E-09
KNPP13	Steam piping downstream HP turbine, EBS1 Post-1988 data	1.33E-05	2.80E-07
KNPP14	Steam piping downstream HP turbine, EBS2 Post-1988 data	1.07E-05	3.29E-07
KNPP15	Steam piping downstream HP turbine, EBS1 with data through 1988	7.15E-05	1.51E-06
KNPP16	Steam piping downstream HP turbine, EBS2 with data through 1988	9.09E-05	2.79E-06
KNPP17	Steam piping downstream HP turbine, EBS1 with FAC events screened out	2.25E-07	2.10E-09
KNPP18	Steam piping downstream HP turbine, EBS2 with FAC events screened out	9.22E-07	7.05E-09
KNPP19	MS piping upstream HP turbine throttle valve, EBS1 Post-1988 data	3.25E-06	3.03E-08
KNPP20	MS piping upstream HP turbine throttle valve, EBS2 Post-1988 data	1.16E-06	8.90E-09
KNPP21	MS piping upstream HP turbine throttle valve, EBS1 with data through 1988	1.60E-05	1.49E-07
KNPP22	MS piping upstream HP turbine throttle valve, EBS2 with data through 1988	2.50E-05	1.91E-07
KNPP23	MS piping upstream HP turbine throttle valve, EBS1 with FAC events screened out	1.74E-07	1.64E-09
KNPP24	MS piping upstream HP turbine throttle valve, EBS2 with FAC events screened out	2.36E-07	1.80E-09

Notes:

- EBS = Equivalent (Diameter) Break Size
- EBS1: 2" < EBS ≤ 6" equivalent diameter break size – moderate energy release
- EBS2: EBS > 6" equivalent diameter break size – major energy release

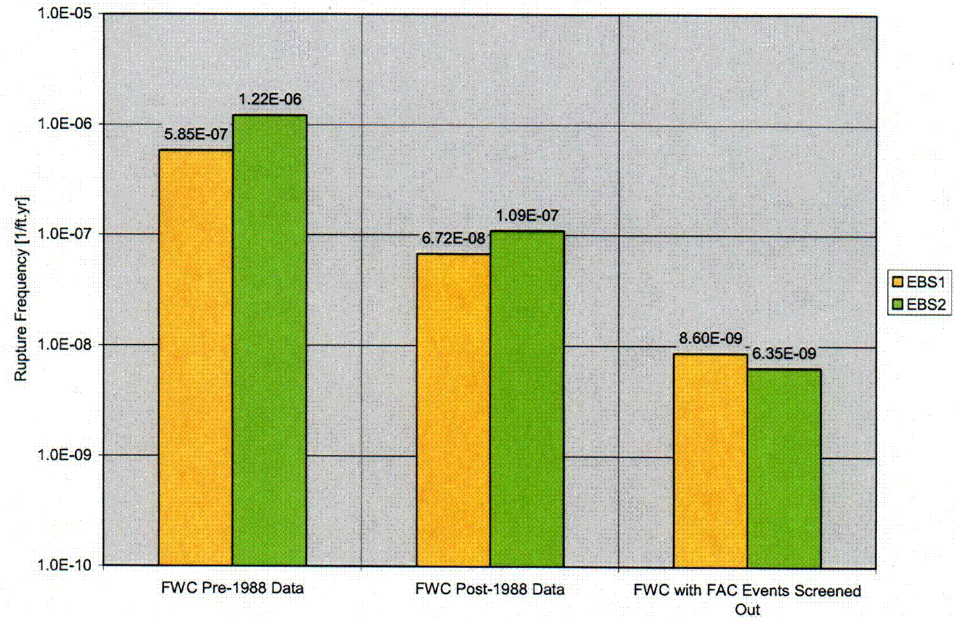

Figure 4-4
Impact of Different Data Screening Assumptions on FWC Piping Reliability

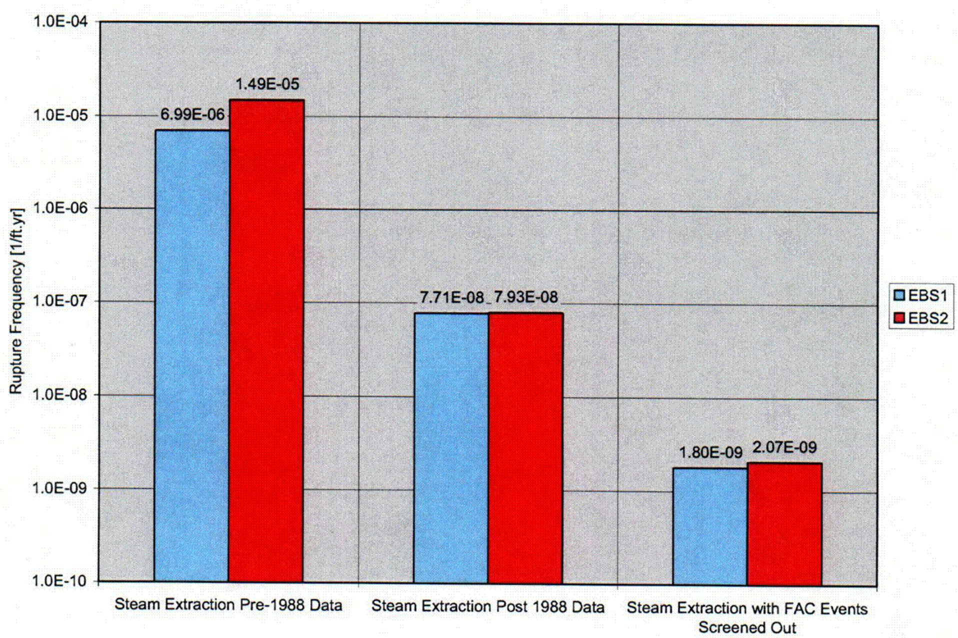

Figure 4-5
Impact of Different Data Screening Assumptions on Steam Extraction Piping Reliability

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5.HELB INITIATING EVENT FREQUENCIES

5.1 *Calculation Steps*

The results for the initiating event frequencies were obtained using the equations in Section 3 and the data parameters developed in Section 4. The uncertainties were calculated using the technical approach described in Section 2 and is comprised of the following steps.

1. A prior distribution for each failure rate was obtained from Reference [1]. The prior is a lognormal distribution with a mean value of 1.50×10^{-4} failures per foot of pipe with a range factor of 100. The same prior was used for all 24 cases in Table 2-1.
2. For each case listed in Table 2-1, Bayes' updates were performed using the prior from Step 1, the number of failures obtained from the PIPExp database for each case, and estimates of the piping population exposures that are documented in Section 4. Bayes' updates were performed using the program BART™ developed by ERIN Engineering and Research, Inc.
3. To account for uncertainty in the population exposure estimates the Bayes' updates were performed for three estimates of the exposure: a best estimate with a probability weight of 80% and a high and low estimate with weights of 10% each.
4. A composite uncertainty distribution was developed for each of the 24 cases of failure rates using a posterior weighting procedure using Crystal Ball™ and Microsoft Excel.
5. The process listed in Steps 1-4 was repeated for two ranges of pipe size: one for pipes greater than or equal to 2", which could produce ruptures of size 2" and greater, and one for pipes sizes greater than 6" which could produce rupture sizes exceeding 6". Hence a total of 48 failure rate distributions were developed: one for 2" and greater, and one for 6" and greater pipe size ranges for each of the 24 cases in Table 2-1.
6. A Beta distribution was developed to represent the conditional probability of rupture for two rupture sizes: 2" to 6", and greater than 6" equivalent break size using the data described in Section 4. These beta distributions include prior distribution parameters that represent the authors expert judgment on the values of these probabilities, and service data experience that is documented in Section 4. Two sets of distributions were developed: one for FAC sensitive carbon steel pipe in systems subject to FAC, and the other for FAC resistant pipe or systems that are not susceptible to FAC, e.g., the high-pressure main steam piping upstream of the turbine throttle valves.
7. The rupture frequencies for rupture sizes between 2" and 6" were obtained by combining the failure rates for 2" and greater pipes and the conditional rupture probabilities developed in Step 6. The rupture frequencies for greater than 6" breaks were obtained by combining the failure rates for greater than 6" pipe sizes with the appropriate conditional rupture probability.
8. The HELB-initiated internal flooding initiating event frequencies were obtained by propagating the uncertainties in the appropriate rupture frequencies through the equations of Section 3 using the Monte Carlo process using Cystall Ball™ and Microsoft Excel. To properly treat the state of knowledge dependencies all the uncertainty calculations from the output of the Bayes' updates through Step 8 were performed in a single integrated Monte Carlo procedure. In each Monte Carlo trial a failure rate was sampled for each case and

pipe size by sampling from either a high, best estimate or low exposure term estimate. A conditional rupture probability for each rupture mode was sampled for each pipe size, and a sample initiating event frequency was calculated by propagating these samples through the equations for the pipe rupture frequencies and the equations for the HELB-initiated internal flooding initiating event frequencies. This process also made it unnecessary to perform a series of Monte Carlo calculations in which the results from each step would be fitted to a distribution for sampling in the next stage.

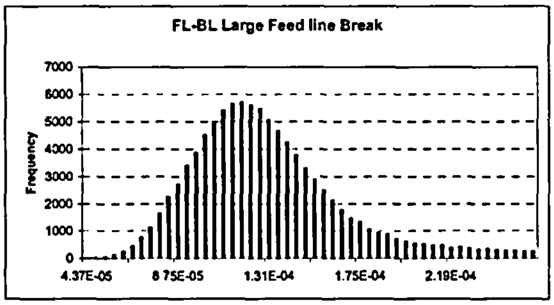
5.2 *Summary of Results*

The results for the initiating event frequencies are summarized in Table 5-1 for each of the equations listed in Section 3. The results listed in bold font are the initiating event frequencies; the remaining values are key intermediate results.

In Figures 5-1 through 5-4 the details of the uncertainty analysis are provided for Large Feedline Breaks, Moderate Feedline Breaks, Large Steamline Breaks, and Moderate Steamline breaks, respectively using as input reports that are generated by Crystal Ball™.

Table 5-1 Uncertainty Distribution Results for HELB-Initiated Internal Flooding Initiating Event Frequencies

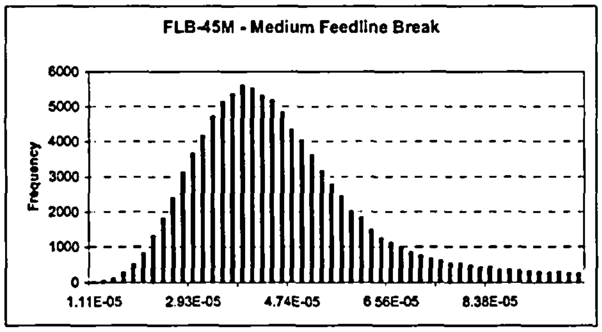
Event	Events per Reactor Operating Year			
	Mean	5%tile	50%tile	95%tile
F_{HP}, Large High Pressure SLB	3.47E-05	1.50E-05	3.11E-05	6.68E-05
F_{RSL}, Large Reheat SLB	2.04E-04	9.82E-05	1.84E-04	3.85E-04
F_{ESL}, Large Extraction SLB	1.40E-05	4.96E-06	1.19E-05	3.00E-05
F_{SLBL}, Large SLB	**2.53E-04**	**1.42E-04**	**2.33E-04**	**4.37E-04**
F_{RSM}, Moderate Reheat SLB	1.74E-04	8.63E-05	1.57E-04	3.25E-04
F_{ESM}, Moderate Extraction SLB	1.28E-05	5.32E-06	1.11E-05	2.58E-05
F_{SLBL}, Moderate Steam Line SLB	**1.87E-05**	**9.84E-05**	**1.71E-04**	**3.37E-04**
F_{FL15}, Large FLB downstream of FWH15	5.85E-05	3.67E-05	5.52E-05	9.40E-05
F_{FL45}, Large FLB between FWH14 and FWH15	7.67E-05	4.15E-05	7.01E-05	1.42E-04
F_{FLBL}, Large FLB	**1.35E-4**	**8.19E-05**	**1.26E-04**	**2.27E-04**
F_{FL45M}, Moderate FLB	**4.69E-05**	**2.47E-05**	**4.29E-05**	**8.63E-05**



Percentiles:	Forecast values
0%	4.15E-05
5%	8.19E-05
10%	9.04E-05
15%	9.65E-05
20%	1.02E-04
25%	1.06E-04
30%	1.10E-04
35%	1.14E-04
40%	1.18E-04
45%	1.22E-04
50%	1.26E-04
55%	1.30E-04
60%	1.34E-04
65%	1.39E-04
70%	1.44E-04
75%	1.50E-04
80%	1.58E-04
85%	1.69E-04
90%	1.87E-04
95%	2.27E-04
100%	4.90E-04

Statistics:	Forecast values
Trials	100,000
Mean	1.35E-04
Median	1.26E-04
Mode	---
Standard Deviation	4.50E-05
Variance	2.02E-09
Skewness	1.76
Kurtosis	10.76
Coeff. of Variability	0.33
Minimum	4.15E-05
Maximum	4.90E-04
Range Width	4.49E-04
Mean Std. Error	1.42E-07

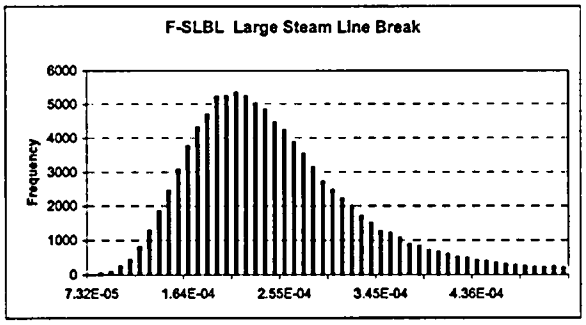
Figure 5-1 Crystal Ball Results for Large Feedline Break Frequency



Percentiles:	Forecast values
0%	1.02E-05
5%	2.47E-05
10%	2.81E-05
15%	3.05E-05
20%	3.27E-05
25%	3.45E-05
30%	3.62E-05
35%	3.79E-05
40%	3.95E-05
45%	4.11E-05
50%	4.29E-05
55%	4.46E-05
60%	4.65E-05
65%	4.86E-05
70%	5.09E-05
75%	5.36E-05
80%	5.70E-05
85%	6.17E-05
90%	6.96E-05
95%	8.63E-05
100%	2.16E-04

Statistics:	Forecast values
Trials	100,000
Mean	4.69E-05
Median	4.29E-05
Mode	---
Standard Deviation	1.94E-05
Variance	3.75E-10
Skewness	1.83
Kurtosis	11.10
Coeff. of Variability	0.41
Minimum	1.02E-05
Maximum	2.16E-04
Range Width	2.06E-04
Mean Std. Error	6.12E-08

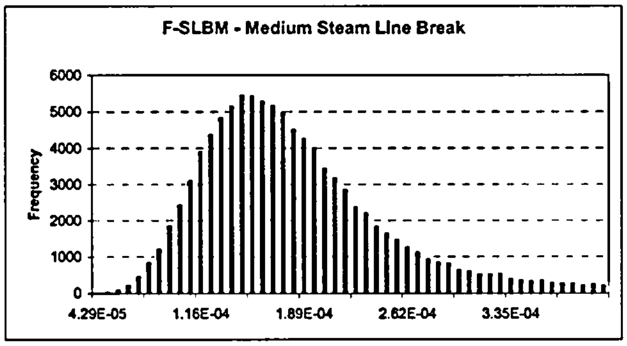
Figure 5-2 Crystal Ball Results for Intermediate Feedline Break Frequency



Percentiles:	Forecast values
0%	6.87E-05
5%	1.42E-04
10%	1.58E-04
15%	1.70E-04
20%	1.80E-04
25%	1.90E-04
30%	1.98E-04
35%	2.07E-04
40%	2.15E-04
45%	2.24E-04
50%	2.33E-04
55%	2.42E-04
60%	2.53E-04
65%	2.64E-04
70%	2.76E-04
75%	2.91E-04
80%	3.09E-04
85%	3.33E-04
90%	3.69E-04
95%	4.37E-04
100%	1.16E-03

Statistics:	Forecast values
Trials	100,000
Mean	2.53E-04
Median	2.33E-04
Mode	—
Standard Deviation	9.61E-05
Variance	9.24E-09
Skewness	1.82
Kurtosis	11.77
Coeff. of Variability	0.38
Minimum	6.87E-05
Maximum	1.16E-03
Range Width	1.10E-03
Mean Std. Error	3.04E-07

Figure 5-3 Crystal Ball Results for Large Steam Line Break



Percentiles:	Forecast values
0%	3.93E-05
5%	9.84E-05
10%	1.11E-04
15%	1.21E-04
20%	1.29E-04
25%	1.36E-04
30%	1.43E-04
35%	1.50E-04
40%	1.57E-04
45%	1.64E-04
50%	1.71E-04
55%	1.78E-04
60%	1.86E-04
65%	1.95E-04
70%	2.04E-04
75%	2.16E-04
80%	2.30E-04
85%	2.49E-04
90%	2.78E-04
95%	3.37E-04
100%	1.02E-03

Statistics:	Forecast values
Trials	100,000
Mean	1.87E-04
Median	1.71E-04
Mode	—
Standard Deviation	7.75E-05
Variance	6.01E-09
Skewness	1.89
Kurtosis	12.03
Coeff. of Variability	0.41
Minimum	3.93E-05
Maximum	1.02E-03
Range Width	9.82E-04
Mean Std. Error	2.45E-07

Figure 5-4 Crystal Ball Results for Intermediate Steam Line Break

5.3 *Sensitivity Study*

As a sensitivity study, the initiating event frequencies were recalculated using different assumptions regarding how the data was screened as discussed in Section 4. This study was performed by propagating the results for the pipe failure rates and rupture frequencies for the different data screening strategies through the equations for the initiating event frequencies in Section 3. The results are summarized in Table 5-2 and Figure 5-5. As seen in these exhibits, the impact of using the service data from 1988 to represent the current industry practice and as a basis to predict the HELB-initiated internal flooding frequencies is approximately an order of magnitude compared with the case of using pre-1988 data. This shows the impact of industry improvement programs, particularly the FAC programs, which were responsible for reducing the frequency of pipe breaks since about 1988. Although these programs were effective in reducing the pipe break frequencies, as seen in the third case in which all the FAC related failures since 1988 were removed, FAC is still a dominant failure mechanism for these systems. The initiating event frequencies would be an order of magnitude lower if all the FAC related failures were removed from the data analysis.

Table 5-2 Impact of Alternative Assumptions Regarding Data Screening on HELB-Initiated Internal Flooding Initiating Event Frequencies

Initiating Event	Mean Initiating Event Frequency per Reactor Operating Year		
	Base Case Data after 1988 only	Data up to 1988 only	Data after 1988 with FAC events removed
F_{HP}, Large High Pressure SLB	3.47E-05	3.01E-04	3.04E-06
F_{RSL} , Large Reheat SLB	2.04E-04	1.73E-03	4.38E-06
F_{ESL}, Large Extraction SLB	1.40E-05	2.63E-03	4.77E-07
F_{SLBL}, Large SLB	**2.53E-04**	**4.67E-03**	**7.09E-06**
F_{RSML}, Moderate Reheat SLB	1.74E-04	9.39E-04	1.31E-06
F_{ESM}, Moderate Extraction SLB	1.28E-05	1.23E-03	3.18E-07
F_{SLBL}, Moderate Steam Line SLB	**1.87E-05**	**2.17E-03**	**1.62E-06**
F_{FL15}, Large FLB downstream of FWH15	5.85E-05	5.98E-04	4.96E-06
F_{FL45}, Large FLB between FWH14 and FWH15	7.67E-05	8.50E-04	4.42E-06
F_{FLBL}, Large FLB	**1.35E-4**	**1.45E-03**	**9.38E-06**
F_{FL45M}, Moderate FLB	**4.69E-05**	**4.07E-04**	**4.29E-05**

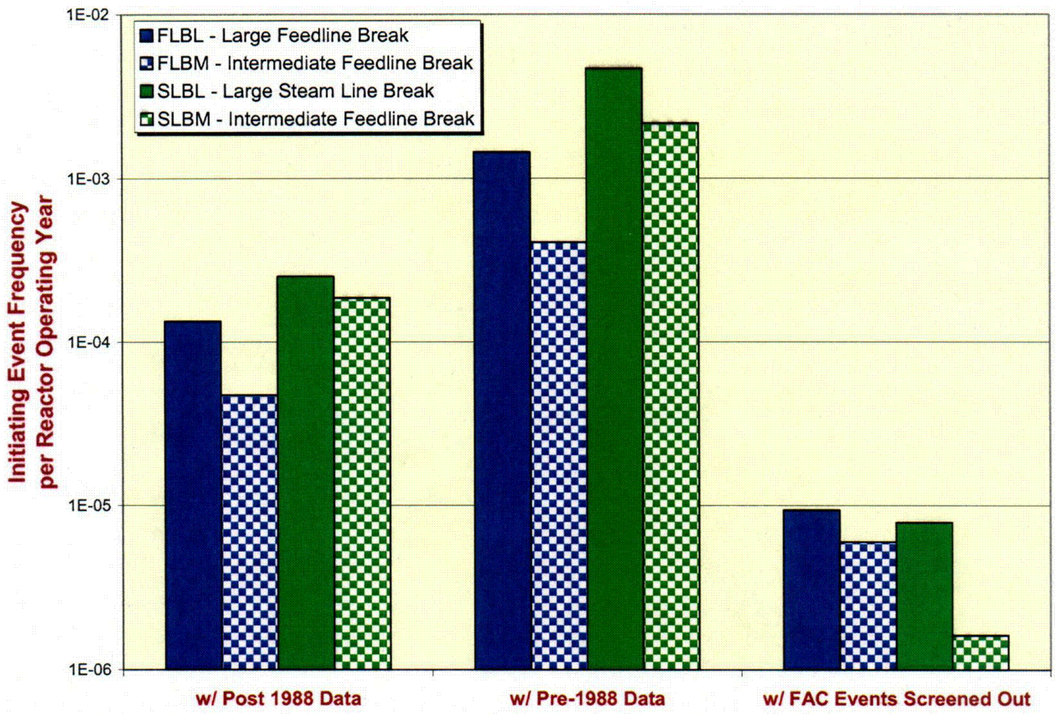


Figure 5-5 Impact of Alternative Data Screening Regarding FAC

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APPENDIX A PIPExp DATABASE DESCRIPTION

A.0 PIPExp / OPDE OVERVIEW

This appendix describes the PIPExp database content and structure, and its relationship with the OECD Pipe Failure Data Exchange Project (OPDE). OPDE was established in 2002 as a cost-shared, multi-national co-operation in piping reliability. The initial objective of OPDE was to establish a comprehensive database on pipe failures in commercial nuclear power plants worldwide and to make the database available to project member organizations that provide data. The project is operated under the umbrella of the OECD Nuclear Energy Agency (NEA). A Clearinghouse is operating the database and provides the quality assurance function. The Clearinghouse is operated by one of the authors of this report.

A.1 Historical Background

The Swedish Nuclear Power Inspectorate (SKI) in 1994 launched a R&D project with the objective of advancing the state-of-art in piping reliability. The stated objective included the following tasks:

- Develop a high-quality, comprehensive database on the service history of piping systems in commercial nuclear power plants.
- In parallel with the database development, identify and develop a general framework for statistical analysis of the service data as recorded in the pipe failure database.
- Perform a pilot application to demonstrate how the pipe failure database and piping reliability analysis framework can be used to develop plant-specific loss of coolant accident (LOCA) frequencies.

A long term strategy for the pipe failure database was formulated during the discussions leading up to the project initiation in mid-1994. This strategy included considerations to establish an international cooperation to support the long term database maintenance and applications program. The R&D project was concluded at the end of 1998. Results of the project included:

- A pipe failure database in Microsoft ACCESS. At the time this database was referred to as "SKI-PIPE", a proprietary database. It included 2291 pipe failure records as of 31-Dec-1998. This version formed the basis of OPDE in 2002 (Figure A-1).
- A series of technical reports (e.g., SKI Reports 95:58, 97:26, 97:32 and 98:30, all available from www.ski.se.

Independent of SKI and in preparation for and support of an international cooperative effort, the maintenance and update of the pipe failure database has continued post-1998. Figure A-1 is a top-level summary of this post-1998 maintenance and update program including the relationship between PIPExp and OPDE. Insights from practical database applications have played a significant role in enhancing and restructuring the database to become tool for piping reliability assessments.

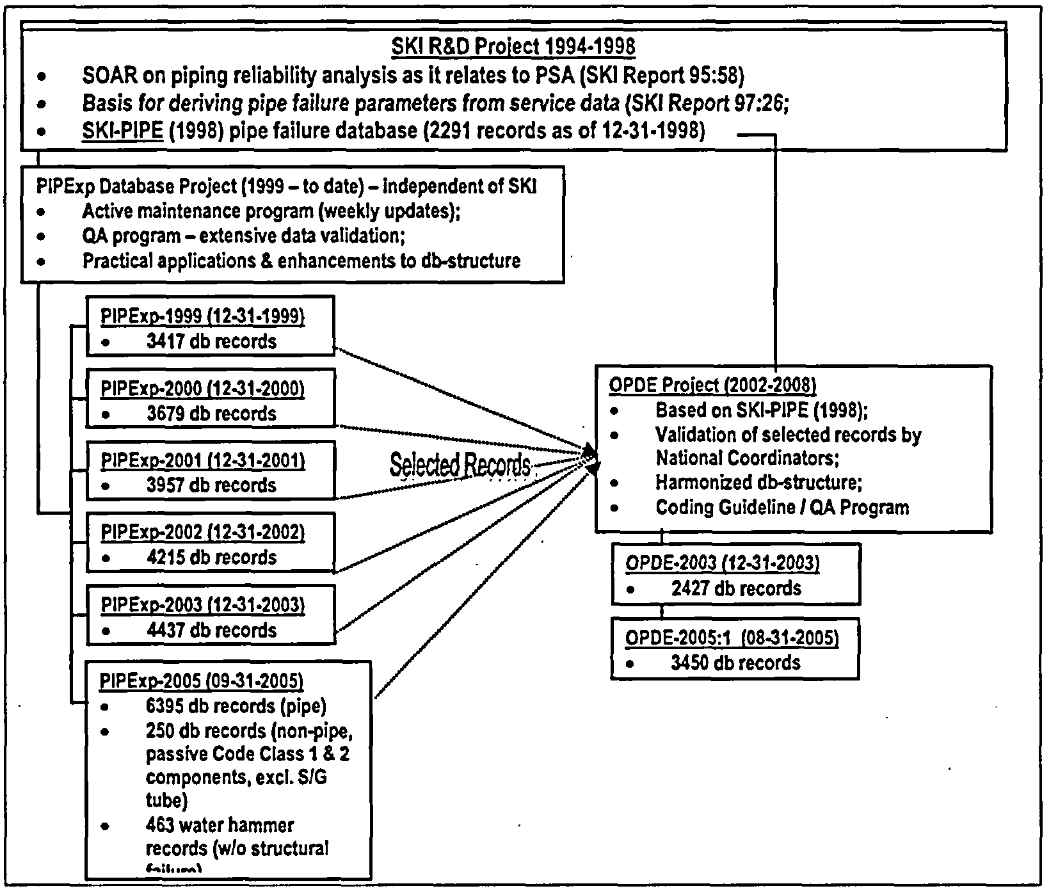

Figure A-1
Evolution of PIPExp Pipe Failure Database

A.2 PIPExp Quality Management

All work associated with database maintenance is controlled by a QA program. Source information including text files, drawings and photographs associated with each database record is stored in an electronic archive. Each data record in PIPExp is assigned a "Quality Index" (or completeness index) per the definitions in Table A-1. The Quality Index is used to assess the completeness and technical accuracy of the source information as well as the classified and coded information in the database. Table A-2 summarizes the evolution of the database since 1998.

Table A-1
Definition of Quality Index for Database Management

Quality-Index	Definition
1	Validated – all source data has been accessed & reviewed – no further action required
2	Validated – source data may be missing some, non-critical information – no further action anticipated
3	Validated – incomplete source data – assumptions made about material grade and/or exact flaw location – no further action anticipated
4	Validation based on incomplete information – depending on application requirements, further action may be necessary
5	Validation based on available, incomplete information – further action expected (e.g., retrieval of additional source data)
6	Not validated – validation is pending, or record is subject to deletion from database

Table A-2
Database Content by Quality Index

	Database as of 12-31-1998 No. Pipe Failure Records by Quality Index						
Plant Type	Totals	1	2	3	4	5	6
BWR	673	210	66	3	74	7	277
PHWR	100	30	3	--	56	1	10
PWR	1376	386	123	6	152	84	746
RBMK	57	3	6	--	19	28	1
	2291	629	198	9	301	120	1034
	Database as of 12-31-2002 No. Pipe Failure Records by Quality Index						
Plant Type	Totals	1	2	3	4	5	6
BWR	1872	1216	174	12	219	75	176
PHWR	106	51	2	--	42	11	--
PWR	2077	1011	198	6	351	233	278
RBMK	160	48	--	--	18	81	--
	4215	2290	379	22	721	349	454
	Database as of 09-30-2005 No. Pipe Failure Records by Quality Index						
Plant Type	Totals	1	2	3	4	5	6
BWR	2510	1489	300	172	282	204	63
GCR, HWLWR	12	8	--	2	1	1	--
PHWR	131	47	4	23	42	15	--
PWR	3563	1318	323	300	453	1070	99
RBMK	179	12	21	4	110	32	--
	6395	2874	648	501	888	1322	162

A.3 PIPExp Database Input Forms

This section gives and overview of the database input requirements. All data entry is done via the four forms (Form 1 through Form 4).

A.3.1 Form 1 – Event Descriptions

Form 1 is shown in Figure A-2. It consists of 35 fields; seven of which are free-format with the balance defined by roll-down menus with key words (or data filters). The data entry requirements are defined below:

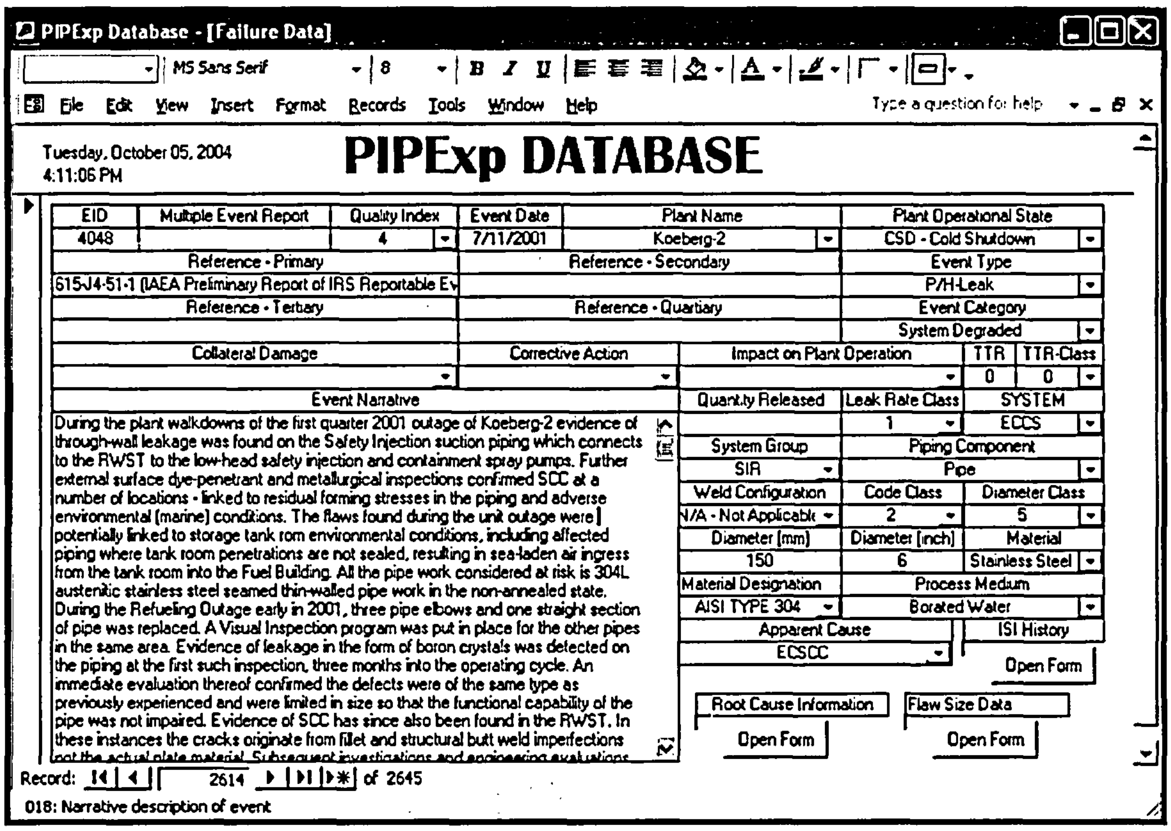

Figure A-2
Event Descriptions – Form 1

<u>Form 1 Data Entry Requirements</u>

- EID (Event ID) is a uniquely defined database record number (or "primary key"); it is generated automatically by Access.
- Multiple Event Report is checked if one source document (reference) includes information about more than one pipe failure and at different piping system locations.

Mainly, this field supports database management activities (e.g., answer to question "have all pipe failures been adequately recorded in PIPExp?").

- Quality Index (a number 1 to 6); a roll-down menu defines the different options together with definitions.
- Event Date is always required.
- Plant Name; a roll-down menu with listing of all commercial nuclear power plants in NEA member and non-member countries.
- Plant Operational State; a roll-down menu defines the different options.
- Reference; there are four free-format fields for primary and supplemental references. Electronic copies of each reference are stored on CD.
- Event Type; a roll-down menu defines the different options.
- Event Category; a roll-down menu defines the different options.
- Collateral Damage; a roll-down menu defines the different options. "N/A – None" is used as the default.
- Corrective Action; a roll-down menu defines the different options. Note that the term "Temporary Repair" always implies that a "Code Repair" or "Replacement" be performed during the next scheduled outage lasting 30 days or more, but no later than the next refueling outage.
- TTR (Time to Repair) is for the repair time in hours.
- TT-Class is a data filter; a roll-down menu defines the different options with definitions.
- Event Narrative is a free-format memo field.
- Quantity Released is free format field; the dimension can be [lb], [kg], [ton], or [m^3].
- Leak Rate Class is a data filter; a roll-down menu defines the different options with definitions.
- System is a free format field for the system name; a roll-down menu includes a selection of BWR- and PWR-specific, English language names.
- System Group is a data filter; a roll-down menu defines the different options.
- Piping Component is a data filter; a roll-down menu defines the different options.
- Weld Configuration; a roll-down menu defines the different options.
- Code Class; a roll-down menu defines the different options. A cross-reference table compares the different national safety classifications with ASME Section III.
- Diameter Class is a data filter; a roll-down menu defines the different options and definitions.
- Diameter [mm] is used for the measured diameter.
- Diameter [inch] is used for the measured diameter.
- Material is a data filter; a roll-down menu defines the different options.
- Material Designation; a roll-down menu defines the different options. A cross-reference includes different carbon steel and stainless steal material designations.
- Process Medium, a roll-down menu defines the different options.
- ISI History (Form 3) is checked only if information is available.
- Root Cause Information (Form 4) is checked only if information is available.
- Flaw Size Information (Form 2) is checked only if flaw size (e.g., crack orientation, depth, length) information is available.

A.3.2 Form 2 – Flaw Size Information

Form 2 is shown in Figure A-3. It consists of 28 fields. The data entry requirements are defined below:

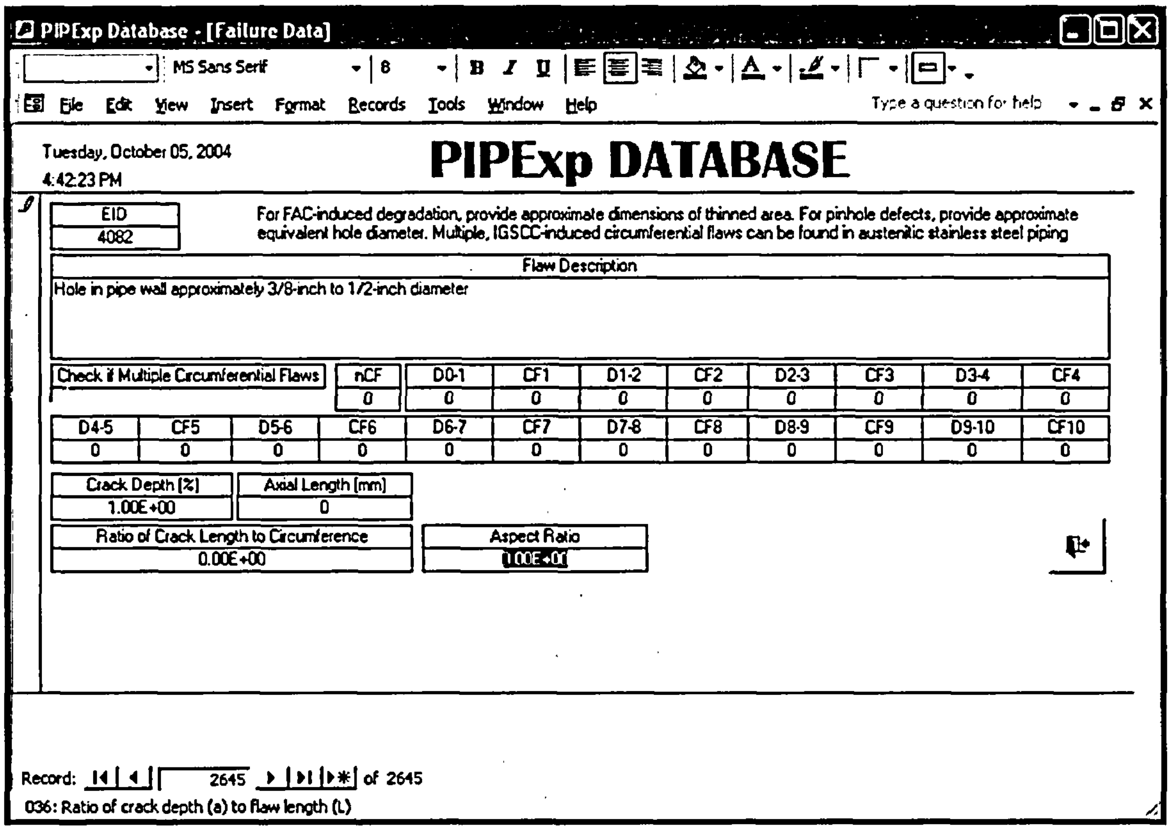

Figure A-3
Flaw Size Information – Form 2

<u>Form 2 Data Entry Requirements</u>

- Flaw Description is a free-format memo field. For through-wall flaws, information about dimensions (e.g., equivalent diameter) should be included in this field. For part through-wall flaws, this field should include information on flaw depth (a) and length (*l*), and orientation. For multiple flaws, the number of flaws and their lengths are recorded in the designated fields.
- Check if Multiple Circumferential Flaws. This check box typically applies to flaws attributed to IGSCC. In PIPExp, on the order of 15% of the records on IGSCC involve multiple, single plane circumferential cracks.
- nCF (number of Circumferential Flaws) includes the total number of flaws in an affected weld.
- D#-## is the distance, in [mm], between adjacent circumferential flaws; e.g., D0-1 is the distance from the TDC (12 o'clock) position to flaw #1, and D2-3 is the distance between

flaw #2 and flaw #3, etc. A blank field indicates that no information on the spacing is available in the database.

- CF-# is the length of circumferential flaw '#' [mm]. The flaw number is relative to the 0-degree position; CF-1 is the first circumferential flaw from the reference position, etc.
- Crack Depth [%] is the ratio of crack depth to pipe wall thickness.
- Axial Length [mm]; this field relates to the Flaw Description.
- Ratio of Crack Length to Circumference; this ratio should be relative to the inside pipe circumference.
- Aspect Ratio; this is the ratio of crack depth to crack length and relates to the information under Flaw Description.

A.3.3 Form 3 – ISI History

Form 3 is shown in Figure A-4. It consists of 3 fields. While primarily intended for ISI program weaknesses, the free-format field may be used to document any information pertaining to the ISI of the affected component, or ISI history such as time of most recent inspection.

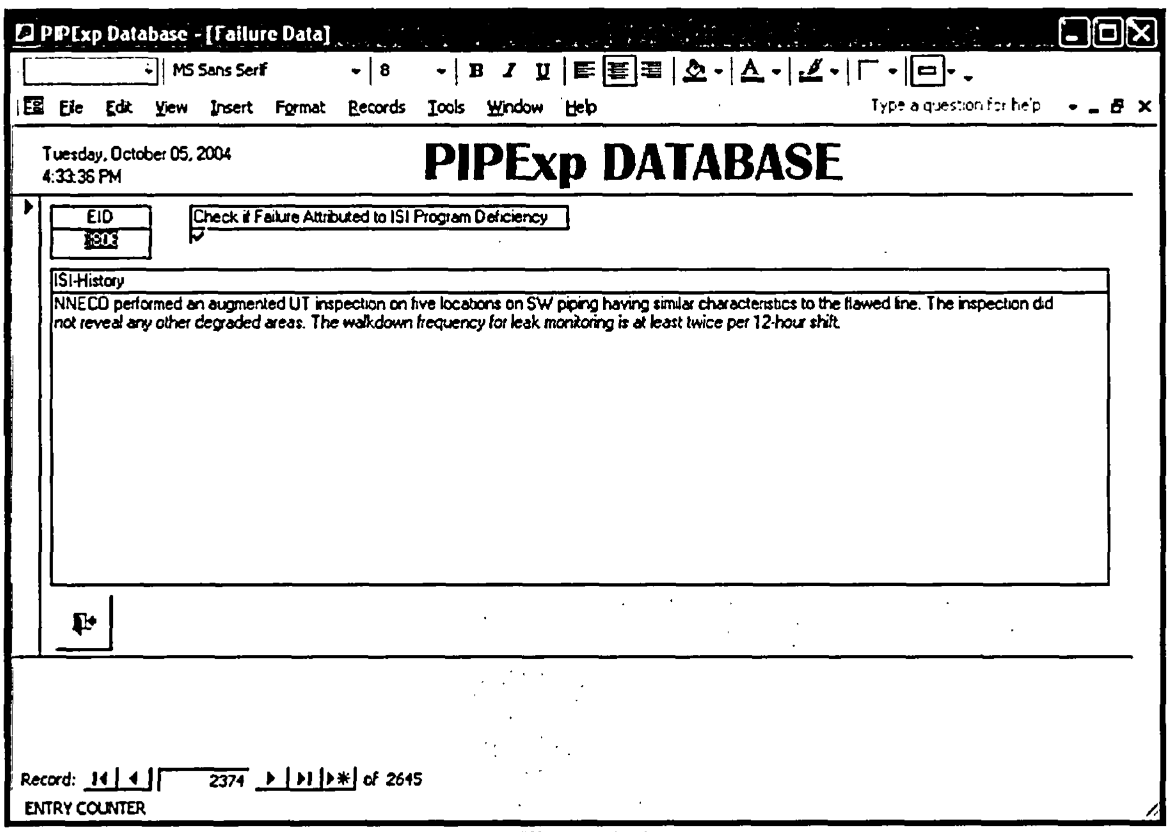

Figure A-4
ISI History – Form 3

A.3.4 Form 4 – Root Cause Information

Form 4 is shown in Figure A-5. It consists of 9 fields. The data entry requirements are defined below:

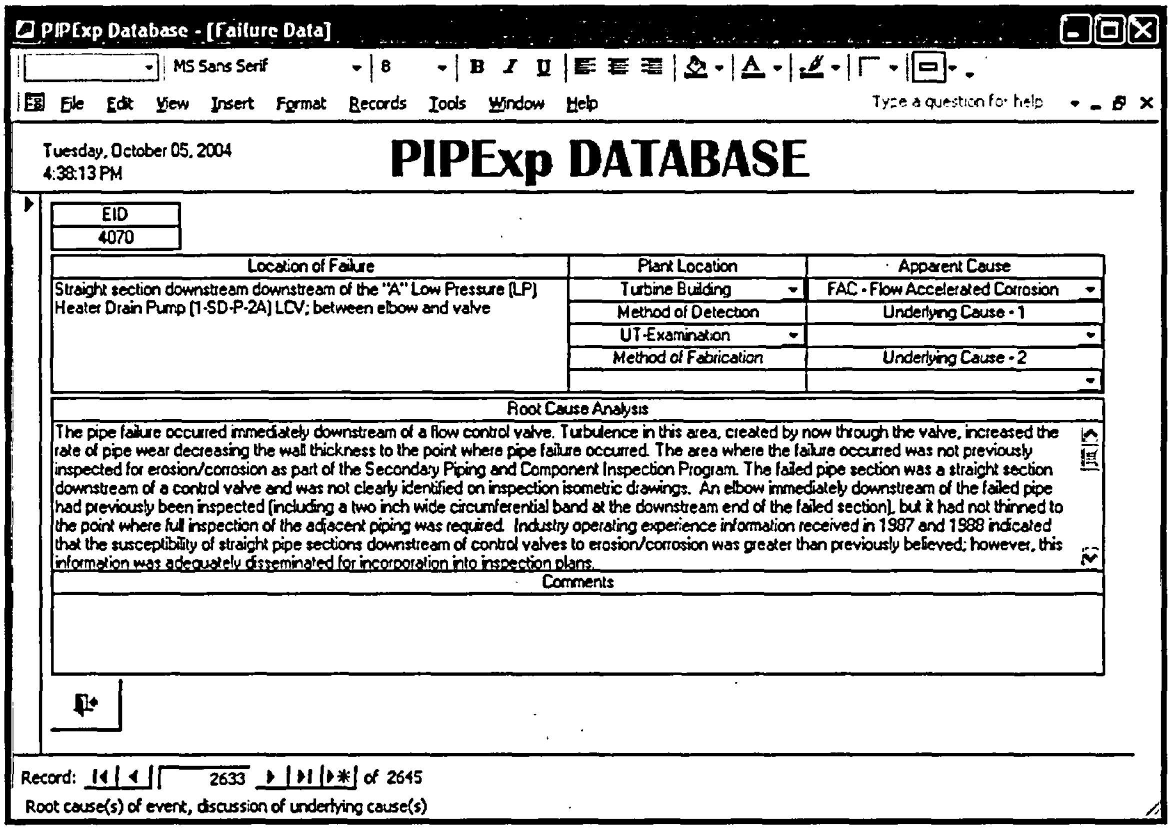

Figure A-5
Root Cause Information – Form 4

<u>Form 4 Data Entry Requirements</u>

- Location of Failure; this is a free-format memo field describing the location of a flaw (e.g., line or weld number, or using a P&ID reference).
- Plant Location; a roll-down menu defines the different options.
- Method of Detection; a roll-down menu defines the different options.
- Method of Fabrication; a free-format text field.
- Apparent Cause; a roll-down menu defines the different options. Normally this field has already been filled in.
- Underlying Cause – 1; a roll-down menu defines possible contributing factors.
- Underlying Cause – 2; a roll-down menu defines possible contributing factors.
- Root Cause Analysis; a free-format memo field. This field should include any relevant information on the cause-consequence relationship and should be supplemental to the Event Narrative in Form 1.

- Comments; a free-format memo field. It is intended for any other, relevant information that is not captured by other database fields.

A.4 Database Accessibility

PIPExp is a proprietary database whereas the OPDE database is restricted. The full OPDE database is available to participating organizations that supply data. An unrestricted version of OPDE ('OPDE-Light') is available to interested parties upon request to respective National Coordinator (the U.S. representative in the project is the Nuclear Regulatory Agency, Office of Nuclear Regulatory Research). OPDE-Light does not include any proprietary information or any information that enables the identification of plant name.

APPENDIX B PIPE FAILURE RATES & RUPTURE FREQUENCIES APPLICABLE TO NON-CODE PIPING SYSTEMS

Table B-1 FWC Piping Failure Rates & Rupture Frequencies

Case	Description	Uncertainty Distribution			
		Mean [1/ft.yr]	5^{th} Percentile	Median	95^{th} Percentile
KNPP01	EBS1 - FWC Pipe Failure Rate - with post 1988 data	3.19E-06	1.99E-06	2.97E-06	5.92E-06
	EBS1 - FWC Pipe Rupture - with post 1988 data	6.72E-08	3.80E-08	6.19E-08	1.24E-07
KNPP02	EBS2 - FWC Pipe Failure Rate - with data through 1988	3.56E-06	2.21E-06	3.31E-06	6.59E-06
	EBS2 - FWC Pipe Rupture - with post 1988 data	1.09E-07	6.25E-08	1.01E-07	2.00E-07
KNPP03	EBS1 - FWC Pipe Failure Rate - with data through 1988	2.78E-05	1.73E-05	2.60E-05	5.20E-05
	EBS1 - FWC Pipe Rupture - with data through 1988	5.85E-07	3.39E-07	5.41E-07	1.09E-06
KNPP04	EBS2 - FWC Pipe Failure Rate - with data through 1988	3.98E-05	2.49E-05	3.73E-05	7.45E-05
	EBS2 - FWC Pipe Rupture - with data through 1988	1.22E-06	7.27E-07	1.14E-06	2.28E-06
KNPP05	EBS1 - FWC Pipe Failure Rate – with FAC events screened out	9.21E-07	5.23E-07	8.45E-07	1.70E-06
	EBS1 - FWC Pipe Rupture – with FAC events screened out	8.60E-09	3.64E-09	7.66E-09	1.68E-08
KNPP06	EBS2 - FWC Pipe Failure Rate – with FAC events screened out	8.29E-07	4.41E-07	7.56E-07	1.52E-06
	EBS2 - FWC Pipe Rupture – with FAC events screened out	6.35E-09	2.40E-09	5.55E-09	1.30E-08

Table B-2 Steam Extraction Piping Failure Rates & Rupture Frequencies

Case	Description	Uncertainty Distribution			
		Mean [1/ft.yr]	5^{th} Percentile	Median	95^{th} Percentile
KNPP07	EBS1 – Steam Extraction Pipe Failure Rate with post 1988 data	3.40E-06	1.65E-06	3.06E-06	6.41E-06
	EBS1 – Steam Extraction Pipe Rupture with post 1988 data	7.71E-08	3.19E-08	6.37E-08	1.39E-07
KNPP08	EBS2 – Steam Extraction Pipe Failure Rate with post 1988 data	2.58E-06	1.00E-06	2.23E-06	5.31E-06
	EBS2 – Steam Extraction Pipe Rupture with post 1988 data	7.93E-08	2.89E-08	6.75E-08	1.68E-07
KNPP09	EBS1 – Steam Extraction Pipe Failure Rate with data through 1988	3.32E-04	2.06E-04	3.10E-04	6.17E-04
	EBS1 – Steam Extraction Pipe Rupture with data through 1988	6.99E-06	4.03E-06	6.45E-06	1.28E-05
KNPP10	EBS2 – Steam Extraction Pipe Failure Rate with data through 1988	4.86E-04	3.03E-04	4.55E-04	9.05E-04
	EBS2 – Steam Extraction Pipe Rupture with data through 1988	1.49E-05	8.78E-06	1.38E-05	2.73E-05
KNPP11	EBS1 – Steam Extraction Pipe Failure Rate – with FAC events screened out	1.93E-07	1.32E-08	9.36E-08	6.73E-07
	EBS1 – Steam Extraction Pipe Rupture – with FAC events screened out	1.80E-09	1.10E-10	8.25E-10	6.45E-09
KNPP12	EBS2 – Steam Extraction Pipe Failure Rate – with FAC events screened out	2.68E-07	1.64E-08	1.23E-07	9.58E-07
	EBS2 – Steam Extraction Pipe Rupture – with FAC events screened out	2.07E-09	1.05E-10	8.81E-10	7.63E-09

Table B-3 LP Steam Piping Failure Rates & Rupture Frequencies

Case	Description	Uncertainty Distribution			
		Mean [1/ft.yr]	5th Percentile	Median	95th Percentile
KNPP13	EBS1 – LP Steam Piping Failure Rate - with post 1988 data	1.33E-05	7.89E-06	1.23E-05	2.42E-05
	EBS1 – LP Steam Piping Rupture - with post 1988 data	2.80E-07	1.47E-07	2.56E-07	5.14E-07
KNPP14	EBS2 – LP Steam Piping Failure Rate - with post 1988 data	1.07E-05	5.82E-06	9.75E-06	1.96E-05
	EBS2 – LP Steam Piping Rupture - with post 1988 data	3.29E-07	1.64E-07	2.97E-07	6.13E-07
KNPP15	EBS1 – LP Steam Piping Failure Rate - with data through 1988	7.15E-05	4.45E-05	6.66E-05	1.33E-04
	EBS1 – LP Steam Piping Rupture – with data through 1988	1.51E-06	8.49E-07	1.39E-06	2.77E-06
KNPP16	EBS2 – LP Steam Piping Failure Rate - with data through 1988	9.09E-05	5.66E-05	8.45E-05	1.68E-04
	EBS2 – LP Steam Piping Rupture – with data through 1988	2.79E-06	1.60E-06	2.57E-06	5.07E-06
KNPP17	EBS1 – LP Steam Piping Failure Rate – with FAC events screened out	2.25E-07	1.47E-08	1.07E-07	7.87E-07
	EBS1 – LP Steam Piping Rupture – with FAC events screened out	2.10E-09	1.19E-10	9.44E-10	7.48E-09
KNPP18	EBS2 – LP Steam Piping Failure Rate – with FAC events screened out	9.22E-07	1.78E-07	6.58E-07	2.52E-06
	EBS2 – LP Steam Piping Rupture – with FAC events screened out	7.05E-09	1.11E-09	4.76E-09	2.04E-08

Table B-4 HP Steam Piping Failure Rates & Rupture Frequencies

Case	Description	Uncertainty Distribution			
		Mean [1/ft.yr]	5th Percentile	Median	95th Percentile
KNPP19	EBS1 – HP Steam Piping Failure Rate - with post 1988 data	3.25E-06	1.62E-06	2.94E-06	6.01E-06
	EBS1 – HP Steam Piping Rupture – with post 1988 data	3.03E-08	1.16E-08	2.64E-08	6.28E-08
KNPP20	EBS2 – HP Steam Piping Failure Rate - with post 1988 data	1.16E-06	3.33E-07	9.37E-07	2.75E-06
	EBS2 – HP Steam Piping Rupture – with post 1988 data	8.90E-09	2.01E-09	6.78E-09	2.26E-08
KNPP21	EBS1 – HP Steam Piping Failure Rate - with data through 1988	1.60E-05	9.34E-06	1.47E-05	2.94E-05
	EBS1 – HP Steam Piping Rupture – with data through 1988	1.49E-07	6.40E-08	1.34E-07	2.90E-07
KNPP22	EBS2 – HP Steam Piping Failure Rate - with data through 1988	2.50E-05	1.47E-05	2.30E-05	4.60E-05
	EBS2 – HP Steam Piping Rupture – with data through 1988	1.91E-07	7.72E-08	1.70E-07	3.78E-07
KNPP23	EBS1 – HP Steam Piping Failure Rate – with FAC events screened out	1.74E-07	1.23E-08	8.44E-08	5.93E-07
	EBS1 – HP Steam Piping Rupture – with FAC events screened out	1.64E-09	9.98E-11	7.52E-10	5.71E-09
KNPP24	EBS2 – HP Steam Piping Failure Rate – with FAC events screened out	2.36E-07	1.53E-08	1.12E-07	8.29E-07
	EBS2 – HP Steam Piping Rupture – with FAC events screened out	1.80E-09	9.99E-11	8.01E-10	6.49E-09

Appendix B

Flood Area Definition for Turbine Building Basement

Flood Area Definition for Turbine Building Basement

Prepared by: [signature] J Russell Sharpe

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10/24/05

Date

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10/24/05

Date

1.0 PURPOSE

Internal floods are defined as those floods that result from the failure, incorrect operation (including errors in maintenance), or incorrect alignment of components within the plant. Accident sequences initiated by internal floods can be a significant contributor to risk because of the potential of the event to impair, simultaneously, multiple components required for accident mitigation. The overall objective of the internal flooding analysis is to determine the contribution of accident sequences initiated by such flooding events to core damage and individual accident class frequencies.

An internal flooding PRA requires that areas of the plant be identified that contain equipment needed to mitigate accidents and that are subject to flooding effects. Areas are defined as separate for flooding purposes where physical boundaries are present that prevent propagation of a flood source in one area from causing damage to equipment in another area. For each flood area, flooding sources are identified in the area that have the potential to damage equipment within the area or that have the potential to propagate from the area to another area and damage equipment needed for accident mitigation. Propagation paths are identified and defined between flood areas. The flooding walkdowns confirmed the boundaries between flood areas and identified barriers in the boundaries that separate the flood areas. This information can be used to identify areas of the plant that can be designated as separate, independent flood areas.

In order to streamline the accident sequence analysis it is beneficial to limit the analysis to only those sequences that will contribute to flooding risk. Such risk-significant sequences are identified through the application of a screening process. Each flood area is evaluated against important factors including the existence of flooding initiators, the existence of safety-significant equipment, and ability of a flooding initiator to cause a reactor trip to determine which flood areas are worthy of additional analysis and quantification.

This document designates independent flood areas that will be analyzed in further detail through accident sequence analysis and initiating event frequency analysis. Development of independent flood areas will support the high level requirements identified in the Flood Area Definition Guideline [GUIDE01]. This document also applies a screening analysis to all the defined flood areas to focus the accident sequence analysis on risk-significant scenarios. Application of a screening process will support some of the high level requirements identified in the Accident Sequence Analysis Guideline [GUIDE02].

2.0 METHODOLOGY

2.1 Flood Area Definition

A flood area addresses physical boundaries that impact the propagation of water and the potential to damage equipment. The subject water originates from a pipe break in the flood area and is categorized as a submergence event or a spray event, thus flood areas are defined differently for these two events. A submergence event is defined as a pipe break with sufficient flow rate to overwhelm the flood area's flood mitigation equipment, accumulate in such a manner as to

damage equipment, and has the potential to propagate laterally in an amount significant enough to damage additional equipment. A spray event is a pipe break with a flow rate within the capacity of the flood area's mitigation equipment (especially floor drains) that can damage equipment from direct spray, but cannot propagate laterally. Thus, a pipe break in a spray flood area is expected to result in direct damage to equipment in the area and to result in the vast majority of that water exiting the flood area via the floor drains and floor openings. Any water that propagates laterally from a spray flood area will be of insignificant quantity and will not cause equipment damage in adjoining areas. Each flood area is analyzed for both spray events and submergence events.

Lateral propagation for submergence events occurs due to failure of barriers separating the areas. Typical barrier failures are of doors, but could include water that flows through open penetrations through walls, water that flows over protective curbs and weirs, and structural failure of gypsum walls. Normally closed access doors are able to withstand some amount of force due to accumulated water, however when the water level reaches a critical depth the door is expected to fail. Thus, water will propagate laterally through such failed doors. Since a failure is required for this lateral propagation to occur, these lateral zones are not included in the flood area definition. Only zones with open communication are considered in defining flood areas.

2.2 Assumptions

The following assumptions were utilized in the definition of flood areas:

1. Leakage under and around doors is the only form of drainage inside Safeguards Alley since a pipe break in the Turbine Hall will fill the Turbine Building sump and subsequently fill the drain lines connecting the sump to the floor drains in Safeguards Alley. Thus, the floor drains will not be able to remove water from Safeguards Alley. Gaps under doors are documented as part of the GOTHIC input. [CALC02]

2. KPS access doors inside the Turbine Building generally can withstand a water height of 4 feet when the water is pushing the door open and 5 feet when the water is pushing the door closed. Exceptions to this include doors 243 and 244 which can withstand 3 feet 3 inches when water is opening the door and 4 feet 9 inches when water is closing the door, and door 8 which can withstand 3 feet 9 inches when water is opening the door. [CALC01]

3. All junction boxes are gasketed and not vulnerable to spray unless otherwise noted in the Walkdown Sheets [FLOOD01].

4. Flood-induced failure of MOVs involves the valve operator's loss of function, but does not involve the MOV changing position. The MOV is expected to remain in the same position, however any new change in position will require manual action to turn the handwheel.

5. Flood-induced failure of AOV involves the valve operator's loss of function, but would also

involve the AOV failing to its fail-safe position.

6. Sealed penetrations are assumed to pass no fluid. Penetrations make use of various types of sealant including grout and elastomer. Grout behaves similar to concrete and is basically impervious to water.

7. Cable insulation is not subject to failure from submergence or spray.

8. Walls and trench barriers are assumed to remain intact throughout a flooding event with the exception of the firewall separating flood areas TU-95A and TU-95B-1. This gypsum wall was analyzed and determined to be structurally capable of withstanding only approximately 3 feet of water. [CALC01]

9. The probability of rupture of encapsulated high-energy lines is insignificant as both the inner pipe and the surrounding guard pipe must fail.

10. Environmentally qualified (EQ) components are assumed to be able to perform their safety functions when exposed to spray conditions and high heat and humidity due to a pipe break. For example, the solenoid operators for feedwater valves in the feedwater valve room, by design, perform their safety functions during high-energy line break (HELB) events.

11. Lines that are not normally pressurized or charged such as drain lines and dry fire protection piping are not considered as credible flood or spray sources.

12. Flooding in containment is not considered in this analysis. This is a subset of the Loss of Coolant Initiating Event (LOCA) in the Internal Events PRA.

13. Rupture of seismic Class I tanks (e.g., concrete reinforced refueling water storage tank) is not considered credible in this analysis.

14. Failure of a fire protection deluge valve is not analyzed as a potential initiator in this analysis. The flow rate of a single deluge valve is insufficient to cause flooding concerns in Safeguards Alley. The simultaneous failure of multiple deluge valves has an insignificantly small probability.

3.0 DESCRIPTION OF FLOOD AREAS IN TURBINE BUILDING BASEMENT

Flood areas were defined in a previous analysis [FLOOD01]. Walkdowns of the various flood areas were performed earlier and are documented on walkdown forms [Appendix C of FLOOD01]. For each flood area these walkdowns recorded information that included resident equipment, flood sources, and barriers (including doors). The information from these walkdowns combined with the information obtained from the general arrangement drawings [DWG01]

provides the basis for the following flood area descriptions.

This analysis is concerned only with flood events that originate in the Turbine Building and then propagate to Safeguards Alley. Therefore, flood areas associated with the Battery Rooms on the mezzanine level of the Turbine Building and the Turbine Oil Storage Area in the Turbine Building basement as well as flood areas in the Auxiliary Building are disregarded as flooding areas of interest in this analysis.

Figure 1 identifies the various flood areas and their important features.

TU-22-1

Description - Flood Zone TU-22-1 comprises all of the general areas of the Turbine Building including the Operating Deck on the 626'-0" elevation, the Mezzanine Floor on the 606'-0" elevation, and the Basement on the 586'-0" elevation. It also includes the rooms in the south end of the Auxiliary Building basement from the waste neutralizer tank (room 17B) west to the Reactor Building Support Ring (room 11B) since these rooms are not part of the radiological area and communicate openly with the Turbine Building basement. Additionally, the shop area, working material storage area, and steam generator blowdown area in the south end of the 606'-0" elevation of the Auxiliary Building are also included in this flood zone since these rooms communicate openly with the other Auxiliary Building rooms in Flood zone TU-22-1 and since these areas are not part of the radiologically controlled area. Table 1 contains a complete listing of the fire zones and room numbers that comprise each flood zone. On the 626'-0" elevation the zone is bounded on the north by the Technical Support Center and exterior walls, on the south by the Transformer Area and exterior walls, on the west by the Auxiliary Building, and on the east by the Administration Building and exterior walls. On the 606'-0" elevation the zone is bounded on the north by zones TU-97 and TU-98, the Technical Support Center, exterior walls, the Containment Building, and zone AX-32-1, on the south by the Transformer Area, exterior walls, and zones AX-33 and AX-39, on the west by the Auxiliary Building and Containment Building, and on the east by the Administration Building and exterior walls. Zones TU-94, TU-95A, TU-95B-1, TU-95B-2, TU-95C, TU-96, TU-97, and TU-98 lie beneath zone TU-22-1 and zone TU-96 and the Turbine Building roof lie above.

All wall and ceiling penetrations are sealed. The floor of this zone is the basement floor and is finished concrete. The north wall has a normally-closed door (120) on the 626'-0" elevation of the Auxiliary Building leading to a stairwell, normally-closed doors (47 and 48) leading to zones TU-97 and TU-98, normally-closed doors (46 and 280) on the 606'-0' elevation of the Turbine Building leading outdoors, normally-closed doors (11, 15, and 16) on the 586'-0" elevation of the Auxiliary Building leading to zones AX-20B, AX-21-1, and AX-23A-1, normally-closed door 401 leading to zone TU-94, and normally-closed doors (4 and 6) leading to zone TU-95B-1. The south wall has a normally-closed door (117) on the 626'-0" elevation leading to the Control Room, a normally-closed roll-up door (42) on the 606'-0" elevation leading to the outdoors,

normally-closed doors (70 and 74) leading to zones AX-39 and AX-33 on the 606'-0" elevation, and no doors on the 586'-0" elevation. The east wall has a normally-closed door (109) on the 626'-0" elevation and a normally-closed door (39) on the 606'-0" elevation leading to the Administrative Building, and no doors on the 586'-0" elevation. The west wall has normally-closed doors (118, 133, and 161) leading to zones AX-32-1 and AX-37 on the 626'-0" elevation, normally-closed doors (41, 44, and 49) leading to zones AX-32-1 and AX-30 on the 606'-0" elevation of the Auxiliary Building, a normally-open door (68) leading to the dosimetry offices on the 606'-0" elevation, a normally-closed door (75) in the Electric Shop leading outdoors, and a normally-closed door (7) on the 586'-0" elevation leading to zone TU-96. The east wall has a normally-closed door (109) on the 626'-0" elevation leading to the Administration Building, normally-closed doors (39 and 40) on the 606'-0" elevation leading to the Administration Building and outdoors, and no doors on the 586'-0" elevation.

The major PRA equipment in zone TU-22-1 includes the feedwater pumps (1A and 1B), the condensate pumps (1A and 1B), MCC 45-F, and the Redundant Overspeed Trip System Cabinet. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-22-1 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include fire protection piping, feedwater piping, service water piping, main steam piping, and circulating water piping which are the primary flood sources and represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of floor grating, open stairways and sump pumps.

Analysis – Water from a pipe break in TU-22-1 will readily propagate to the basement level. The effects of a spray source in any part of the zone are limited to equipment in the vicinity of the spray source. Water is likely to splash onto equipment on lower levels as it passes through the floor grating. Accumulation is possible in the basement level (586'-0") of the zone.

As water from any pipe break in zone TU-22-1 makes its way into the Turbine Building basement, it will eventually fill the Turbine Building Sump. The sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

Thus, only pipe breaks of greater than 200 gpm, the combined discharge capacity of the Turbine Building sump pumps, are of concern for zone TU-22-1.

The first indication of such a break would be a Turbine Building sump high level alarm in the control room. The procedure for abnormal operation of the miscellaneous drains and sumps instructs the operator to dispatch someone to investigate the source of the alarm. If the source of leakage is from a break in the Circulating Water System, the operator is instructed to trip the circulating water pumps, trip the reactor, and perform a shutdown using emergency operating procedure E-0.

The effectiveness of such operator actions is dependent on the size of the pipe break. A small pipe break would likely afford the operator the time to perform the actions necessary to protect vital equipment in the Turbine Building basement. A large break would result in significant accumulation in the Turbine Building basement and could challenge the flood protection features in place to protect equipment located in adjacent zones. Water level in areas TU-94, TU-95B-1, TU-95B-2, and TU-95C would closely mirror the water level in TU-22-1 due to leakage under doors 4, 6, and 401 and due to flow through the drain lines that connect Safeguards Alley and the Turbine Building sump (these lines do not have check valves). Since drainage in these areas will be disabled due to the water in the Turbine Building, water will begin to accumulate in these rooms and begin to propagate to zones TU-90, TU-92, and TU-95A due to leakage under doors 3, 263, and 268. The 4 kV buses in TU-90 and TU-92 will fail when the water level reaches 4 inches.

Summary – Pipe breaks in zone TU-22-1 can result in both equipment spray and submergence. For spray events TU-22-1 becomes a flood area by itself since only equipment in TU-22-1 is susceptible to damage from direct spray originating in zone TU-22-1. However, water from such a spray event can result in the splashing of equipment in other elevations of the zone. For submergence events, zone TU-22-1 combines with all the zones in Safeguards Alley due to leakage under the doors associated with these rooms. When the water level in the Turbine Building sump reaches the high-high setpoint (approximately 34.5 inches above the sump floor) an annunciator sounds in the control room. The 4 kV buses are expected to fail at 4 inches of water, the 480 V buses at 6.25 inches of water, and the TDAFW pump will fail to start at 9 inches of water and fail to continue running at approximately 18 inches of water.

Zone TU-22-1 is a relatively large room such that any water from a pipe break is expected to spray only equipment in zone TU-22-1 that is in close proximity to the pipe break.

For a pipe break in zone TU-22-1, equipment in zones TU-22-1, TU-90, TU-92, TU-94, TU-95A, TU-95B-1, TU-95B-2 and TU-95C can be vulnerable and could be at risk.

<u>TU-90</u>

Description - Flood Zone TU-90 is Diesel Generator Room 1A on the 586'-0" elevation. The zone is bounded on the north by an exterior wall, on the south by zone TU-92, on the east by an exterior wall and the pipe tunnel leading to the Screenhouse, and on the west by zones TU-94 and TU-95A. The Administrative Building lies above zone TU-90 and exterior soil lies below. All penetrations in zone TU-90 are sealed. The south wall has a normally-closed access door (2) leading to a Screenhouse pipe tunnel and the west wall has a normally-closed access door (136) leading to zone TU-95A.

The major PRA equipment in zone TU-90A includes Diesel Generator 1A, 4 kV Switchgear Bus 5, and MCC 52A. The Internal Flood Walkdown Form (Appendix C of FLOOD01] for zone TU-90 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping and fire protection piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a trench which is sealed to prevent flow from traveling to zones TU-94 and TU-95A, but is open via a 4-inch pipe to the pipe tunnel leading to the Screenhouse. Floor drains will transfer water to the Turbine Building sump.

Analysis – Water from a pipe break in TU-90 will easily propagate to the pipe tunnel leading to the Screenhouse through an open 4-inch pipe that connects the two areas in the existing trench. Floor drains will divert water to the Turbine Building sump. Thus, only pipe breaks that exceed the capability of the floor drains are a concern for accumulation in zone TU-90. Equipment damage from spray sources in TU-90 is limited to the equipment residing in that zone.

Zone TU-90 is equipped with two normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 2 (double door with a 1/64" gap) opens outwardly to the pipe tunnel leading to the Screenhouse and door 136 (double door with a 1/8" gap) opens inwardly from zone TU-95A. Initially water would flow through the floor drains to the Turbine Building sump and flow through the open 4-inch pipe to the Screenhouse sump. However, given the limited capacity of the floor drains and the 4-inch pipe in TU-90, neither the Turbine Building sump nor the Screenhouse sump will reach a level high enough to initiate a control room alarm. While water is flowing through the floor drains it will also be leaking under door 2 to the pipe tunnel that leads to the Screenhouse. Once the seiche hump is overcome in the pipe tunnel, water leaking under the door will also flow to the Screenhouse sump. When the water level inside TU-90 reaches a critical height, both doors are expected to fail allowing water to freely propagate to zone TU-95A and the pipe tunnel leading to the Screenhouse. A significant flow of water through a pipe break would be required for any accumulation of water in TU-90.

The Turbine Building Sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A

subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

The Screenhouse sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Screenhouse sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump.

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached.

The Screenhouse sump contains Level Switch LA-16669 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached [SYSTEM01].

The operator's first indication of a pipe break inside TU-90 will be the high Screenhouse sump level alarm in the control room once the water level inside TU-90 rises high enough to fail door 2 which will allow water to flow freely to the Screenhouse. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-90 can result in both equipment spray and submergence. For spray events TU-90 becomes a flood area by itself since only equipment in TU-90 is susceptible to damage from direct spray originating in zone TU-90. For submergence events, zone TU-90 combines with zone TU-95A and the pipe tunnel leading to the Screenhouse due to leakage under the doors.

Zone TU-90 is a relatively small room such that any water from a pipe break is expected to spray all the equipment in zone TU-90.

For a pipe break in zone TU-90, equipment in the zone zones TU-90, TU-95A, and the pipe tunnel leading to the Screenhouse can be vulnerable and could be at risk.

<u>TU-92</u>

Description - Flood Zone TU-92 is Diesel Generator Room 1B on the 586'-0" elevation. The

zone is bounded on the north by zones TU-90 and the pipe tunnel leading to the Screenhouse, on the south by an exterior wall, on the east by an exterior wall and the pipe tunnel leading to the Screenhouse, and on the west by zones TU-94 and TU-22-1. The Administrative Building lies above and exterior soil lies below.

All penetrations in zone TU-92 are sealed. The north wall has a normally-closed access door (1) leading to a service water piping tunnel that leads to the Screenhouse and the west wall has a normally-closed access door (3) leading to zone TU-94.

The major PRA equipment in zone TU-92 includes Diesel Generator 1B, 4 kV Switchgear Bus 6, and MCC 62A. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-92 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping and fire protection piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of floor drains. (A six-inch curb that ran east and west just north of all the equipment protected the equipment from water originating from outside the room until late 2004, however it has since been removed.)

Analysis – Water from a pipe break in TU-92 will not easily propagate elsewhere since all the penetrations are sealed. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-92. Equipment damage from spray sources in TU-92 is limited to the equipment residing in that zone.

Zone TU-92 is equipped with two normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 1 (double door with a 1/64" gap) opens outwardly to the pipe tunnel leading to the Screenhouse and door 3 (double door with a 1/64" gap) opens inwardly from zone TU-94. Initially water would flow through the floor drains to the Turbine Building sump, but given the limited capacity of the floor drains in TU-92, the Turbine Building sump will not reach a level high enough to initiate a control room alarm. While water is flowing through the floor drains it will also be leaking under door 1 to the pipe tunnel that leads to the Screenhouse. Once the seiche hump is overcome in the pipe tunnel, water leaking under the door will flow to the Screenhouse sump. When the water level inside TU-92 reaches a critical height, both doors are expected to fail allowing water to freely propagate to zone TU-94 and the pipe tunnel leading to the Screenhouse.

The Turbine Building Sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps

continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

The Screenhouse sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Screenhouse sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump.

If a high-high water level is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached.

The Screenhouse sump contains Level Switch LA-16669 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached [SYSTEM01].

The operator's first indication of a pipe break inside TU-92 will be the high Screenhouse sump level alarm in the control room once the water level inside TU-92 rises high enough to fail door 1 which will allow water to flow freely to the Screenhouse. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-92 can result in both equipment spray and submergence. For spray events TU-92 becomes a flood area by itself since only equipment in TU-92 is susceptible to damage from direct spray originating in zone TU-92. For submergence events, zone TU-92 combines with zone TU-94 and the pipe tunnel leading to the Screenhouse due to leakage under the doors.

Zone TU-92 is a relatively small room such that any water from a pipe break is expected to spray all the equipment in zone TU-92.

For a pipe break in zone TU-92, equipment in the zone zones TU-92, TU-94, and the pipe tunnel leading to the Screenhouse can be vulnerable and could be at risk.

TU-94

Description - Flood Zone TU-94 is the CO2 Storage Tank Room 1B on the 586'-0" elevation. The zone is bounded on the north by zone TU-95A, on the south by zone TU-22-1, on the east by zones TU-90 and TU-92, and on the west by zone TU-22-1. Zone TU-22-1 lies above and exterior soil lies below.

All penetrations in zone TU-94 are sealed. The north wall has a normally-closed access door (5) leading to zone TU-95A, the south wall has a normally-closed access door (401) leading to zone TU-22-1, and the east wall has a normally-closed access door (3) leading to zone TU-92.

The major PRA equipment in zone TU-94 includes Station and Instrument Air Compressor 1A. The Internal Flood Walkdown Form for zone TU-94 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping and fire protection piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a floor drain in a trench that is sealed at the boundary of zone TU-90.

Analysis – Water from a pipe break in TU-94 will not easily propagate elsewhere since all the penetrations are sealed. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-94. Equipment damage from spray sources in TU-94 is limited to the equipment residing in that zone.

Zone TU-94 is equipped with three normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 3 (double door with a 1/64" gap) opens outwardly to zone TU-92, door 5 (double door with 1/64" gap) opens inwardly from zone TU-95A, and door 401 (double door with 7/8" gap) opens outwardly to zone TU-22-1. Initially water would simply leak under doors 3 and 5 to flood areas TU-92 and TU-95A, respectively. Water will also flow to the Turbine Building sump via the floor drains. When the water level inside TU-94 reaches a critical height, doors 3 and 401 are expected to fail allowing water to freely propagate to zones TU-92 and TU-22-1, respectively.

The first indication of such a break would be a Turbine Building sump high level alarm in the control room if the flow via the floor drain is sufficiently high to fill the sump. The procedure for abnormal operation of the miscellaneous drains and sumps instructs the operator to dispatch someone to investigate the source of the alarm, regardless of which sump fills first. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-94 can result in both equipment spray and submergence.

For spray events TU-94 becomes a flood area by itself since only equipment in TU-94 is susceptible to damage from direct spray originating in zone TU-94. For submergence events, zone TU-94 combines with zones TU-22-1, TU-95A, and TU-92 due to leakage under the associated doors.

Zone TU-94 is a relatively small room such that any water from a pipe break is expected to spray all the equipment in zone TU-94.

For a pipe break in zone TU-94, equipment in the zone zones TU-94, TU-22-1 and TU-95A can be vulnerable and could be at risk.

TU-95A

Description - Flood Zone TU-95A is the 480 V Switchgear Bus 1-51 and 1-52 Room on the 586'-0" elevation. The zone is bounded on the north by an exterior wall and the Technical Support Center, on the south by zones TU-22-1 and TU-94, on the east by zone TU-90, and on the west by zone TU-95B-1. Zone TU-22-1 lies above and exterior soil lies below.

All penetrations in zone TU-95A are sealed. The south wall has normally-closed access doors (5, 263 and 268) leading to zones TU-94 and TU-95B-1 and the east wall has a normally closed door (136) leading to zone TU-90.

The major PRA equipment in zone TU-95A includes Station and Instrument Air Compressor 1C, and 480 V Switchgear Buses 51 and 52. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-95A contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping and fire protection piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a trench that communicates with zone TU-90 and contains a floor drain leading to the Turbine Building sump.

Analysis – Water from a pipe break in TU-95A will easily propagate to zone TU-90 via an open 4-inch pipe under door 136. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-95A. Equipment damage from spray sources in TU-95A is limited to the equipment residing in that zone.

Zone TU-95A is equipped with three normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 5 (double door with 1/64" gap) opens outwardly to zone TU-94, door 136 (double door with 1/8" gap) opens outwardly to zone TU-90, door 263 (double door with 3/16" gap) opens outwardly to zone

TU-95B-1, and door 268 (single door) opens outwardly to zone TU-95B-1. Additionally, a firewall constructed of gypsum board separates TU-95A and TU-95B-1. Initially water would simply leak under doors to the various adjoining zones and flow to the Turbine Building sump via the floor drains. When the water level inside TU-95A reaches a critical height, the firewall is expected to fail structurally allowing water to freely propagate to zones TU-95B-1.

The first indication of such a break would likely be from investigation of failed equipment since free flow to either the Screenhouse sump or the Turbine Building sump does not occur until water level accumulates to several feet and doors and gypsum wall begin to fail.

Summary – Pipe breaks in zone TU-95A can result in both equipment spray and submergence. For spray events TU-95A becomes a flood area by itself since only equipment in TU-95A is susceptible to damage from direct spray originating in zone TU-95A. For submergence events, zone TU-95A combines with zones TU-90, TU-94, and TU-95B-1 due to leakage under the associated doors and an open pipe that allows communication between TU-95A and TU-90.

Zone TU-95A is a relatively small room such that any water from a pipe break is expected to spray all the equipment in zone TU-95A.

For a pipe break in zone TU-95A, equipment in zones TU-94, TU-95B-1, TU-90, and TU-95A can be vulnerable and could be at risk.

TU-95B-1

Description - Flood Zone TU-95B-1 consists of the 480 V Switchgear Bus 61 and 62 Room and the Auxiliary Feedwater Pump 1B Room on the 586'-0" elevation. These two rooms are connected via an open trench such that any water in one room will travel freely to the other, thus they are combined to form a single flood area for submergence issues. The zone is bounded on the north by the Technical Support Center, on the south by zone TU-22-1, on the east by zones TU-95A, TU-95B-2, and TU-95C, and on the west by zone AX-23B-1. Zone TU-22-1 lies above and exterior soil lies below.

All penetrations in zone TU-95B-1 are sealed. The south wall has normally-closed access doors (4 and 6) leading to zone TU-22-1, the north wall has normally-closed access doors (268, 263, 262, and 261) leading to zones TU-95A and TU-95C, the west wall has a normally-closed access door (244) leading to zone TU-95B-2 and a normally-closed access door (8) leading to the Auxiliary Building, and the east wall has a normally-closed door (243) leading to zone TU-95B-2.

The major PRA equipment in zone TU-95B-1 includes Station and Instrument Air Compressor 1B, Motor Driven Auxiliary Feedwater Pump B, and 480 V Switchgear Buses 1-61 and 1-62. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-95B-1 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping, CST piping, main steam piping, and fire protection piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a trench that is sealed at the boundary of zone TU-95A and zone TU-95B-1. The trench contains a floor drain leading to the Turbine Building sump.

Analysis – Water from a pipe break in TU-95B-1 will not easily propagate elsewhere since all the penetrations are sealed. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-95B-1. Equipment damage from spray sources in TU-95B-1 is limited to the equipment residing in that zone unless it is a prolonged spray. A prolonged spray (greater than 90 minutes) in the western half of the area would probably degrade the gypsum board that comprises area TU-95C to the point that the auxiliary feedwater components housed inside TU-95C would be damaged.

Zone TU-95B-1 is equipped with seven normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 4 (double door with a 1/8" gap) opens outwardly to zone TU-22-1, door 6 (double door with 1/4" gap) opens outwardly to zone TU-22-1, door 243 (single door with 1/32" gap) opens outwardly to TU-95B-2, door 244 (single door with 1/32" gap) opens outwardly to TU-95B-2, door 261 (single door with 3/16" gap) opens inwardly from TU-95C, door 262 (double door with 3/16" gap) opens inwardly from TU-95C, door 263 (double door with 3/16" gap) opens inwardly from zone TU-95A, and door 268 (single door) opens inwardly from zone TU-95A. Initially water would simply leak under doors to flood areas TU-95A, TU-95B-2, and TU-95C as well as flow to the Turbine Building sump via the floor drains. When the water level inside TU-95B-1 reaches a critical height, doors and gypsum walls are expected to fail allowing water to freely propagate to adjoining areas. As doors fail water will propagate to TU-22-1 where it will fill the Turbine Building sump.

The Turbine Building Sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

The first indication of such a break would be a Turbine Building sump high level alarm in the control room. The procedure for abnormal operation of the miscellaneous drains and sumps instructs the operator to dispatch someone to investigate the source of the alarm. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-95B-1 can result in both equipment spray and submergence. For spray events TU-95B-1 becomes a flood area by itself since only equipment in TU-95B-1 is susceptible to damage from direct spray originating in zone TU-95B-1. For submergence events, zone TU-95B-1 combines with zones TU-22-1, TU-95B-2, TU-95C, and TU-95A due to leakage under the associated doors.

Zone TU-95B-1 is separated into two distinct sections by zone TU-95B-2. Each of these sections is a relatively small area such that any water from a pipe break is expected to spray all the equipment in that area of zone TU-95B-1.

For a pipe break in zone TU-95B-1, equipment in zones TU-95B-1, TU-22-1, TU-95B-2, TU-95C, and TU-95A can be vulnerable and could be at risk.

TU-95B-2

Description - Flood Zone TU-95B-2 is the Turbine Driven Auxiliary Feedwater Pump Room on the 586'-0" elevation. The zone is bounded on the north by an exterior wall and the Technical Support Center, on the south by zone TU-22-1, on the east by zones TU-95B-1 and TU-95C, and on the west by zone TU-95B-1. Zone TU-95B-2 makes use of a false ceiling for HELB purposes and Zone TU-95B-1 actually lies above. Exterior soil lies below.

All penetrations in zone TU-95B-2 are sealed. The east wall has a normally closed access door (244) leading to zone TU-95B-1 and the west wall has a normally closed door (243) leading to zone TU-95B-1. The south wall has a normally closed blowout panel that opens to zone TU-22-1.

The major PRA equipment in zone TU-95B-2 includes the Turbine Driven Auxiliary Feedwater Pump. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-95B-2 contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping, CST piping, and main steam piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a covered trench that communicates with zone TU-95B-1. A floor drain approximately 4 inches above the ground also communicates with this trench.

Analysis – Water from a pipe break in TU-95B-2 will not easily propagate elsewhere since all the penetrations are sealed. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-95B-2. Equipment damage from spray sources in TU-95B-2 is limited to the equipment residing in that zone.

Zone TU-95B-2 is equipped with two normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 243 (single door with 1/32" gap) opens inwardly from TU-95B-1 and door 244 (single door with 1/32" gap) opens inwardly from TU-95B-1. Initially water would simply leak under doors to the various adjoining zones and flow to the Turbine Building sump via the floor drains. When the water level inside TU-95B-2 reaches a critical height, one of two things will occur. Either the blowout panel will fail allowing water to propagate to TU-22-1 and subsequently to the Turbine Building sump or both doors will fail allowing water to freely propagate to zone TU-95B-1. When the water level inside TU-95B-1 reaches a critical height, doors are expected to fail allowing water to freely propagate to TU-22-1 where it will fill the Turbine Building sump. In either case water will reach the Turbine Building sump.

The Turbine Building Sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

The first indication of such a break would be a Turbine Building sump high level alarm in the control room. The procedure for abnormal operation of the miscellaneous drains and sumps instructs the operator to dispatch someone to investigate the source of the alarm. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-95B-2 can result in both equipment spray and submergence. For spray events TU-95B-2 becomes a flood area by itself since only equipment in TU-95B-2 is susceptible to damage from direct spray originating in zone TU-95B-2. For submergence events, zone TU-95B-2 combines with zone TU-95B-1 due to door leakage.

Zone TU-95B-2 is a relatively small room such that any water from a pipe break is expected to

spray all the equipment in zone TU-95B-2.

For a pipe break in zone TU-95B-2, equipment in zones TU-95B-1 and TU-95B-2 can be vulnerable and could be at risk.

TU-95C

Description - Flood Zone TU-95C is the Motor Driven Auxiliary Feedwater Pump 1A Room on the 586'-0" elevation. The zone is bounded on the north by the Technical Support Center, on the south by zone TU-95B-1, on the east by zone TU-95B-2, and on the west by zone TU-95B-1. Zone TU-22-1 lies above and exterior soil lies below.

All penetrations in zone TU-95C are sealed. The south wall has normally-closed access doors (261 and 262) leading to zone TU-95B-1. The south and west walls are constructed of simple drywall and are expected to initially survive a spray event, but prolonged exposure to water will result in failure of the walls.

The major PRA equipment in zone TU-95C includes Motor Driven Auxiliary Feedwater Pump 1A. The Internal Flood Walkdown Form [Appendix C of FLOOD01] for zone TU-95C contains a complete listing of the flood-susceptible PRA equipment in this zone.

Potential flood sources in this zone include service water piping, CST piping, and main steam piping which represent both a flooding hazard and a spray hazard.

Flood mitigation is present in this zone in the form of a floor drain approximately 4 inches above the ground that communicates with the trench in zone TU-95B-1.

Analysis – Water from a pipe break in TU-95C will not initially propagate elsewhere since all the penetrations are sealed. Floor drains will divert water to the Turbine Building sump. Thus, only significant pipe breaks are a concern for accumulation in zone TU-95C. Equipment damage from spray sources in TU-95C is initially limited to the equipment residing in that zone.

However, a sustained pipe break could eventually spray equipment in the western half of TU-95B-1 since the west and south walls of TU-95C are constructed of gypsum that is not expected to survive a sustained spray of water.

Zone TU-95C is equipped with two normally closed doors that initially prevent lateral propagation of water from pipe breaks beyond the capacity of the floor drains. Door 261 (single door with 3/16" gap) opens outwardly to TU-95B-1 and door 262 (double door with 3/16" gap) opens outwardly to TU-95B-1. Initially water would simply leak under doors to the various adjoining zones and flow to the Turbine Building sump via the floor drains. However, since the west and south walls of TU-95C are constructed of drywall, any sustained exposure to water is expected to result in failure of walls and open communication with TU-95B-1. Regardless of the

failure mechanism, water will propagate to TU-95B-1.

When the water level inside TU-95B-1 reaches a critical height, doors are expected to fail allowing water to freely propagate to TU-22-1 where it will fill the Turbine Building sump.

The Turbine Building Sump contains two pumps with design capacities of < 100 gpm each. The level switch for the Turbine Building sump pump control is a mechanically alternating device. A high water level (30") starts one pump. A return to low level (12") stops the pump. A subsequent high level starts the alternate pump. [SYSTEM01]

If a high-high water level (34.5") is reached, the level switch starts the second pump. Both pumps continue to run until an intermediate level cutoff point, 19", is reached. At this point, the level switch turns off the leading (first) pump. The lagging (second) pump continues to run until the low-level setpoint, 12", is reached. [SYSTEM01]

The Turbine Building sump contains Level Switch LA-16666 that actuates Control Room Alarm 47033P when a high-high-high water level setpoint, 34½", is reached. [SYSTEM01]

The first indication of such a break would be a Turbine Building sump high level alarm in the control room. The procedure for abnormal operation of the miscellaneous drains and sumps instructs the operator to dispatch someone to investigate the source of the alarm. The only other possible indication of a pipe break would be equipment failure that forces an operator to investigate locally.

Summary – Pipe breaks in zone TU-95C can result in both equipment spray and submergence. For spray events TU-95C combines with TU-95B-1 to become a flood area since the drywall construction of the TU-95C walls cannot withstand sustained exposure to water spray. For submergence events, zone TU-95C combines with TU-95B-1 to become a flood area due to door leakage and eventual door failure or gypsum wall failure.

Zone TU-95C is a relatively small room such that any water from a pipe break is expected to spray all the equipment in zones TU-95C and TU-95B-1.

For a pipe break in zone TU-95C, equipment in zones TU-95C and TU-95B-1 can be vulnerable and could be at risk.

4.0 REFERENCES

[DWG01] Drawings

a. A-203 Rev. AW, General Arrangement Turbine and Administration Building Basement Floor

b. A-204 Rev. BC, General Arrangement Reactor and Auxiliary Building Basement Floor

c. A-205 Rev. AM, General Arrangement Turbine and Administration Building Mezzanine Floor

d. A-206 Rev. BS, General Arrangement Reactor and Auxiliary Building Mezzanine Floor

e. A-207 Rev. U, General Arrangement Turbine and Administration Building Operating Floor

f. A-208 Rev. BL, General Arrangement Reactor and Auxiliary Building

g. A-209 Rev. Y, General Arrangement Reactor and Auxiliary Building Miscellaneous Floor Plans

h. A-212 Rev. Y, General Arrangement Miscellaneous Plans and Sections

i. A-213 Rev. Y, General Arrangement Screenhouse and Circulating Water Discharge

[CALC01] "Evaluation of Various Doors and Walls for HELB Flooding – Turbine Building Basement," Revision 1, Scientel Wireless, LLC.

[CALC02] Attachment "KNPP Design Input Document.pdf" to email from Ling Yu Song (MPR) to Dale Franson (NMC) and Paul Miller (NMC), April 8, 2005.

[FLOOD01] Kewaunee Nuclear Plant Internal Flooding Analysis – Qualitative Screening Assessment and Flood Frequency Development, SCIENTECH, LLC.

[GUIDE01] Dominion Probabilistic Risk Assessment Manual, Part II, Chapter G, Section 2, *Flood Area Definition*, Revision 0.

[GUIDE02] Dominion Probabilistic Risk Assessment Manual, Part II, Chapter G, Section 4, *Accident Sequence Analysis*, Revision 0.

[NOTEBOOK01] KPS Internal Flooding Accident Sequence Analysis Notebook, Rev. 0

[PROC01] KNPP Operating Procedure A-MDS-30, Rev. P, "Miscellaneous Drains and Sumps (MDS) Abnormal Operation"

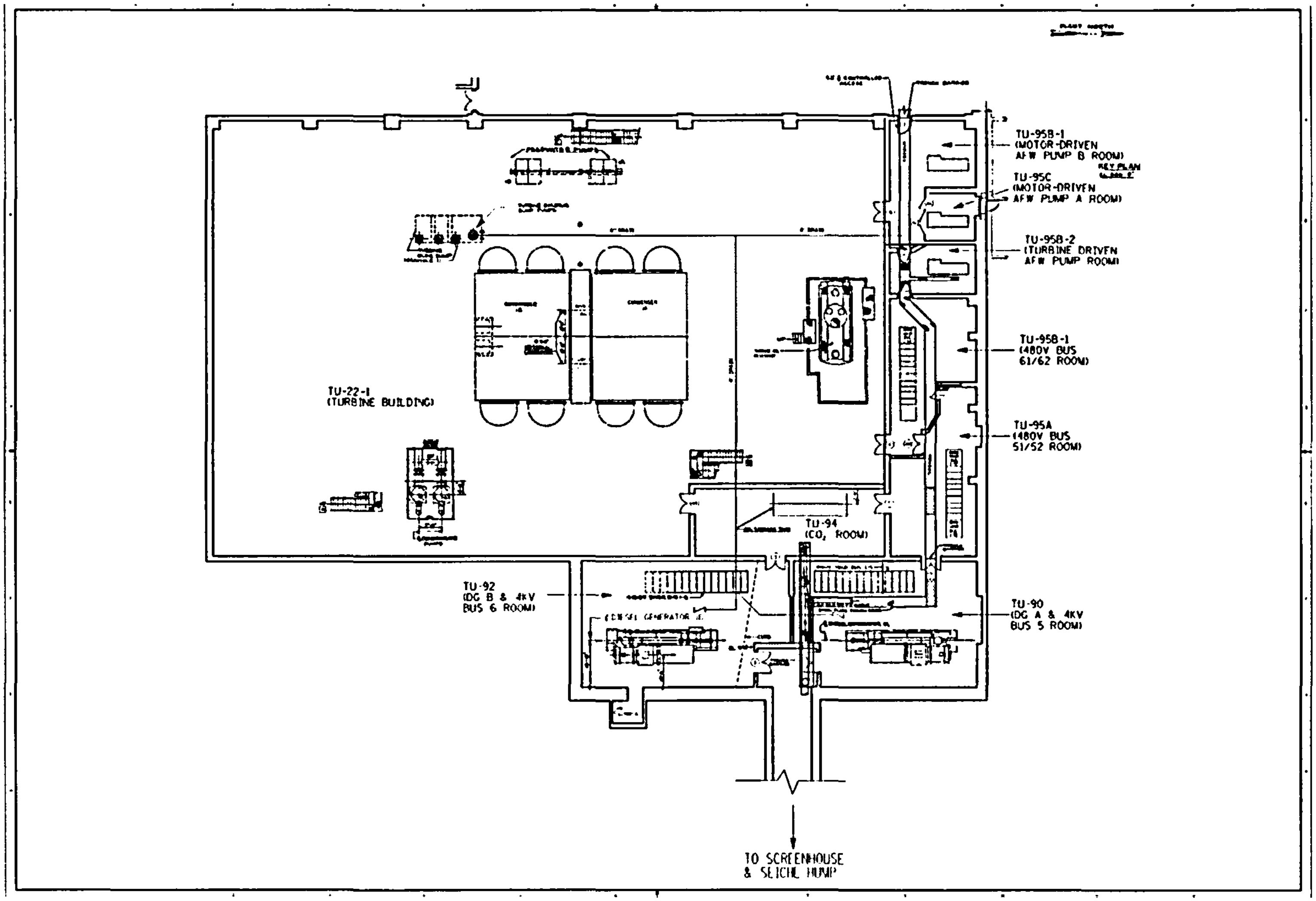
[STANDARD01] ASME RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," 2002

[SYSTEM01] KPS System Description 30, Rev. 2, "Miscellaneous Drains and Sumps (MDS)"

Table 1 – Flood Area Descriptions

Flood Zone	Room Number	Room Description
TU-22-1	6B	Turbine Building - (Condenser) Basement Floor
	120	Turbine Building - Mezzanine Floor
	121	Turbine Building - Mezzanine Floor
	122	Turbine Building - Mezzanine Floor
	123	Turbine Building - Mezzanine Floor
	124	Turbine Building - Mezzanine Floor
	125	Turbine Building - Mezzanine Floor
	126	Turbine Building - Mezzanine Floor
	127	Turbine Building - Mezzanine Floor
	128	Turbine Building - Mezzanine Floor
	220A	Turbine Building - Operating Floor
	10B	Elevator B Machine Room
	11B	Corridor and Ramps
	17B	Waste Tank Area
	144	Welding Shop
	147	Corridor
	149	Main Shop and Corridor (147)
	150	Working Material Storage Area
	154	Shop Office
	155	Electric Shop
	234	Cation, Brine, and Mixed Beds - Water Treatment Area
	234A	SG Boric Acid Area
TU-90	2B	Diesel Generator A Room
	25B	Diesel Generator A Fuel Oil Day Tank Room
TU-92	3B	Diesel Generator B Room
	24B	Diesel Generator B Fuel Oil Day Tank Room
TU-94	4B	CO_2 Storage Room
TU-95A	5B	480V Swgr Bus 1-51 and 1-52 Room
TU-95B-1	5B-1	480V Swgr Bus 1-61 and 1-62 Room
	5B-3	Aux FW Pump B Room
TU-95B-2	5B-4	Turbine Driven Aux FW Pump Room
TU-95C	5B-2	Aux FW Pump A Room

Figure 1 – Turbine Building Basement/Safeguards Alley Arrangement



Appendix C

Fault Tree Analysis

Fault Tree Analysis

Owner's Acceptance: Thomas G Hook (Signature) THOMAS G. HOOK (Print Name)

10-30-05 (Date)

Kewaunee Power Station

Fault Tree Analysis for Turbine Building Floods

Effective Date: October 2005

Prepared By: J. R. Sharpe — Date: 10/28/05

Reviewed By: D. Jones — Date: 10/29/05

INTERNAL FLOODING – Fault Tree Analysis for Turbine Building Floods

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INTERNAL FLOODING – **Fault Tree Analysis for Turbine Building Floods**

1.0 PURPOSE

The purpose of this notebook is to document the WinNUPRA model that was developed to analyze flooding scenarios originating from pipe breaks in the Turbine Building before February 2005.

The following information is identified, correlated, and developed as part of this analysis:

- Fault trees developed to support event tree analysis
- Basic event data used to support the flooding model
- Human error probabilities (HEPs) used to support the flooding model

2.0 MODEL SCOPE

This notebook documents the models that were developed for evaluating internal flooding sequences due to pipe breaks in the Turbine Building before February 2005.

3.0 UNIT DIFFERENCES

Kewaunee Power Station is a single unit site so there are no unit differences.

4.0 RISK MONITOR CONSIDERATIONS

The risk monitor used at KPS is the Safety Monitor. The Safety Monitor was not modified to reflect this analysis.

5.0 MODEL DEVELOPMENT

5.1 FAULT TREES

The existing system fault trees for the KPS internal events PRA [NB01] comprise the majority of the Turbine Building Flood model. Two new fault trees were developed to support this analysis; AFM.LGC and FLOODING.LGC are described below in Sections 5.1.1 and 5.1.2. Fault tree AFM.LGC contains the logic associated with Auxiliary Feedwater (AFW) failures and fault tree FLOODING.LGC was developed to accommodate new initiating events and new human actions specifically related to Turbine Building flooding. Of the existing fault trees from the internal events PRA, only those for DC power were modified, as described in Section 5.1.3.

The human error probabilities (HEPs) used in the analysis are documented in Attachment 1. The bases for the HEPs from a review of procedures (e.g., cues) and training materials is provided in Attachment 2. A summary of a simulator exercise performed to determine timing for operator

actions in the feedwater line break scenario with actuation of all the fire sprinklers in the turbine building is provided in Attachment 3.

5.1.1 Fault Tree AFM

Fault Tree AFM is presented as Figure 1. This fault tree contains the logic associated with failure of the Turbine Driven AFW pump and Motor Driven AFW Pump B (MDAFP B) to deliver flow to the steam generators. The logic in AFM is simply copied from Fault Tree AFW in the Internal Events PRA [NB01] and rearranged for use in this flooding analysis. No new analysis was performed in the development of fault tree AFM. Top Event AFS (as defined in the Accident Sequence Analysis, Appendix D) uses gate GAFM302 to model the failure of MDAFP B to start. Top Event AFR uses gate GAFM700 to model the failure of MDAFP B to run and provide flow to Steam Generator B. Top Event AFT uses gate GAFM1002 to model the failure of the TDAFP to start and run.

5.1.2 Fault Tree FLOODING

Fault Tree FLOODING is presented as Figure 2. This fault tree contains the logic used to model the initiating events used for Turbine Building floods and the HEPs associated with the isolation of pipe breaks and the operation of mitigating equipment. In some cases the hardware failure basic events are also included.

5.1.3 DC Power Fault Tree Modifications

The DC power fault trees were modified to include basic event 16-BATCLG--F-HE, which represents operator action to establish battery room cooling. This event applies to flooding scenarios where the 480 V buses have failed, thereby causing failure of normal battery room cooling. After the Battery Room A/B Exhaust Flow Low annunciator activates in the control room, the operator is directed to use the fire equipment to ventilate the Battery Rooms. The air trunks and fans are then rigged to supply battery room cooling.

Figure 3 shows the placement of new event 16-BATCLG--F-HE in fault tree BRA104, at grid location "2-3". The same event is similarly placed in the following DC power fault trees:

BRA104B	BRB104	BRB127
BRA104T	BRB104B	BRC103
BRA105	BRB104T	BRC103T
BRA105T	BRB105	BRD103
BRA113	BRB105T	BRD103T
BRA127	BRB114	BRD115

5.2 HUMAN ERROR PROBABILITIES

Human error probabilities (HEPs) were developed using the same methodology used in the existing PRA [NB02]. This section briefly describes each HEP developed as part of the analysis of Turbine Building floods. The detailed analyses of these HEPs are documented as attachments to this report. Table 1 lists all of the new human actions and their values that were developed in support of the flooding analysis.

5.2.1 04-CW-TRIP-F-HE – Detection and Isolation of a 58,000 gpm Circulating Water Break before Failing Both 480 V Buses

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Circulating Water break in the Turbine Building. This basic event represents the failure of the operator to trip the Circulating Water pumps in time to prevent the eventual failure of the 480 V buses.

A large rupture of an inlet condenser expansion joint in the Turbine Building (TU-22-1) could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Areas TU-95A and TU-95B-1 contain the train A and B 480 VAC buses which could be failed due to propagation of a break in TU-22-1.

Indication of this type of break would be provided by a reactor trip due to low condenser vacuum and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 3 minutes to prevent eventual loss of the 480 VAC buses in Safeguards Alley.

Thus, 3 minutes would be available to trip the Circulating Water pumps following an expansion joint rupture to prevent the eventual failure of the 480 V buses. Based on simulator observations and operator interviews at least 8 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 04-CW-TRIP-F-HE and the human error probability (HEP) is 1.0 since sufficient time does not exist to perform the isolation.

5.2.2 04-CWSTP13-F-HE – Detection and Isolation of a 14,000 gpm Circulating Water Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Moderate Circulating Water break in the Turbine Building. This basic event represents the failure of the operator to trip the Circulating Water pumps in time to prevent the eventual failure of 4 kVAC Bus 5.

A rupture of an outlet condenser expansion joint in the Turbine Building (TU-22-1) could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1.

Indication of this type of break would be provided by a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 13 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 13 minutes would be available to trip the Circulating Water pumps following an outlet expansion joint rupture to prevent the eventual failure of 4 kV Bus 5. Based on simulator observations and operator interviews at least 8 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 04-CWSTP13-F-HE and the human error probability (HEP) is 2.6E-01.

5.2.3 04-CWSTP19-F-HE – Detection and Isolation of a 14,000 Circulating Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Moderate Circulating Water break in the Turbine Building. This basic event represents the failure of the operator to trip the Circulating Water pumps in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.2 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 19 minutes to prevent eventual loss of the ability to start the TDAFP.

Based on simulator observations and operator interviews at least 8 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 04-CWSTP19-F-HE and the human error probability (HEP) is 1.2E-01.

5.2.4 04-CWSTP22-F-HE – Detection and Isolation of a 14,000 Circulating Water Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Moderate Circulating Water break in the Turbine Building. This basic event represents the failure of the operator to trip the Circulating Water pumps in time to prevent the eventual failure of 4 kV Bus 6.

This event is identical to the one described in section 5.2.2 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 22 minutes to prevent eventual failure of 4 kVAC Bus 6.

Based on simulator observations and operator interviews at least 8 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 04-CWSTP22-F-HE and the human error probability (HEP) is 1.2E-01.

5.2.5 04-CWSTP25-F-HE – Detection and Isolation of a 14,000 Circulating Water Break before Water Level Reaches 18 Inches in the Turbine Building

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Moderate Circulating Water break in the Turbine Building. This basic event represents the failure of the operator to trip the Circulating Water pumps in time to prevent the water level from reaching 18 inches in the Turbine Building.

This event is identical to the one described in section 5.2.2 except that the result of interest is 18 inches of water in the Turbine Building. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 25 minutes to prevent 18 inches of water in the Turbine Building.

Based on simulator observations and operator interviews at least 9 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 04-CWSTP25-F-HE and the human error probability (HEP) is 1.2E-01.

5.2.6 02-SW4A-B29F-HE – Detection and Isolation of a Service Water Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Service Water break in the Turbine Building. This basic event represents the failure of the operator to close MOVs SW-4A and SW-4B in time to prevent the eventual failure of 4 kVAC Bus 5.

A large Service Water pipe break in the Turbine Building (TU-22-1) could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1.

Indication of this type of break would be provided by a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 29 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 29 minutes would be available to close MOV SW-4A or SW-4B (only one will be open normally) following a Service Water pipe break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews about 13 minutes are required to diagnose the cause of the high sump level alarm, decide the course of action, and execute the isolation. The basic event ID for this HEP is 02-SW4A-B29F-HE and the human error probability (HEP) is 2.0E-02.

5.2.7 02-SW4A-B45F-HE – Detection and Isolation of a Service Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Service Water break in the Turbine Building. This basic event represents the failure of the operator to close MOVs SW-4A and SW-4B in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.6 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 45 minutes to prevent eventual loss of the ability to start the TDAFP.

Based on simulator observations and operator interviews about 13 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 02-SW4A-B45F-HE and the human error probability (HEP) is 2.0E-02.

5.2.8 02-SW4A-B51F-HE – Detection and Isolation of a Large Service Water Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Service Water break in the Turbine Building. This basic event represents the failure of the operator to close MOVs SW-4A and SW-4B in time to prevent the eventual failure of 4 kVAC Bus 6.

This event is identical to the one described in section 5.2.6 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 51 minutes to prevent eventual failure of 4 kV Bus 6.

Based on simulator observations and operator interviews at least 13 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 02-SW4A-B51F-HE and the human error probability (HEP) is 2.0E-02.

5.2.9 02-SW4A-B66F-HE – Detection and Isolation of a Large Service Water Break before Water Level Reaches 18 Inches in the Turbine Building

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Service Water break in the Turbine Building. This basic event represents the failure of the operator to close MOVs SW-4A and SW-4B in time to prevent the water level from reaching 18 inches in the Turbine Building.

This event is identical to the one described in section 5.2.6 except that the result of interest is 18 inches of water in the Turbine Building. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 66 minutes to prevent 18 inches of water in the Turbine Building.

Based on simulator observations and operator interviews at least 13 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 02-SW4A-B66F-HE and the human error probability (HEP) is 2.0E-02.

5.2.10 08-FPISO29-F-HE – Detection and Isolation of a Fire Protection Water Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Fire Protection Water break in the Turbine Building. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump or by securing the power to the pumps in time to prevent the eventual failure of 4 kVAC Bus 5.

A large Fire Protection Water pipe break in the Turbine Building (TU-22-1) could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1.

Indication of this type of break would be provided by the Fire Pump Abnormal alarm in the control room and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 29 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 29 minutes would be available to close the Fire pump discharge manual valves or isolate power to the Fire pumps following a Fire Protection Water pipe break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews about 30 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPISO29-F-HE and the human error probability (HEP) is 1.0.

5.2.11 08-FPISO45-F-HE – Detection and Isolation of a Fire Protection Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Fire Protection Water break in the Turbine Building. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump or by securing the power to the pumps in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.10 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 45 minutes to prevent eventual loss of the ability to start the TDAFP.

Based on simulator observations and operator interviews about 30 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPISO45-F-HE and the human error probability (HEP) is 6.6e-02.

5.2.12 08-FPISO56-F-HE – Detection and Isolation of a Fire Protection Water Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Large Fire Protection Water break in the Turbine Building. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump or by securing the power to the pumps in time to prevent the eventual failure of 4 kV Bus 6.

This event is identical to the one described in section 5.2.10 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 56 minutes to prevent eventual failure of 4 kV Bus 6.

Based on simulator observations and operator interviews nearly 30 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPISO56-F-HE and the human error probability (HEP) is 2.4E-02.

5.2.13 08-ISO-FS18F-HE – Detection and Isolation of a Large Flood due to a Feedwater Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a large Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kVAC Bus 5.

A Feedwater pipe break in the Turbine Building (TU-22-1) would set off multiple fire sprinklers in addition to pumping the hotwell inventory into the Turbine Building. This water could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1. This event analyzes a Feedwater pipe break resulting in a 6000 gpm discharge of the Fire Protection system.

Indication of this type of break would be provided by the Fire Pump Abnormal alarm in the control room and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 18 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 18 minutes would be available to isolate the sprinklers following a Feedwater pipe break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS18F-HE and the human error probability (HEP) is 1.0 since sufficient time does not exist to isolate flow from the Fire pumps.

5.2.14 08-ISO-FS33F-HE – Detection and Isolation of a Large Flood due to a Feedwater Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a large Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.13 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 33 minutes to prevent eventual failure of the ability to start the TDAFP.

Thus, 33 minutes would be available to isolate the sprinkler flow following a Feedwater pipe break to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump. Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS33F-HE and the human error probability (HEP) is 2.2E-01.

5.2.15 08-ISO-FS40F-HE – Detection and Isolation of a Large Flood due to a Feedwater Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a large Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4

kV Bus 6.

This event is identical to the one described in section 5.2.13 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 40 minutes to prevent eventual failure of 4 kV Bus 6.

Thus, 40 minutes would be available to isolate the sprinkler flow following a Feedwater pipe break to prevent eventual failure of 4 kVAC Bus 6. Based on simulator observations and operator interviews at least 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS40F-HE and the human error probability (HEP) is 6.7E-02.

5.2.16 08-ISO-FS55F-HE – Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a moderate Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kVAC Bus 5.

A Feedwater pipe break in the Turbine Building (TU-22-1) would set off multiple fire sprinklers in addition to pumping the hotwell inventory into the Turbine Building. This water could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1. This event analyzes a Feedwater pipe break resulting in a 2000-gpm discharge of the Fire Protection system.

Indication of this type of break would be provided by the Fire Pump Abnormal alarm in the control room and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 55 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 55 minutes would be available to isolate the sprinkler flow following a Feedwater pipe

break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS55F-HE and the human error probability (HEP) is 3.0E-02.

5.2.17 08-ISO-FS97F-HE – Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a moderate Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.16 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 97 minutes to prevent eventual failure of the ability to start the TDAFP.

Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS97F-HE and the human error probability (HEP) is 3.0E-02.

5.2.18 08-ISO-FS2HF-HE – Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Feedwater break resulting in a moderate Fire Protection System discharge in the Turbine Building. A Feedwater line break in the Turbine Building will spill the contents of the hotwell onto the Turbine Building floor and result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kV Bus 6.

This event is identical to the one described in section 5.2.16 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within approximately 2 hours to prevent eventual failure of 4 kV Bus 6.

Based on simulator observations and operator interviews at least 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-ISO-FS2HF-HE and the human error probability (HEP) is 1.7E-02.

5.2.19 08-FPSISO29F-HE – Detection and Isolation of a Large Flood due to a Steamline Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Steamline break resulting in a large Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kVAC Bus 5.

A Steamline pipe break in the Turbine Building (TU-22-1) would set off multiple fire sprinklers in the Turbine Building. This water could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1. This event analyzes a Steamline break resulting in a 6000 gpm discharge of the Fire Protection system.

Indication of this type of break would be provided by the Fire Pump Abnormal alarm in the control room and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 29 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 29 minutes would be available to isolate the sprinkler flow following a Steamline pipe break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews, diagnosing that the fire alarms are being caused by a steamline break and not a fire and then isolating the sprinkler flow will require about 28 minutes. The basic event ID for this HEP is 08-FPSISO29F-HE and the human error probability (HEP) is 4.5E-01.

5.2.20 08-FPSISO45F-HE – Detection and Isolation of a Large Flood due to a Steamline Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Steamline break resulting in a large Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.19 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 45 minutes to prevent eventual failure of the ability to start the TDAFP.

Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPSISO45F-HE and the human error probability (HEP) is 3.9E-02.

5.2.21 08-FPSISO56F-HE – Detection and Isolation of a Large Flood due to a Steamline Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Steamline break resulting in a large Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kV Bus 6.

This event is identical to the one described in section 5.2.19 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 56 minutes to prevent eventual failure of 4 kV Bus 6.

Based on simulator observations and operator interviews at least 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPSISO56F-HE and the human error probability (HEP) is 3.0E-02.

5.2.22 08-FPSISO1CF-HE – Detection and Isolation of a Medium Flood due to a Steamline Break before Failing 4 kVAC Bus 5

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a

Steamline break resulting in a moderate Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kVAC Bus 5.

A Steamline pipe break in the Turbine Building (TU-22-1) would set off multiple fire sprinklers in the Turbine Building. This water could propagate through the open drain lines and under doors to Safeguards Alley (TU-90, TU-92, TU-95A, TU-95B-1, TU-95B-2 and TU-95C). Area TU-90 contains kVAC Bus 5 which could be failed due to propagation of a break in TU-22-1. This event analyzes a Steamline break resulting in a 2000-gpm discharge of the Fire Protection system.

Indication of this type of break would be provided by the Fire Pump Abnormal alarm in the control room and a Miscellaneous Sump Level High alarm in the control room.

Propagation to Safeguards Alley will begin when the Turbine Building sump begins to fill since the open drain lines from Safeguards Alley directly communicate with this sump. Additionally, when water begins to accumulate on the floor water will begin to leak under doors 4, 6, and 401 into Safeguards Alley. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 100 minutes to prevent eventual loss of 4 kVAC Bus 5 in Safeguards Alley.

Thus, 100 minutes would be available to isolate the sprinkler flow following a Steamline pipe break to prevent eventual failure of 4 kVAC Bus 5. Based on simulator observations and operator interviews, diagnosing that the fire alarms are being caused by a steamline break and not a fire and then isolating the sprinkler flow will require about 28 minutes. The basic event ID for this HEP is 08-FPSISO1CF-HE and the human error probability (HEP) is 3.0E-02.

5.2.23 08-FPSISO2CF-HE – Detection and Isolation of a Medium Flood due to a Steamline Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Steamline break resulting in a moderate Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of the Turbine Driven AFW pump auxiliary lube oil pump.

This event is identical to the one described in section 5.2.22 except that the failure of interest is the Turbine Driven AFW pump auxiliary lube oil pump at 9 inches of water. Based on GOTHIC

analysis [CALC01] the operator must isolate the break within 150 minutes to prevent eventual failure of the ability to start the TDAFP.

Based on simulator observations and operator interviews about 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPSISO2CF-HE and the human error probability (HEP) is 3.0E-02.

5.2.24 08-FPSISO3CF-HE – Detection and Isolation of a Medium Flood due to a Steamline Break before Failing 4 kV Bus 6

The analysis of this HEP is documented in Attachment 1. This basic event applies only to a Steamline break resulting in a large Fire Protection System discharge in the Turbine Building. A Steamline break in the Turbine Building will result in an elevated building temperature that actuates multiple fire sprinklers. This basic event represents the failure of the operator to isolate flow from the Fire Pumps either by closing the manual discharge isolation valve on each pump, securing the power to the pumps, or closing the manual isolation valves for the sprinklers in time to prevent the eventual failure of 4 kV Bus 6.

This event is identical to the one described in section 5.2.22 except that the failure of interest is 4 kV Bus 6. Based on GOTHIC analysis [CALC01] the operator must isolate the break within 170 minutes to prevent eventual failure of 4 kV Bus 6.

Based on simulator observations and operator interviews at least 28 minutes is required to receive the initial signal, decide the course of action, and execute the isolation. The basic event ID for this HEP is 08-FPSISO3CF-HE and the human error probability (HEP) is 3.0E-02.

5.2.25 16-BATCLG--F-HE – Establish Battery Room Cooling

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where the 480 V buses have failed, thereby causing failure of normal battery room cooling. After the Battery Room A/B Exhaust Flow Low annunciator activates in the control room, the operator is directed to use the fire equipment to ventilate the Battery Rooms. The air trunks and fans are then rigged to supply battery room cooling.

The operator must execute the action within 180 minutes to prevent excessive Battery Room heatup. Based on simulator observations and operator interviews about 30 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 16-BATCLG--F-HE and the human error probability (HEP) is 7.9E-02.

5.2.26 27A-ORR----F-HE – Failure to Throttle SI Flow to Conserve RWST Inventory

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where secondary cooldown has failed and the remaining SI pump is available. If secondary cooldown fails, the flow rate through existing RCP Seal LOCA is expected to worsen. The operator would attempt to replace the lost RCS inventory using the available SI pump. Since high-pressure recirculation is unavailable due to the failure of the CCW pump power supplies, the operator must conserve the RWST inventory. This is done by manually throttling the SI pump discharge flow.

The operator must execute the action within 67 minutes to extend the time the RWST is available. Based on simulator observations and operator interviews about 58 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 27A-ORR----F-HE and the human error probability (HEP) is 5.0E-03.

5.2.27 05B-BYALOP-F-HE – Failure to Bypass AFW Auxiliary Lube Oil Pressure Interlock

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where the water level in the AFW pump area has risen to 9 inches and the operator needs to start an AFW pump. If the auxiliary lube oil pump is failed due to submergence, then the associated AFW pump will not start due to a lube oil pressure interlock. This basic event addresses the bypass of this interlock to allow starting of the AFW pump.

The operator must execute the action within approximately 4 hours to restart an AFW pump. Based on simulator observations and operator interviews about 3.5 hours is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05B-BYALOP-F-HE and the human error probability (HEP) is 4.4E-01.

5.2.28 06B-BLINDAFWF-HE – Failure to Feed Steam Generator Without Level Indication

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where power to the instrument bus is failed and AFW operation is required to maintain steam generator level. The operator must perform a blind feed of the steam generators (operating AFW without steam generator level indication).

The basic event ID for this HEP is 06B-BLINDAFWF-HE and the human error probability (HEP) is 6.4E-01.

5.2.29 06--OC2----F-HE – Failure to Perform RCS Cooldown Using Natural Circulation

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where RXCP seal cooling systems, i.e., charging and CCW, are not failed by the flooding event, but fail randomly shortly into the event. For this event, the operators must

cooldown and depressurize the RCS per ES-0.2.

The operator must execute the action within approximately 6 hours to perform cooldown. Based on simulator observations and operator interviews about 3 hours is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 06--OC2----F-HE and the human error probability (HEP) is 7.4E-02.

5.2.30 06--OC6----F-HE – Failure to Perform RCS Cooldown with Boration

The analysis of this HEP is documented in Attachment 1. This basic event applies to flooding scenarios where 480 VAC power is lost to all charging and CCW pumps. In these scenarios, a RXCP seal LOCA is assumed to occur and the operators would cooldown and depressurize the RCS per ES-1.2.

The operator must execute the action within approximately 200 minutes to perform cooldown. Based on simulator observations and operator interviews about 53 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 06--OC6----F-HE and the human error probability (HEP) is 9.2E-02.

5.2.31 05-MDPTD36F-HE – Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (36 Minutes)

The analysis of this HEP is documented in Attachment 1. This basic event applies to the Moderate Circulating Water pipe break. After the Motor Driven AFW pumps have failed, the operator must start the Turbine Driven AFW pump within 36 minutes of the initial pipe break to avoid submergence of the auxiliary lube oil pump and subsequent failure of the Turbine Driven AFW pump to start due to a lube oil pressure interlock. [CALC01]

Based on simulator observations and operator interviews about 18 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05-MDPTD36F-HE and the human error probability (HEP) is 4.7E-01.

5.2.32 05-MDPTD49F-HE – Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (49 Minutes)

The analysis of this HEP is documented in Attachment 1. This basic event applies to the Large Feedwater pipe break. After the Motor Driven AFW pumps have failed, the operator must start the Turbine Driven AFW pump within 49 minutes of the initial pipe break to avoid submergence of the auxiliary lube oil pump and subsequent failure of the Turbine Driven AFW pump to start due to a lube oil pressure interlock. [CALC01]

Based on simulator observations and operator interviews about 18 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05-MDPTD49F-HE and the human error probability (HEP) is 4.7E-01.

5.2.33 05-MDPTD61F-HE – Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (61 Minutes)

The analysis of this HEP is documented in Attachment 1. This basic event applies to the Large Service Water, Fire Protection Water, and Large Steamline pipe breaks. After the Motor Driven AFW pumps have failed, the operator must start the Turbine Driven AFW pump within 61 minutes of the initial pipe break to avoid submergence of the auxiliary lube oil pump and subsequent failure of the Turbine Driven AFW pump to start due to a lube oil pressure interlock. [CALC01]

Based on simulator observations and operator interviews about 18 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05-MDPTD61F-HE and the human error probability (HEP) is 3.1E-01.

5.2.34 05-MDPTD1CF-HE – Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (108 Minutes)

The analysis of this HEP is documented in Attachment 1. This basic event applies to the Moderate Feedwater pipe break. After the Motor Driven AFW pumps have failed, the operator must start the Turbine Driven AFW pump within 108 minutes of the initial pipe break to avoid submergence of the auxiliary lube oil pump and subsequent failure of the Turbine Driven AFW pump to start due to a lube oil pressure interlock. [CALC01]

Based on simulator observations and operator interviews about 18 minutes is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05-MDPTD1CF-HE and the human error probability (HEP) is 1.6E-01.

5.2.35 05-MDPTD2HF-HE – Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (2 Hours)

The analysis of this HEP is documented in Attachment 1. This basic event applies to the Moderate Steamline pipe break. After the Motor Driven AFW pumps have failed, the operator must start the Turbine Driven AFW pump within 2 hours of the initial pipe break to avoid submergence of the auxiliary lube oil pump and subsequent failure of the Turbine Driven AFW pump to start due to a lube oil pressure interlock. [CALC01]

Based on simulator observations and operator interviews about 18 minutes is required to receive

the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 05-MDPTD2HF-HE and the human error probability (HEP) is 4.1E-02.

5.2.36 86-INSTRRCRF-HE – Failure to Recover AFW Control

The analysis of this HEP is documented in Attachment 1. This basic event applies to all scenarios where AFW flow exists and at least one train of safety-related AC power is available. Under these conditions the operator is instructed to control AFW flow using the AFW pump discharge valves to adjust the flow rate to the steam generators. If these valves cannot be controlled remotely from the control room, then the operator has approximately 11 hours to operate them manually from the pump room. [CALC01]

Based on simulator observations and operator interviews about 9.5 hours is required to receive the initial signal, decide the course of action, and execute the action. The basic event ID for this HEP is 86-INSTRRCRF-HE and the human error probability (HEP) is 1.8E-02.

5.3 DATA

The KNPP.BED database was used for the flooding analysis. The Turbine Building flooding initiators and the HEPs discussed in Section 5.2 were added to KNPP.BED, along with the basic events modeled in fault tree FLOODING.LGC. One other new basic event was also added to the database:

> Basic Event 05B-FRACTDP-OFF represents the fraction of time that the operator is expected to trip the Turbine Driven AFW pump early in a flooding event given that both Motor Driven AFW pumps have successfully started.

No other basic events were added.

Table 1 lists all of the new operator actions and their HEPs that were developed in support of the flooding analysis.

Table 2 lists all the new basic events (and their values) that were added to KNPP.BED in support of the flooding analysis.

6.0 MODEL EVALUATION (EQUATIONS)

Each fault tree used to represent an event tree top event in this analysis is quantified various times under different initial conditions. Each of these fault tree quantifications produces an equation. The equation's location on the event tree (i.e., which previous top events have succeeded and

failed) dictates the initial conditions used to quantify the fault tree and develop that unique equation. Such initial conditions are modeled by setting to TRUE the failure rates of equipment that is known to be unavailable due to the flooding event. The same fault tree is then quantified with different initial conditions to yield different equations.

With the exception of Top Events AFZ and AFX (which are described in more detail in the following subsection), this analysis generally develops three unique equations for each top event. The initial conditions for the first equation consist of the flood-induced failures of equipment in the Turbine Building as well as the bottom row of breakers on Buses 51/52 and 61/62. This represents the flood-induced equipment failures that occur very early in the event. For example, when analyzing the Large Feedwater scenario (WI06B) the equation for Top Event AFR using these initial conditions is named AFRWI06B

The initial conditions for the second equation simply build on those of the first equation. In addition to the equipment failures of the first equation, the second equation adds the flood-induced failures of 4 kVAC Bus 5 and 480 VAC Bus 51/52. Thus, the second equation is quantified assuming the failure of Train A safety-related AC power. For example, when analyzing the Large Feedwater scenario (WI06B) the equation for Top Event AFR using these initial conditions is named AFRWI06BB.

The third equation builds on the initial conditions of the second and adds the flood-induced failures of 4 kVAC Bus 6 and 480 VAC Bus 61/62. Thus, the third equation is quantified assuming the failure of all safety-related AC power. For example, when analyzing the Large Feedwater scenario (WI06B) the equation for Top Event AFR using these initial conditions is named AFRWI06B4.

6.1 EVALUATION OF TOP EVENT AFZ

Instead of quantifying the same fault tree various times to develop different equations, the equations associated with Top Event AFZ use multiple fault trees that are quantified a single time. This is due to the complexity added by various human actions and the potential of equipment to already be running. Only the equations associated with a Large Feedwater Break are described here (e.g., AFZ-AWIB). The descriptions of the equations associated with all other initiators (e.g., AFZ-ACXB, AFZ-ASIB, AFZ-ATIB, etc.) are identical except for the name of the initiator and the timing associated with the model.

6.1.1 AFZ-AWIB

This equation is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The equation is used to model operator action-related failures only. Hardware-related failures of the turbine-driven AFW train are evaluated by

other equations in the event tree.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The break was isolated before the volume of water released in the turbine building would cause water level in the AFW pump rooms to submerge the TDAFP auxiliary lube oil pump.
- The break was isolated before the volume of water released in the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6 or 480 VAC Buses 61/62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The B-train motor-driven AFW pump successfully started.
- The B-train motor-driven AFW pump failed to run. By definition of the sequences where equation AFZ-AW1B is used, the mission time for the AFW pump is 24 hours. On average, the pump is assumed to run halfway through the mission time or 12 hours.

For the sequences where equation AFZ-AW1B is used, several potential success paths exist. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, then restart would merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal.

6.1.2 AFZ-BWIB

This equation is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The equation is used to model operator action-related failures only. Hardware-related failures of the turbine-driven AFW train are evaluated by other equations in the event tree.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The water volume released to the turbine building would cause water level in the AFW pump rooms to submerge the TDAFP auxiliary lube oil pump.

- The break was isolated before the volume of water released in the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6 or 480 VAC Buses 61/62.
- The B-train motor-driven AFW pump successfully started.
- The B-train motor-driven AFW pump failed to run. By definition of the sequences where equation AFZ-BWIB is used, the mission time for the AFW pump is 24 hours. On average, the pump is assumed to run halfway through the mission time or 12 hours.

For the sequences where equation AFZ-BWIB is used, multiple potential success paths exist. First, the operators could have maintained the turbine-driven AFW pump running throughout the event. The pump would be maintained running if either motor-driven AFW pump failed or if the operators recognized that the flooding event could threaten the motor-driven AFW pumps and would want the added reliability of the third AFW pump. Second, even if the turbine-driven AFW pump was secured early in the event, then the operators could recognize that the rising water levels would soon threaten the motor-driven AFW pumps and may restart the turbine-driven AFW pump. By definition of the sequences where equation AFZ-BWIB is used, water level will reach a level that will submerge the turbine-driven AFW pump auxiliary lube oil pump. Therefore, for the operators to successfully start the pump from the control room, action must be taken before 49 minutes. Otherwise, the auxiliary lube oil pump would be submerged, thereby preventing the turbine-driven AFW pump from starting.

If the turbine-driven pump is not started within 49 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Given the definition of the sequences where equation AFZ-BWIB is used, the B-train motor-driven AFW pump started, but failed to run. Since, on average, the pump is assumed to fail one-half way through the mission time, or 12 hours, steam generator water level would be at or near normal level when flow from the motor-driven AFW pump is lost. Previous analyses have shown that about three hours are required for water level in the steam generators to decrease from nominal to 5-percent wide range. Therefore, three hours would be available to bypass the interlock.

6.1.3 AFZ-BWI4

This equation is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The equation is used to model operator action-related failures only. Hardware-related failures of the turbine-driven AFW train are evaluated by

other equations in the event trees.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The water volume released to the turbine building would cause water level in the AFW pump rooms to submerge the TDAFP auxiliary lube oil pump.
- The water volume released to the turbine building would cause water level in safeguards alley to submerge 480 VAC Buses 61 and 62.
- The water volume released to the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6.
- The break was isolated before the volume of water released in the turbine building would cause water level in the safeguards alley to fail the turbine-driven AFW pump if it was already running.

For the sequences where equation AFZ-BWI4 is used, the only method available for long-term decay heat removal is the turbine-driven AFW pump. Although the B-train motor-driven AFW pump may start and provide flow, the pump will be lost when water level on 4 kVAC Bus 6 reaches the level at which bus failure is expected. Therefore, no credit is taken for operation of the B-train motor-driven AFW pump.

Multiple potential success paths exist for the conditions where equation AFZ-BWI4 is used. First, the operators could have maintained the turbine-driven AFW pump running throughout the event. The pump would be maintained running if either motor-driven AFW pump failed or if the operators recognized that the flooding event could threaten the motor-driven AFW pumps and would want the added reliability of the third AFW pump. Second, even if the turbine-driven AFW pump was secured early in the event, then the operators could recognize that the rising water levels would soon threaten the motor-driven AFW pumps and may restart the turbine-driven AFW pump. By definition of the sequences where equation AFZ-BWIB is used, water level will reach a level that will submerge the turbine-driven AFW pump auxiliary lube oil pump. Therefore, for the operators to successfully start the pump from the control room, action must be taken within 49 minutes. Otherwise, the auxiliary lube oil pump would be submerged, thereby preventing the turbine-driven AFW pump from starting.

If the turbine-driven pump is not started within 49 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would

be initiated.

6.2 EVALUATION OF TOP EVENT AFX

Instead of quantifying the same fault tree various times to develop different equations, the equations associated with Top Event AFX use multiple fault trees that are quantified a single time. This is due to the complexity added by various human actions and the potential of equipment to already be running. Only the equations associated with a Large Feedwater Break are described here (e.g., AFX-1WIB). The descriptions of the equations associated with all other initiators (e.g., AFX-1CXB, AFX-1SIB, AFX-1TIB, etc.) are identical except for the name of the initiator and the timing associated with the model.

6.2.1 AFX-1WIB

This equation is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The break was isolated before the volume of water released in the turbine building would cause water level in the AFW pump rooms to submerge the TDAFP auxiliary lube oil pump.
- The break was isolated before the volume of water released in the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6 or 480 VAC Buses 61/62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The B-train motor-driven AFW pump successfully started.
- The B-train motor-driven AFW pump can successfully run for 24 hours.

By definition, all equipment in the turbine building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where equation AFX-1WIB is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available, as are the alternate power supplies to the 120 VAC instrument inverters.

Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, several loads that impact the flooding accident sequence progression are lost. These loads include the power supply to the

associated train battery room fan cooling units, battery chargers, standby power supplies for 120 VAC instrument inverters, battery room exhaust fans, and auxiliary lube oil pumps for the motor-driven AFW pumps.

Given the conditions described above, success of the AFX-1WIB equation can be achieved by several means. First the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. Air could be supplied from instrument air compressor C1B and power is provided from panel BRD-115, which is supplied with power from either battery BRD-101 or MCC-62C. These power sources can be backed up by DC distribution cabinet BRC-102 via either battery BRC-101 or MCC-46C. Given the redundancy and diversity of these four power supplies, explicit consideration of their failure is assumed to be insignificant and need not be modeled. If air is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. If the turbine-driven AFW pump was maintained running, then no additional actions are required. If the turbine-driven AFW pump was secured, then taking the control switch from pull-to-lock would restart the pump when level reached the low-low setpoint. Once the turbine-driven AFW pump is running, flow can be controlled using valves AFW-10A/B. For either of these options, either a long-term source of DC power must be provided for instrumentation or steam generator level must be controlled following a loss of all level indication. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

Provision of a long-term source of DC power can be ensured by multiple means for sequences involving equation AFX-1WIB. First, the 120 VAC instrument inverters can be aligned to their alternate power source. Since 480 VAC Buses 61 and 62 are available, the alternate sources are available. Evaluations have shown that if the instrument inverters are removed from battery BRB-101, then the battery can supply needed DC loads for well in excess of 24 hours. Alignment of the instrument inverters to their alternate power source also ensures that steam generator level indication is available in the control room even if the battery fails or is depleted. If needed, an alternate power source can be aligned to the DC buses. Alternatives include installation of an alternate power source to the existing battery charger or installation of a spare battery charger with power from an alternative source.

Given the availability of equipment for sequences where equation AFX-1WIB is used and the multiple success paths that are available, it is likely that many hours would be available for the operators to initiate the actions. Therefore, time would not be critical to completing any of the actions and explicit evaluation of timing is not necessary.

6.2.2 AFX-2WIB

This equation is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

This equation name is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The break was isolated before the volume of water released in the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6 or 480 VAC Buses 61/62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The B-train motor-driven AFW pump successfully started.
- The B-train motor-driven AFW pump failed to run. By definition of the sequences where equation AFX-2WIB is used, the mission time for the AFW pump is 24 hours. On average, the pump is assumed to fail to run halfway through the mission time or 12 hours.
- The turbine-driven AFW pump has been started and can successfully operate for 24 hours.

By definition, all equipment in the turbine building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where equation AFX-2WIB is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available, as are the alternate power supplies to the 120 VAC instrument inverters.

Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, several loads that impact the flooding accident sequence progression are lost. These loads include the power supply to the associated train battery room fan cooling units, battery chargers, standby power supplies for 120 VAC instrument inverters, battery room exhaust fans, and auxiliary lube oil pumps for the motor-driven AFW pumps.

Given the conditions described above, success of the AFX-2WIB equation can be achieved by controlling AFW flow using valves AFW-10A/B. If a long-term source of DC power is available, then steam generator level can be controlled from the control room. Provision of a long-term source of DC power can be ensured by multiple means for sequences involving equation AFX-2WIB. First, the 120 VAC instrument inverters can be aligned to their alternate power source. Since 480 VAC Buses 61 and 62 are available, the alternate sources are available. Evaluations have shown that if the instrument inverters are removed from battery BRB-101, then the battery can supply needed DC loads for well in excess of 24 hours. Alignment of the instrument inverters

to their alternate power source also ensures that steam generator level indication is available in the control room even if the battery fails or is depleted. If needed, an alternate power source can be aligned to the DC buses. Alternatives include installation of an alternate power source to the existing battery charger or installation of a spare battery charger with power from an alternative source.

Given the availability of equipment for sequences where equation AFX-2WIB is used and the multiple success paths that are available, it is likely that many hours would be available for the operators to initiate the actions. Therefore, time would not be critical to completing any of the actions and explicit evaluation of timing is not necessary.

6.2.3 AFX-1AWI

This equation is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The water volume released to the turbine building will result in submergence of the TDAFP auxiliary lube oil pump.
- The break was isolated before the volume of water released in the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6 or 480 VAC Buses 61/62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The B-train motor-driven AFW pump successfully started.
- The B-train motor-driven AFW pump can successfully run for 24 hours.

By definition, all equipment in the turbine building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where equation AFX-1AWI is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available, as are the alternate power supplies to the 120 VAC instrument inverters.

Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, several loads that impact the flooding accident sequence progression are lost. These loads include the power supply to the associated train battery room fan cooling units, battery chargers, standby power supplies for 120 VAC instrument inverters, battery room exhaust fans, and auxiliary lube oil pumps for the motor-

driven AFW pumps.

Given the conditions described above, success of the AFX-1AWI equation can be achieved by several means. First the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. Air could be supplied from instrument air compressor C1B and power is provided from panel BRD-115, which is supplied with power from either battery BRD-101 or MCC-62C. These power sources can be backed up by DC distribution cabinet BRC-102 via either battery BRC-101 or MCC-46C. Given the redundancy and diversity of these four power supplies, explicit consideration of their failure is assumed to be insignificant and need not be modeled. If air is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. By definition of the sequences where equation AFX-1AWI is used, water level will reach a level that will submerge the turbine-driven AFW pump auxiliary lube oil pump. Therefore, for the operators to successfully start the pump from the control room, action must be taken within 49 minutes. Otherwise, the auxiliary lube oil pump would be submerged, thereby preventing the turbine-driven AFW pump from starting.

If the turbine-driven pump is not started within 49 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

For either of these options, either a long-term source of DC power must be provided for instrumentation or steam generator level must be controlled following a loss of all level indication. Provision of a long-term source of DC power can be ensured by multiple means for sequences involving equation AFX-1AWI. First, the 120 VAC instrument inverters can be aligned to their alternate power source. Since 480 VAC Buses 61 and 62 are available, the alternate sources are available. Evaluations have shown that if the instrument inverters are removed from battery BRB-101, then the battery can supply needed DC loads for well in excess of 24 hours. Alignment of the instrument inverters to their alternate power source also ensures that steam generator level indication is available in the control room even if the battery fails or is depleted. If needed, an alternate power source can be aligned to the DC buses. Alternatives include installation of an alternate power source to the existing battery charger or installation of a spare battery charger with power from an alternative source.

6.2.4 AFX-2WI4

This equation is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

This equation is used for sequences with the following conditions:

- The water volume released to the turbine building will result in opening the bottom row of breakers on 480 VAC Buses 51, 52, 61, and 62.
- The water volume released to the turbine building will result in failure of 4kVAC Bus 5.
- The water volume released to the turbine building would cause water level in the AFW pump rooms to submerge the TDAFP auxiliary lube oil pump.
- The water volume released to the turbine building would cause water level in safeguards alley to submerge 480 VAC Buses 61 and 62.
- The water volume released to the turbine building would cause water level in the B-train 4kVAC room to reach a level that would fail 4 kVAC Bus 6.
- The break was isolated before the volume of water released in the turbine building would cause water level in the safeguards alley to fail the turbine-driven AFW pump if it was already running.
- The turbine-driven AFW pump has been started and can successfully operate for 24 hours.

By definition of the sequences where equation AFX-2WI4 is used, all AC power will be lost. In addition, all DC power may eventually be lost because of the loss of power to the battery chargers.

Success of the AFX-2WI4 equation requires that the operators control flow using valves AFW-10A/B. In addition, either a long-term source of DC power must be provided for instrumentation or steam generator level must be controlled following a loss of all level indication.

7.0 REFERENCES

[CALC01] Calculation 0064-0515-LYS-01, Evaluation of Flooding Levels for Various PRA Cases, Revision 0, MPR Associates, Inc.

[NB01] KPS Internal Events PRA, Volumes 2 through 4.

[NB02] KPS Internal Events PRA, Section 4.15, "Human Reliability Analysis."

Table 1
Summary of KPS Turbine Building Flood Human Actions

Basic Event ID	Basic Event Description	HEP
02-SW4A-B29F-HE	Detection and Isolation of a Service Water Break before Failing 4 kVAC Bus 5	2.0E-02
02-SW4A-B45F-HE	Detection and Isolation of a Service Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	2.0E-02
02-SW4A-B51F-HE	Detection and Isolation of a Large Service Water Break before Failing 4 kV Bus 6	2.0E-02
02-SW4A-B66F-HE	Detection and Isolation of a Large Service Water Break before Water Level Reaches 18 Inches in the Turbine Building	2.0E-02
04-CWSTP13-F-HE	Detection and Isolation of a 14,000 gpm Circulating Water Break before Failing 4 kVAC Bus 5	2.6E-01
04-CWSTP19-F-HE	Detection and Isolation of a 14,000 Circulating Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	1.2E-01
04-CWSTP22-F-HE	Detection and Isolation of a 14,000 Circulating Water Break before Failing 4 kV Bus 6	1.2E-01
04-CWSTP25-F-HE	Detection and Isolation of a 14,000 Circulating Water Break before Water Level Reaches 18 Inches in the Turbine Building	1.2E-01
04-CW-TRIP-F-HE	Detection and Isolation of a 58,000 gpm Circulating Water Break before Failing Both 480 V Buses	1.0E+00
05B-BYALOP-F-HE	Failure to Bypass AFW Auxiliary Lube Oil Pressure Interlock	4.4E-01
05-MDPTD1CF-HE	Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (108 Minutes)	1.6E-01

Table 1
Summary of KPS Turbine Building Flood Human Actions

Basic Event ID	Basic Event Description	HEP
05-MDPTD2HF-HE	Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (2 Hours)	4.1E-02
05-MDPTD36F-HE	Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (36 Minutes)	4.7E-01
05-MDPTD49F-HE	Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (49 Minutes)	4.7E-01
05-MDPTD61F-HE	Failure to Start Turbine Driven AFW Pump Before Loss of Motor Driven AFW Pump (61 Minutes)	3.1E-01
06B-BLINDAFWF-HE	Failure to Feed Steam Generator Without Level Indication	6.4E-01
06--OC2----F-HE	Failure to Perform RCS Cooldown Using Natural Circulation	7.4E-02
06--OC6----F-HE	Failure to Perform RCS Cooldown with Boration	9.2E-02
08-FPISO29-F-HE	Detection and Isolation of a Fire Protection Water Break before Failing 4 kVAC Bus 5	1.0E+00
08-FPISO45-F-HE	Detection and Isolation of a Fire Protection Water Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	6.6e-02
08-FPISO56-F-HE	Detection and Isolation of a Fire Protection Water Break before Failing 4 kV Bus 6	2.4E-02
08-FPSISO1CF-HE	Detection and Isolation of a Medium Flood due to a Steamline Break before Failing 4 kVAC Bus 5	3.0E-02
08-FPSISO29F-HE	Detection and Isolation of a Large Flood due to a Steamline Break before Failing 4 kVAC Bus 5	4.5E-01
08-FPSISO2CF-HE	Detection and Isolation of a Medium Flood due to a Steamline Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	3.0E-02

Table 1
Summary of KPS Turbine Building Flood Human Actions

Basic Event ID	Basic Event Description	HEP
08-FPSISO3CF-HE	Detection and Isolation of a Medium Flood due to a Steamline Break before Failing 4 kV Bus 6	3.0E-02
08-FPSISO45F-HE	Detection and Isolation of a Large Flood due to a Steamline Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	3.9E-02
08-FPSISO56F-HE	Detection and Isolation of a Large Flood due to a Steamline Break before Failing 4 kV Bus 6	3.0E-02
08-ISO-FS18F-HE	Detection and Isolation of a Large Flood due to a Feedwater Break before Failing 4 kVAC Bus 5	1.0E+00
08-ISO-FS2HF-HE	Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing 4 kV Bus 6	1.7E-02
08-ISO-FS33F-HE	Detection and Isolation of a Large Flood due to a Feedwater Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	2.2E-01
08-ISO-FS40F-HE	Detection and Isolation of a Large Flood due to a Feedwater Break before Failing 4 kV Bus 6	6.7E-02
08-ISO-FS55F-HE	Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing 4 kVAC Bus 5	3.0E-02
08-ISO-FS97F-HE	Detection and Isolation of a Medium Flood due to a Feedwater Break before Failing the Turbine Driven AFW Pump Auxiliary Lube Oil Pump	3.0E-02
16-BATCLG--F-HE	Establish Battery Room Cooling	7.9E-02
27A-ORR----F-HE	Failure to Throttle SI Flow to Conserve RWST Inventory	5.0E-03
86-INSTRRCRF-HE	Failure to Recover AFW Control	1.8E-02

Table 2: Basic Events Added to KNPP.BED

Basic Event ID	Basic Event Description	Point Estimate
04-CW-MDAFPAMHE	Operator Fails to Control MDAFP Med CW Break AC Avail	1.00E-01
04-CW-TRIP-F-HE	FAIL TO ISOL LRG CIRC WTR BRK BEFORE FAILURE OF 480V BUS	1.00E+00
05B-BYALOP-F-HE	Fail to Bypass AFW ALOP Permissive Large FW Break	1.00E+00
05B-FRACTDP-OFF	Prob of Conditions Where TDAFP Is Secured	9.00E-01
05B-MDPTD1CF-HE	Start TD AFW Pump before loss of MD AFW Pump - 108 min.	1.60E-01
05B-MDPTD2HF-HE	Start TD AFW Pump before loss of MD AFW Pump - 2 Hr.	4.10E-02
05B-MDPTD36F-HE	Start DT AFW Pump before loss of MD AFW Pump - 36 min.	4.70E-01
05B-MDPTD49F-HE	Start TD AFW Pump before loss of MD AFW Pump - 49 min.	4.70E-01
05B-MDPTD61F-HE	Start TD AFW Pump before loss of MD AFW Pump - 61 min.	3.10E-01
06--OC2----F-HE	Local Operation of S/G PORV	5.00E-01
06--OC6----F-HE	Fail to Cooldown per ES-1.2	1.00E-01
06-BLINDAFWF-HE	Operator fails to feed S/G without Level indication	6.40E-01
16-BATCLG--F-HE	Establish Battery Room Cooling – Flood	7.90E-02
27A-ORR----F-HE	FAILURE TO THROTTLE SI FLOW OR REFILL RWST	1.00E-02
86-INSTRFCRF-HE	Fail to Control AFW	1.80E-02
86-INSTRRCRF-HE	Fail to Control AFW	1.80E-02
CX06-ISOL-A	Fail to Isolate Before Failure of any Buses CW Mod	5.00E-01
CX06-ISOL-B	Fail to Isolate Before Failure of AFWP CW Mod	5.00E-01

Table 2: Basic Events Added to KNPP.BED

Basic Event ID	Basic Event Description	Point Estimate
CX06-ISOL-C	Fail to Start MDAFP CW Moderate	5.00E-01
CX06-ISOL-D	Fail to Start MDAFP CW Moderate	5.00E-01
FI06-ISOL-A	Fail to Isolate Before Failure of any Buses FP Large	5.00E-01
FI06-ISOL-B	Fail to Isolate Before Failure of AFWP FP Large	5.00E-01
FI06-ISOL-C	Fail to Start MDAFP FP Large	5.00E-01
IE-CI06B	LARGE CIRC WTR LINE BREAK IN TURB BLDG BASEMENT	4.76E-05
IE-CX06B	MEDIUM CIRC WTR LINE BREAK IN TURB BLDG BASEMENT	4.76E-05
IE-FI06B	LARGE FIRE PROTECT LINE BREAK IN TURB BLDG BASEMENT	1.05E-04
IE-SI06B	LARGE SERVICE WTR LINE BREAK IN TURB BLDG BASEMENT	3.22E-05
IE-TI06B	STEAMLINE BRK IN TURB BLDG CAUSES LARGE FIRE PROT	9.00E-03
IE-TX06B	STEAMLINE BRK IN TURB BLDG CAUSES MEDIUM FIRE PROT	9.00E-03
IE-WI06B	LARGE FEEDWATER BREAK IN TURBINE BLDG BASEMENT	9.41E-04
IE-WX06B	MEDIUM FEEDWATER BREAK IN TURBINE BLDG BASEMENT	9.41E-04
SI06-ISOL-A	Fail to Isolate Before Failure of any Buses SW Large	1.00E+00
SI06-ISOL-B	Fail to Isolate Before Failure of AFWP SW Large	5.00E-01
SI06-ISOL-C	Fail to Start MDAFP SW Large	5.00E-01
SI06-ISOL-D	FAIL ISOLATION BEFORE 18 INCHES ON TDAFP SW LARGE	5.00E-01
SL182	MEDIUM REACTOR COOLANT PUMP SEAL LOCA NO C/D 480GPM	5.00E-01
SL480	LARGE REACTOR COOLANT PUMP SEAL LOCA WITH C/D	2.50E-03

Table 2: Basic Events Added to KNPP.BED

Basic Event ID	Basic Event Description	Point Estimate
TI06-ISOL-A	Fail to Isolate Before Failure of any Buses STM Large	5.00E-01
TI06-ISOL-B	Fail to Isolate Before Failure of AFWP STM Large	5.00E-01
TI06-ISOL-C	Fail to Start MDAFP STM Large	5.00E-01
TX06-ISOL-A	Fail to Isolate Before Failure of any Buses STM Mod	5.00E-01
TX06-ISOL-B	Fail to Isolate Before Failure of AFWP STM Mod	5.00E-01
TX06-ISOL-C	Fail to Start MDAFP STM Moderate	5.00E-01
WI06-ISOL-A	Fail to Isolate Before Failure of any Buses FW Large	1.00E+00
WI06-ISOL-B	Fail to Isolate Before Failure of AFWP FW Large	5.00E-01
WI06-ISOL-C	Fail to Start MDAFP FW Large	5.00E-01
WX06-ISOL-A	Fail to Isolate Before Failure of any Buses FW Mod	5.00E-01
WX06-ISOL-B	Fail to Isolate Before Failure of AFWP FW Mod	5.00E-01
WX06-ISOL-C	Fail to Start MDAFP FW Moderate	5.00E-01

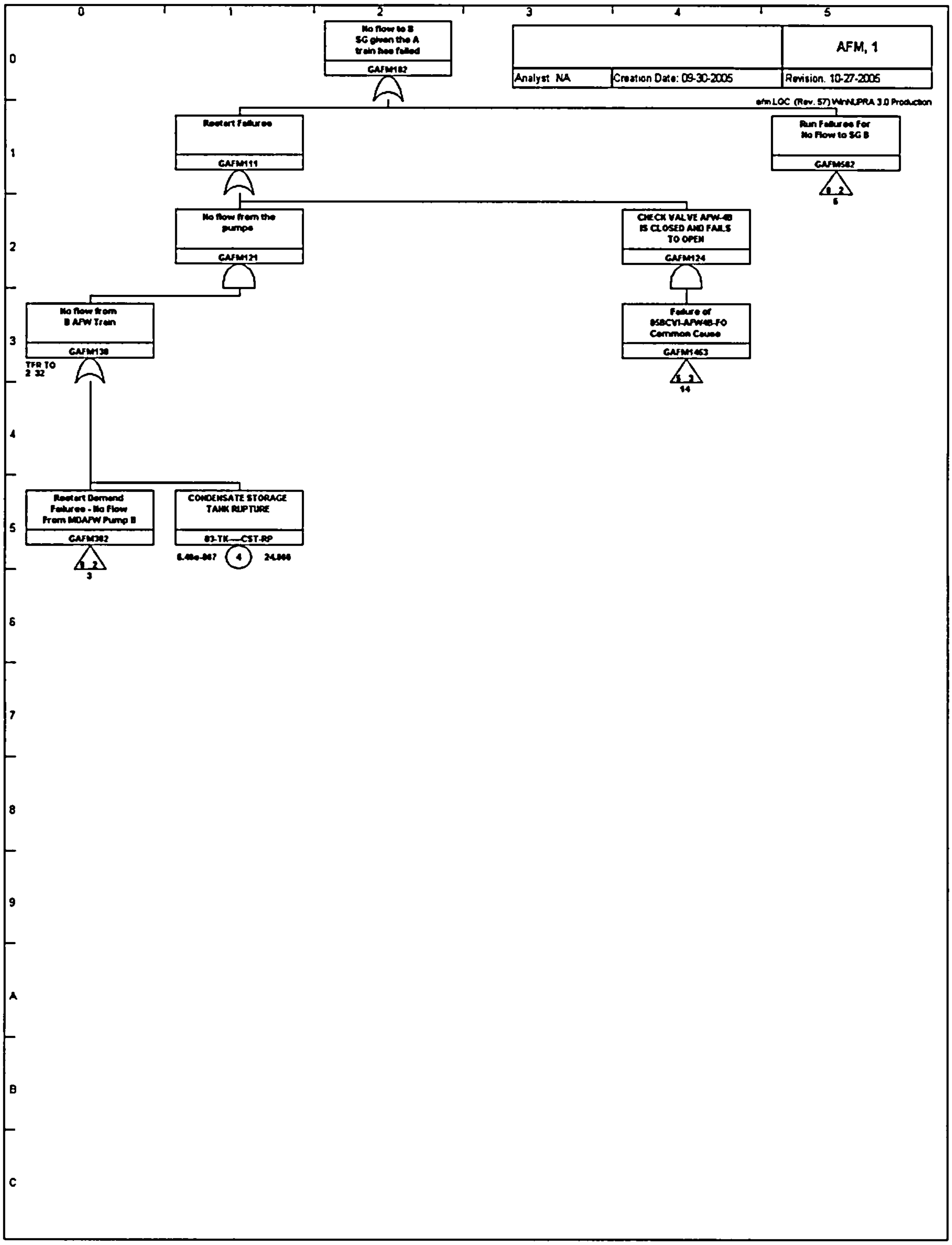


Figure 1 – Fault Tree AFM.LGC

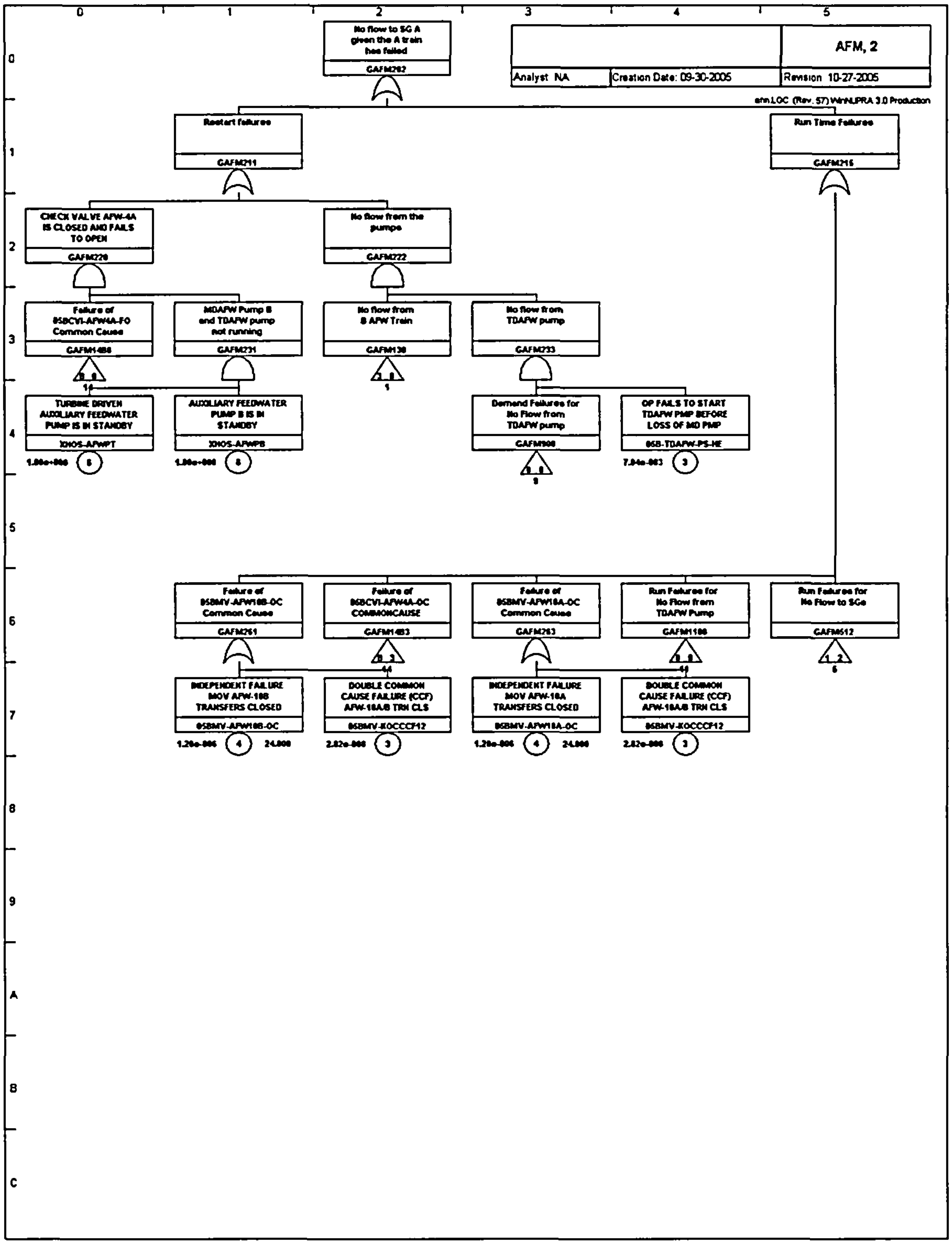


Figure 1 – Fault Tree AFM.LGC (continued)

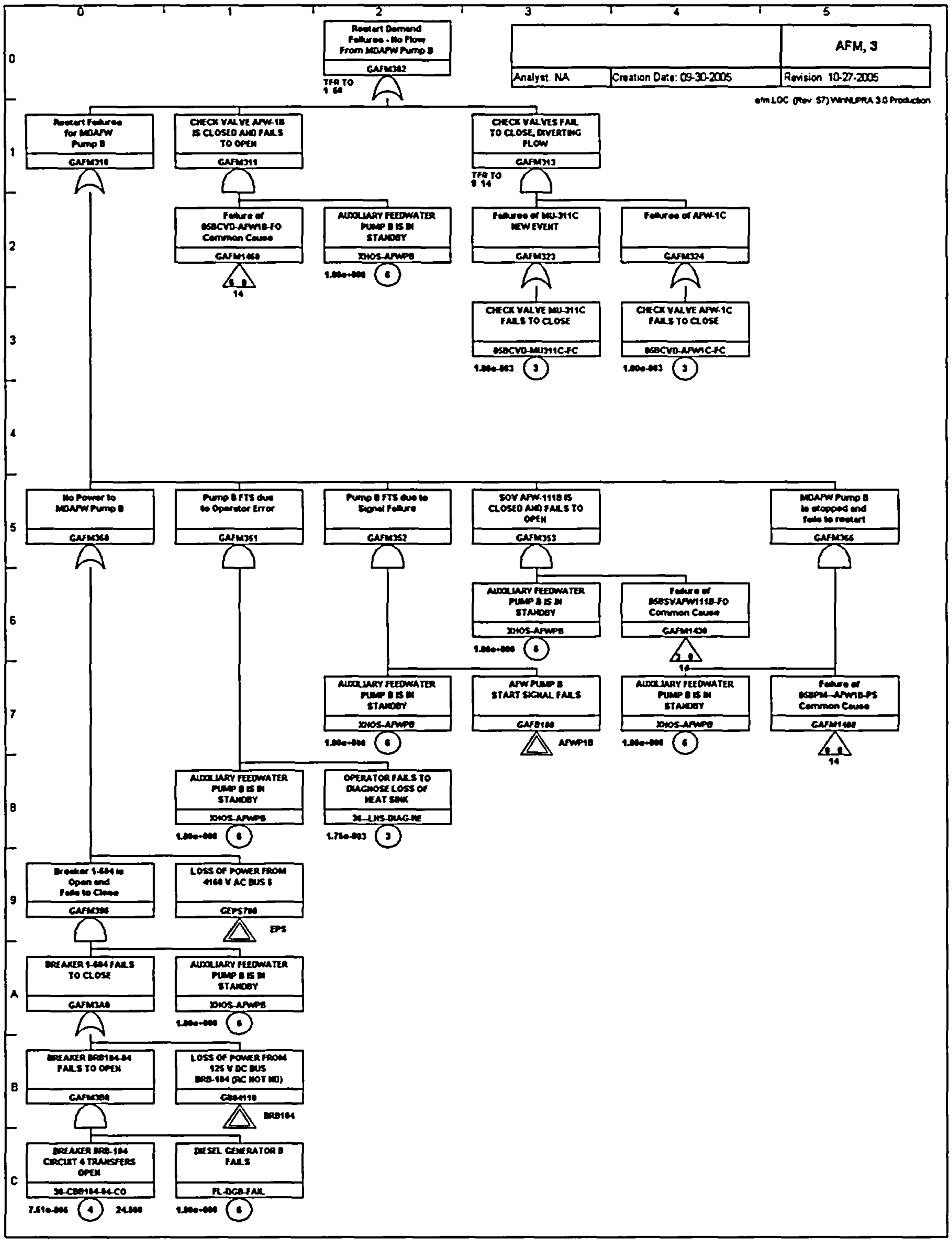


Figure 1 – Fault Tree AFM.LGC (continued)

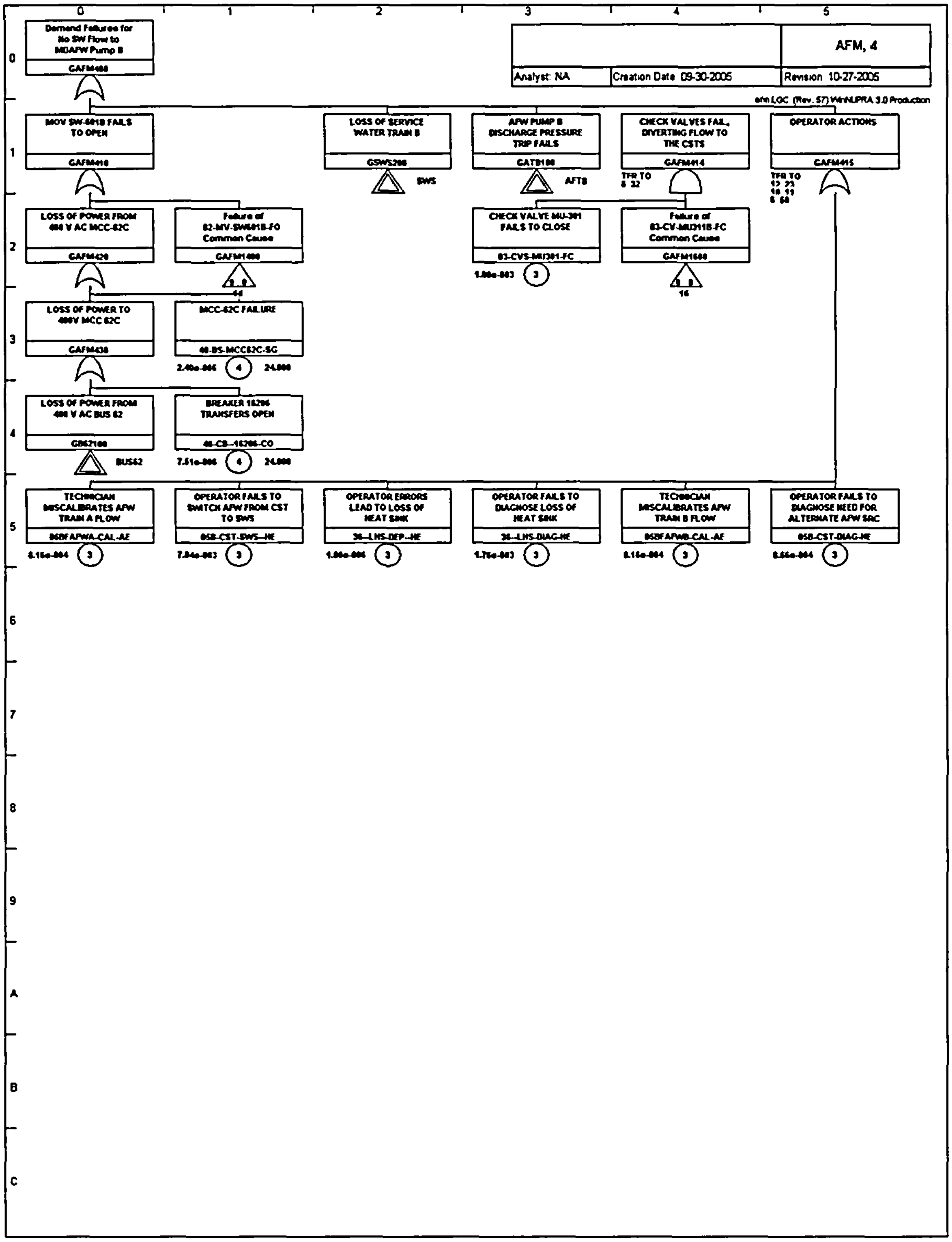


Figure 1 – Fault Tree AFM.LGC (continued)

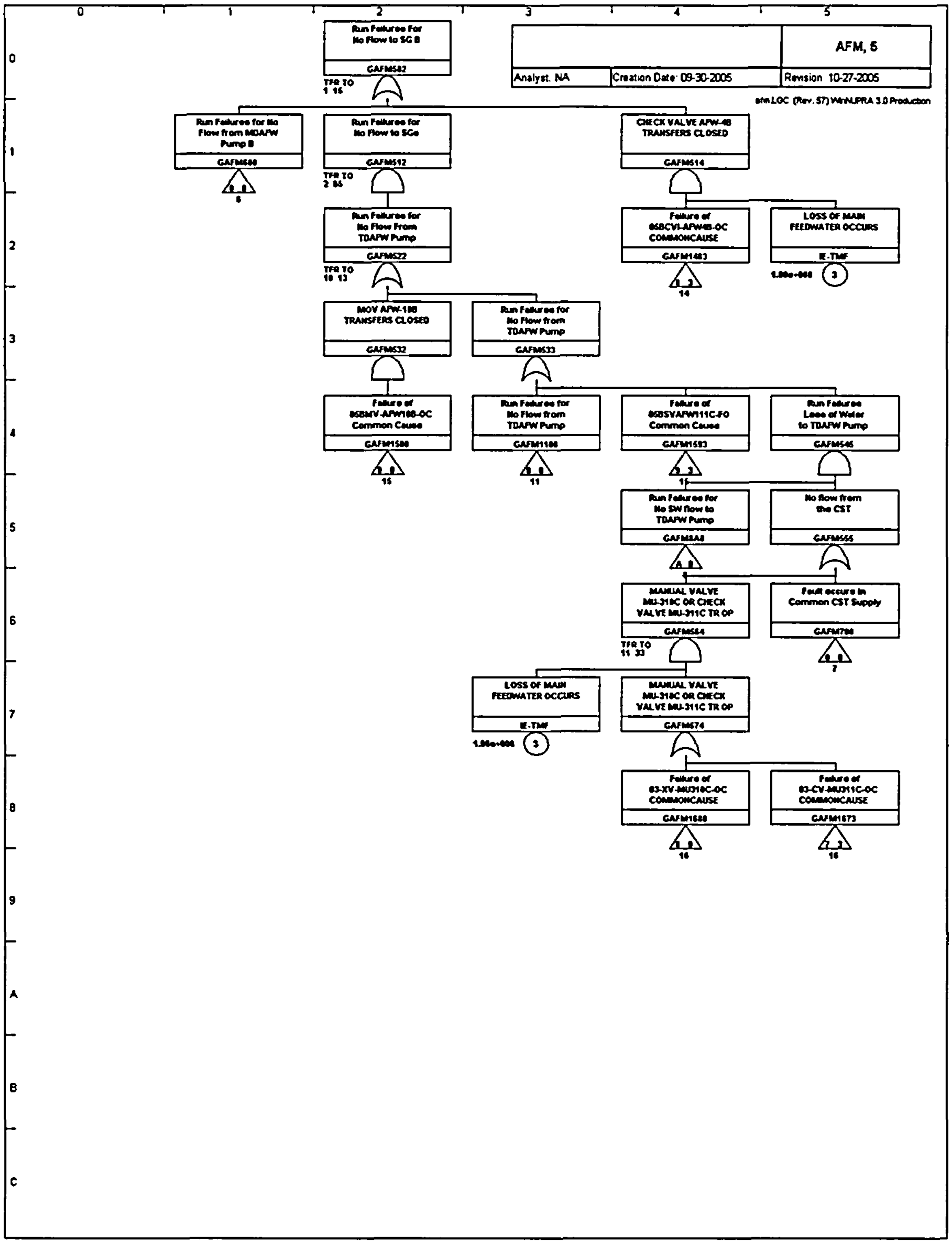


Figure 1 – Fault Tree AFM.LGC (continued)

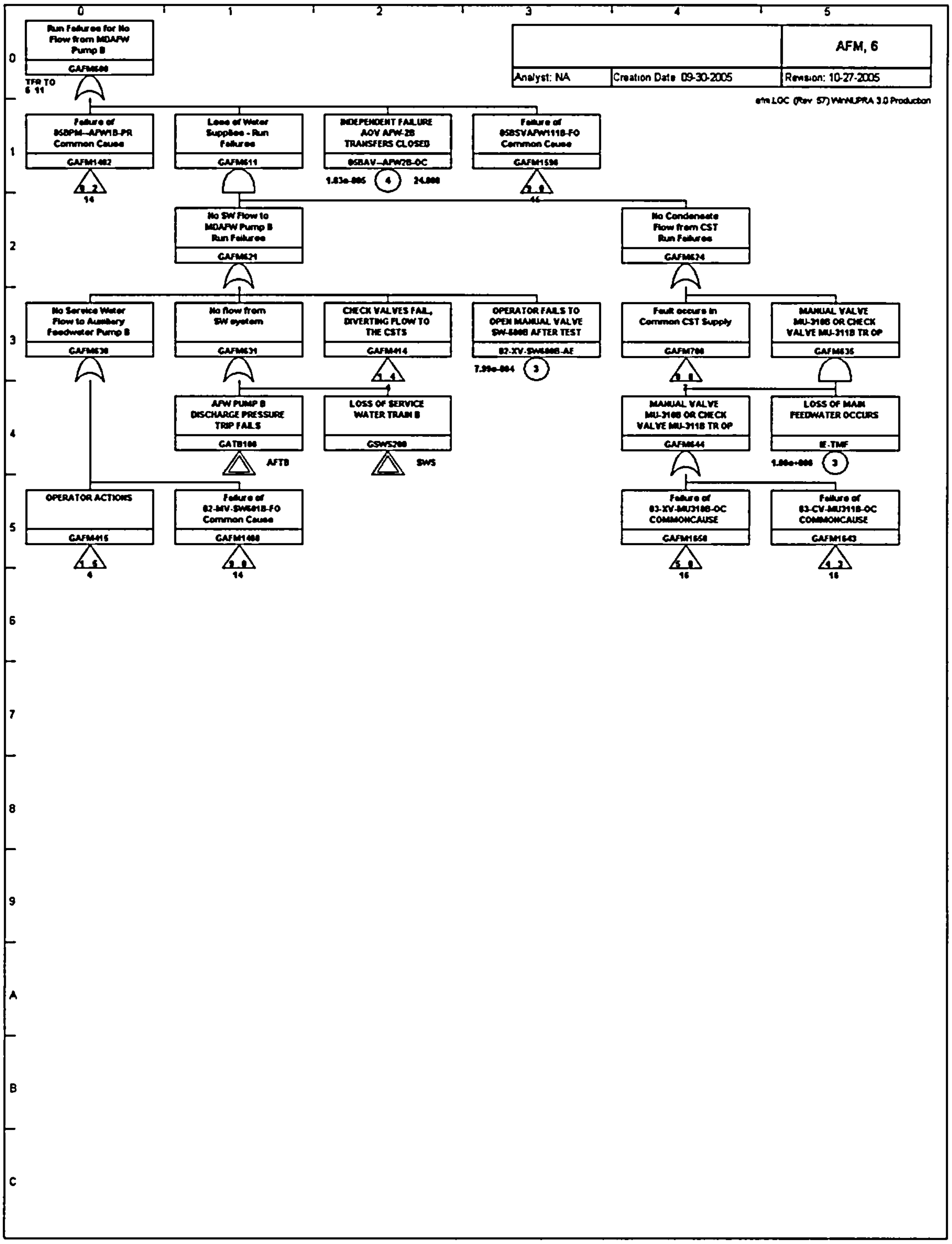


Figure 1 – Fault Tree AFM.LGC (continued)

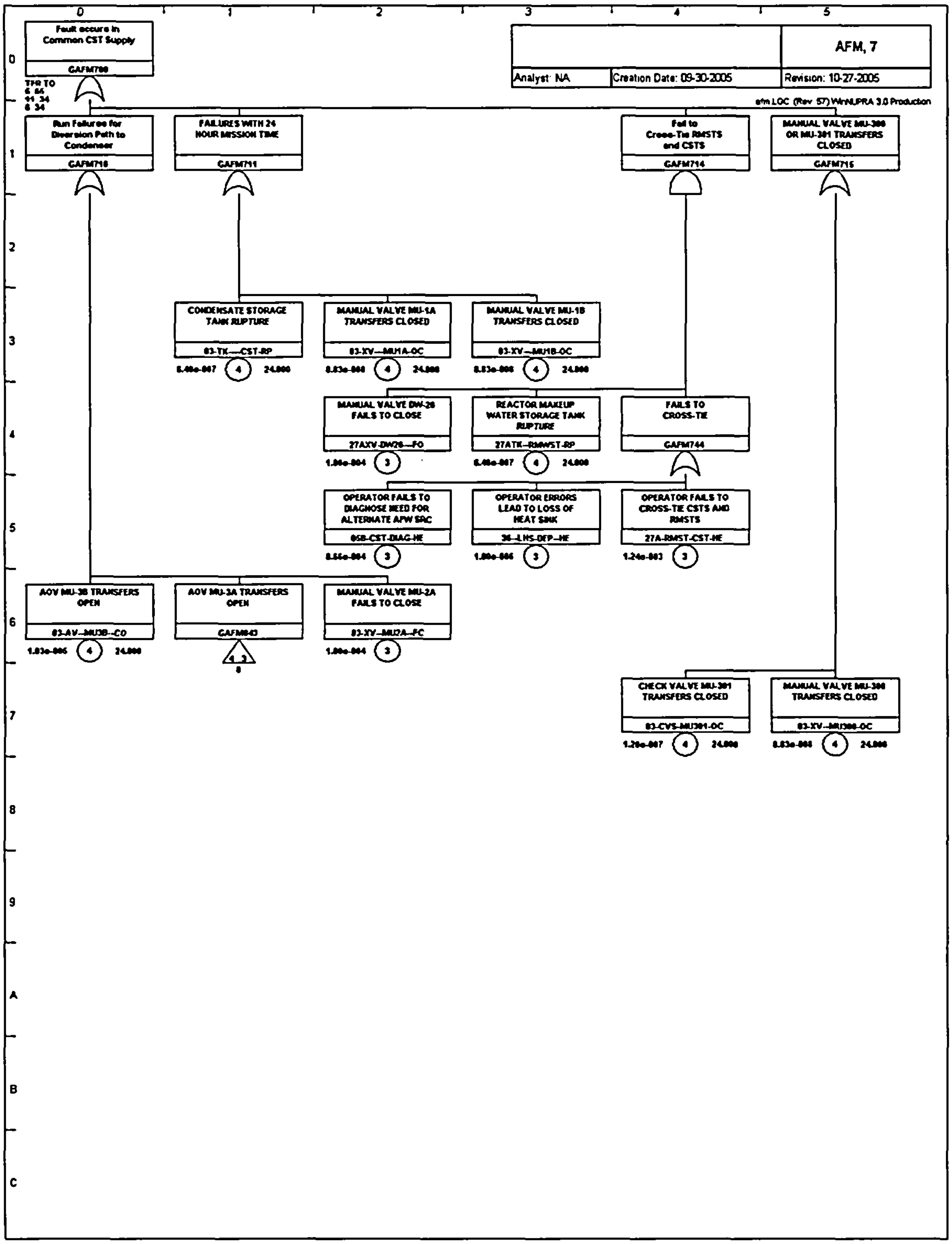
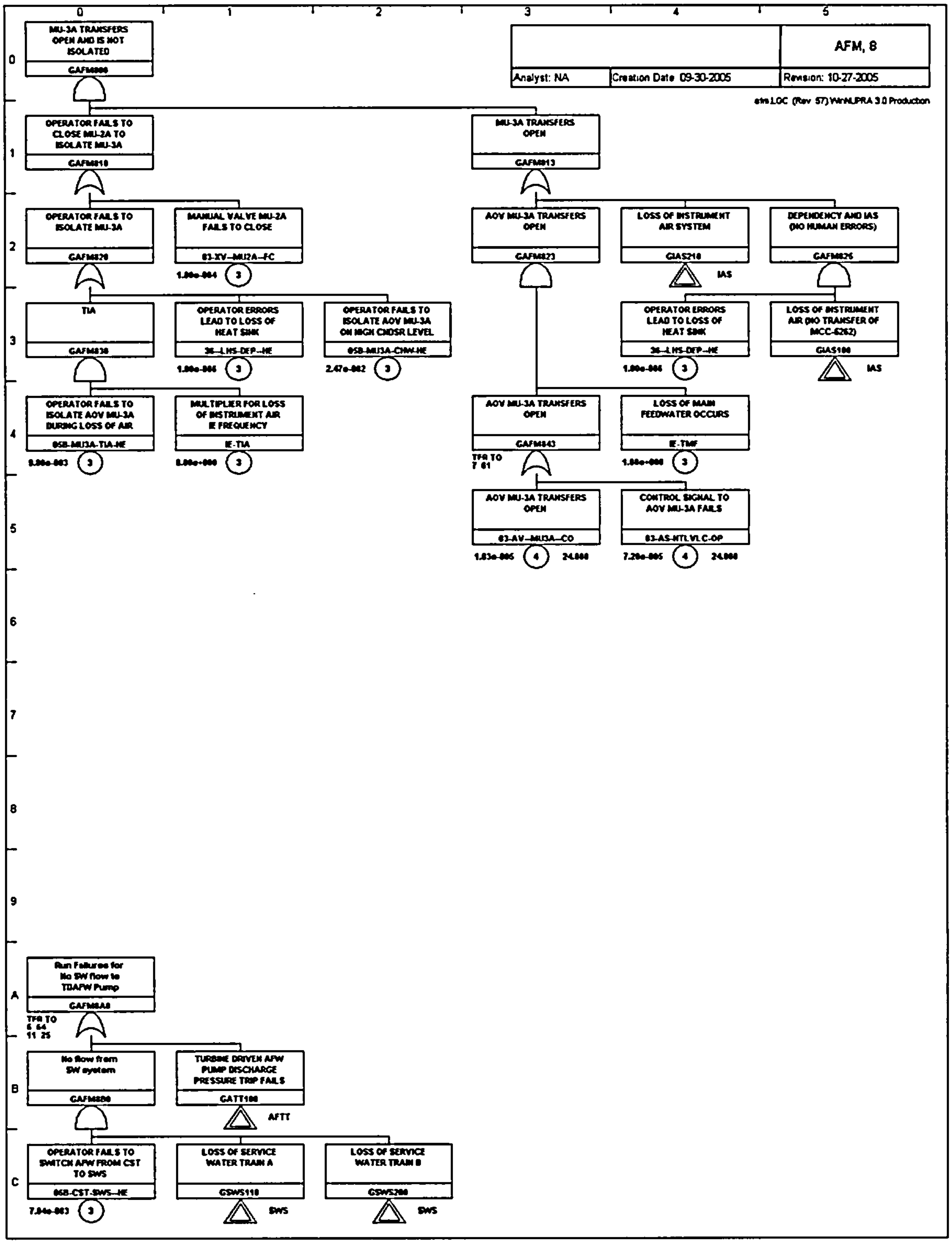


Figure 1 – Fault Tree AFM.LGC (continued)



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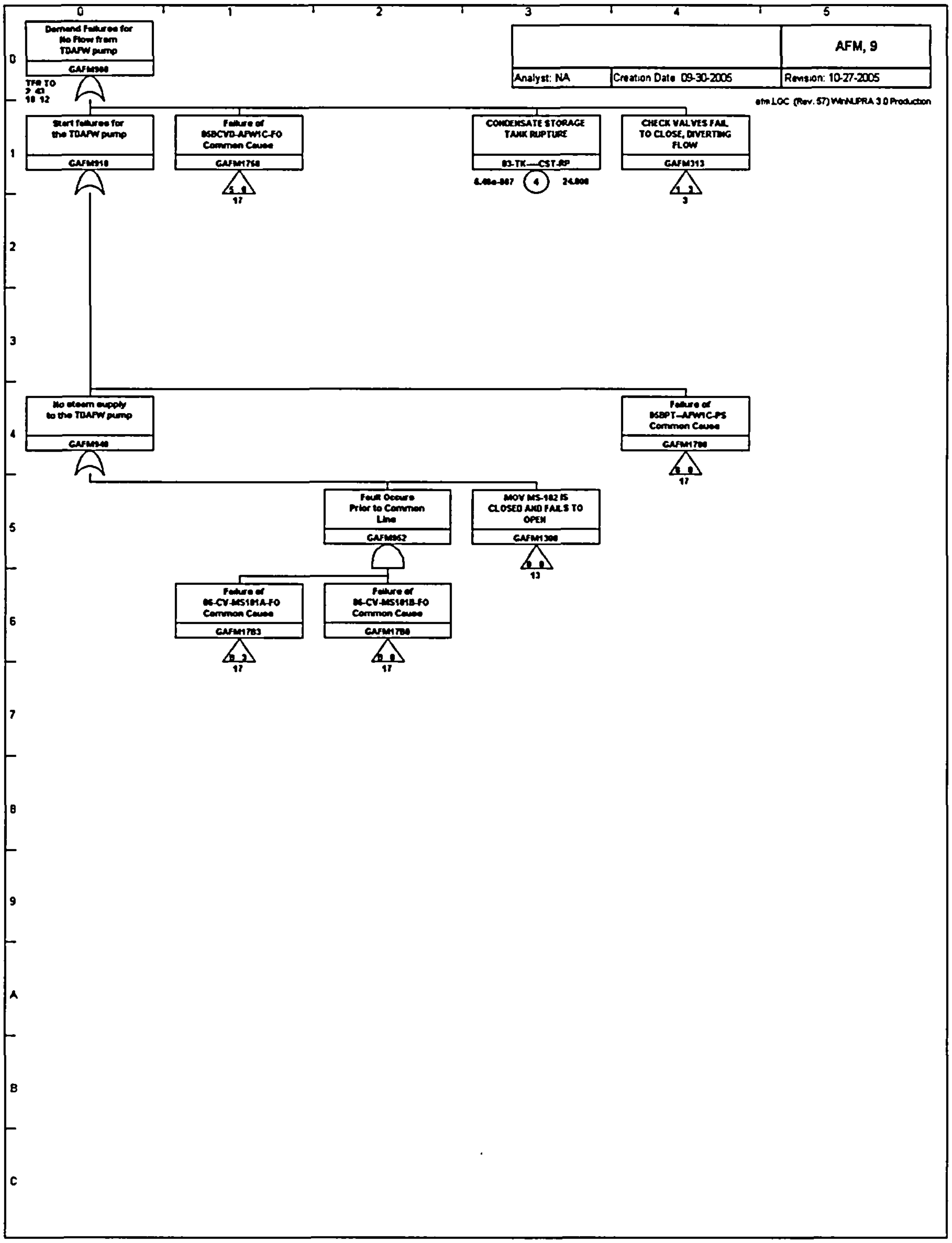


Figure 1 – Fault Tree AFM.LGC (continued)

INTERNAL FLOODING – Fault Tree Analysis for Turbine Building Floods

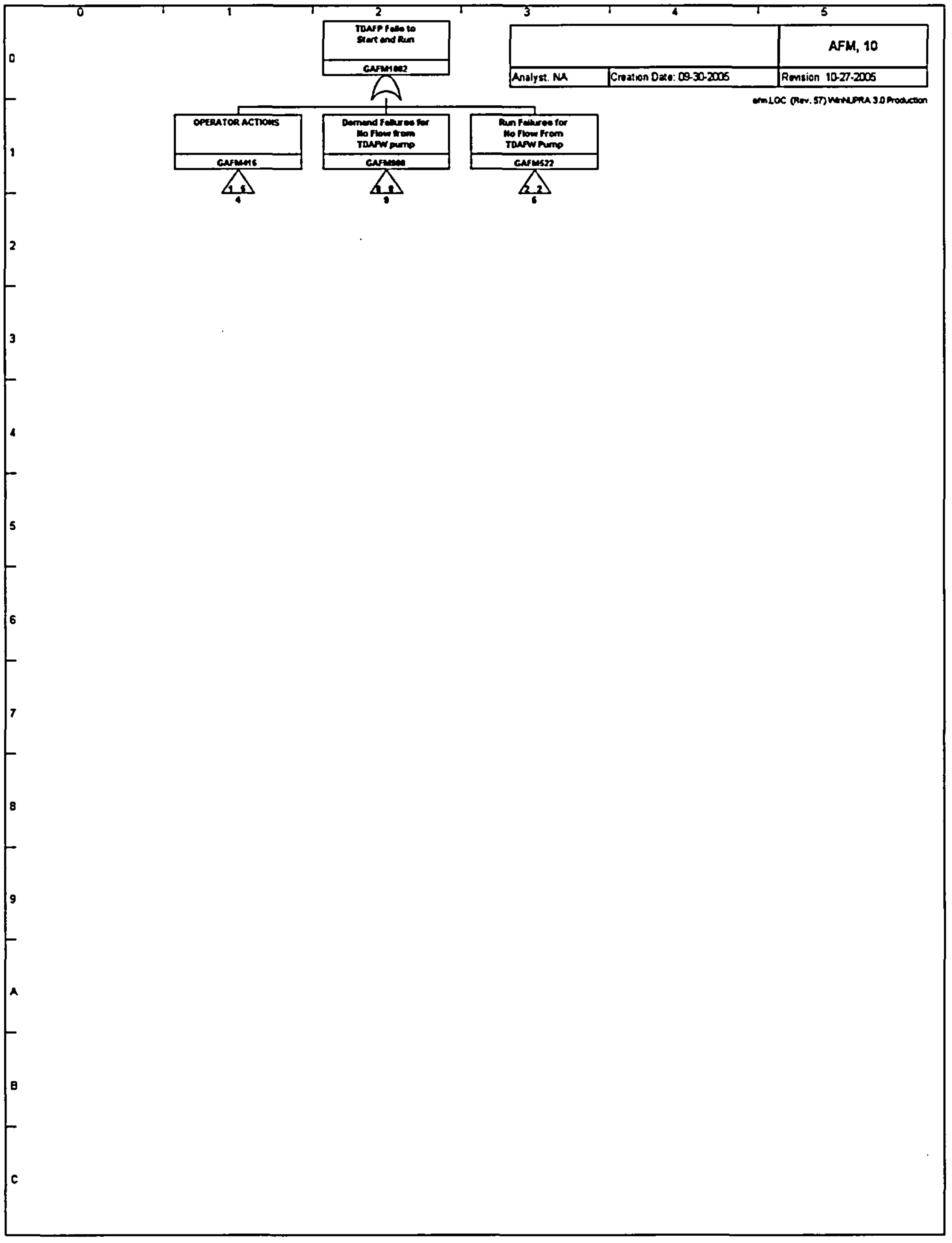
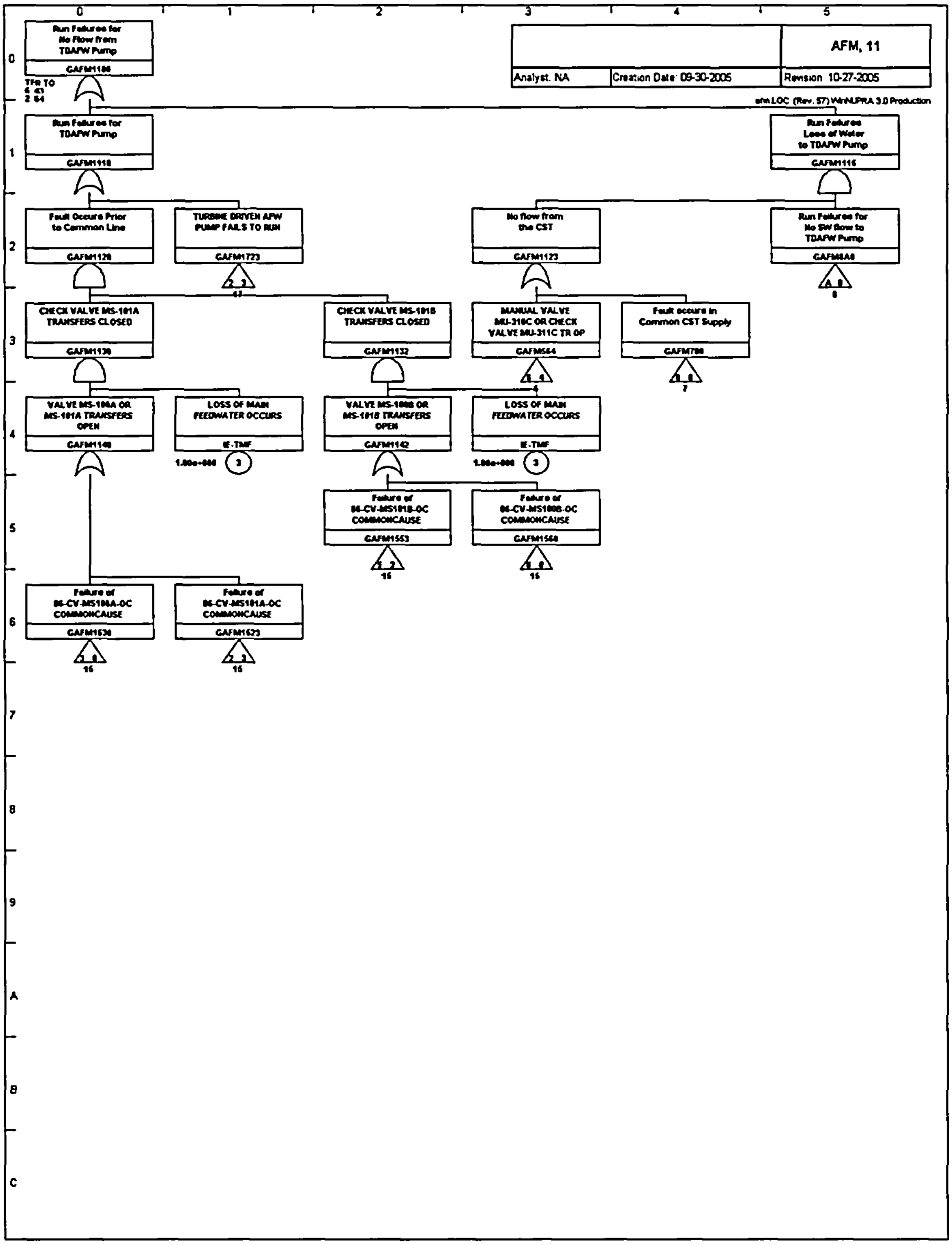


Figure 1 – Fault Tree AFM.LGC (continued)

INTERNAL FLOODING – Fault Tree Analysis for Turbine Building Floods



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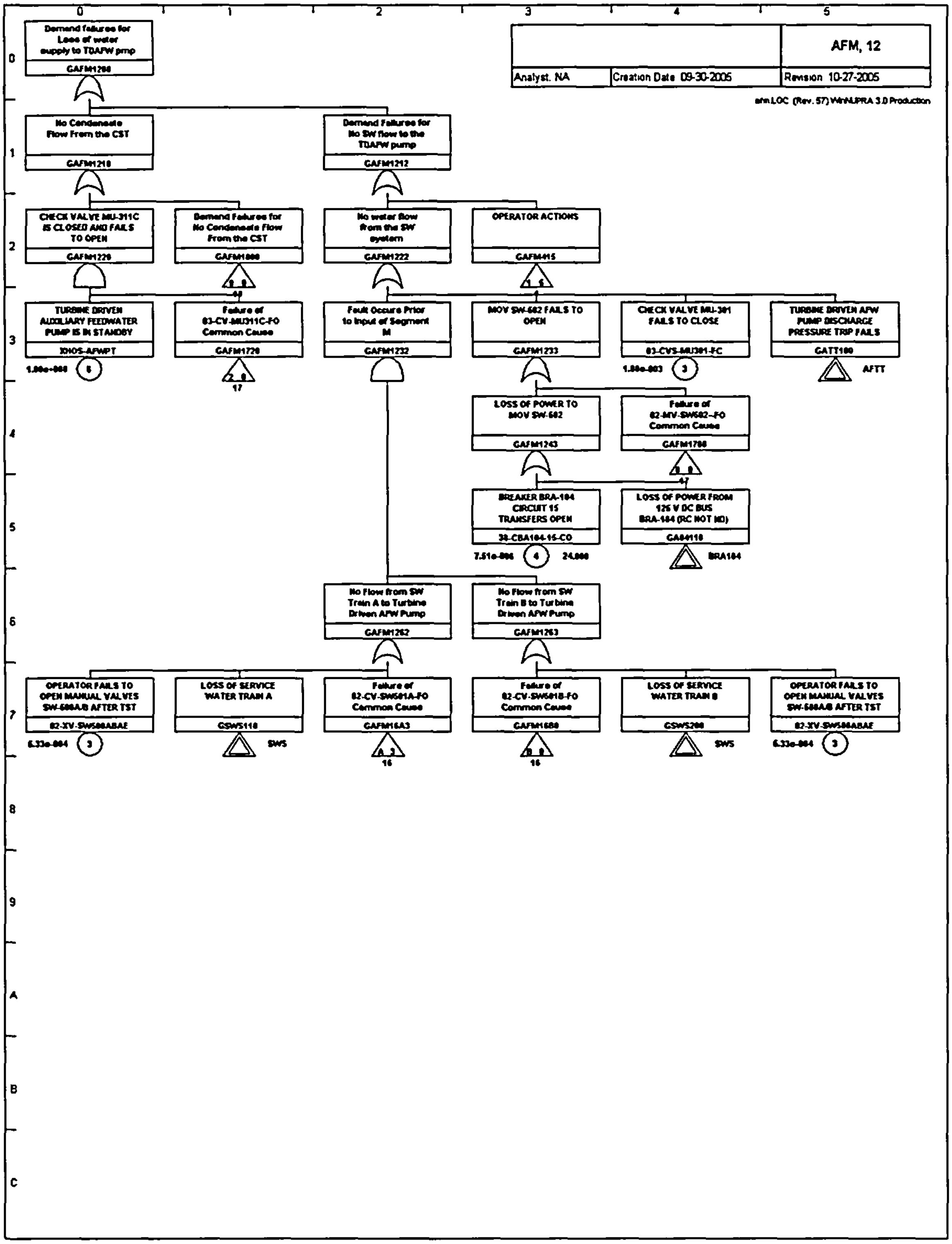


Figure 1 – Fault Tree AFM.LGC (continued)

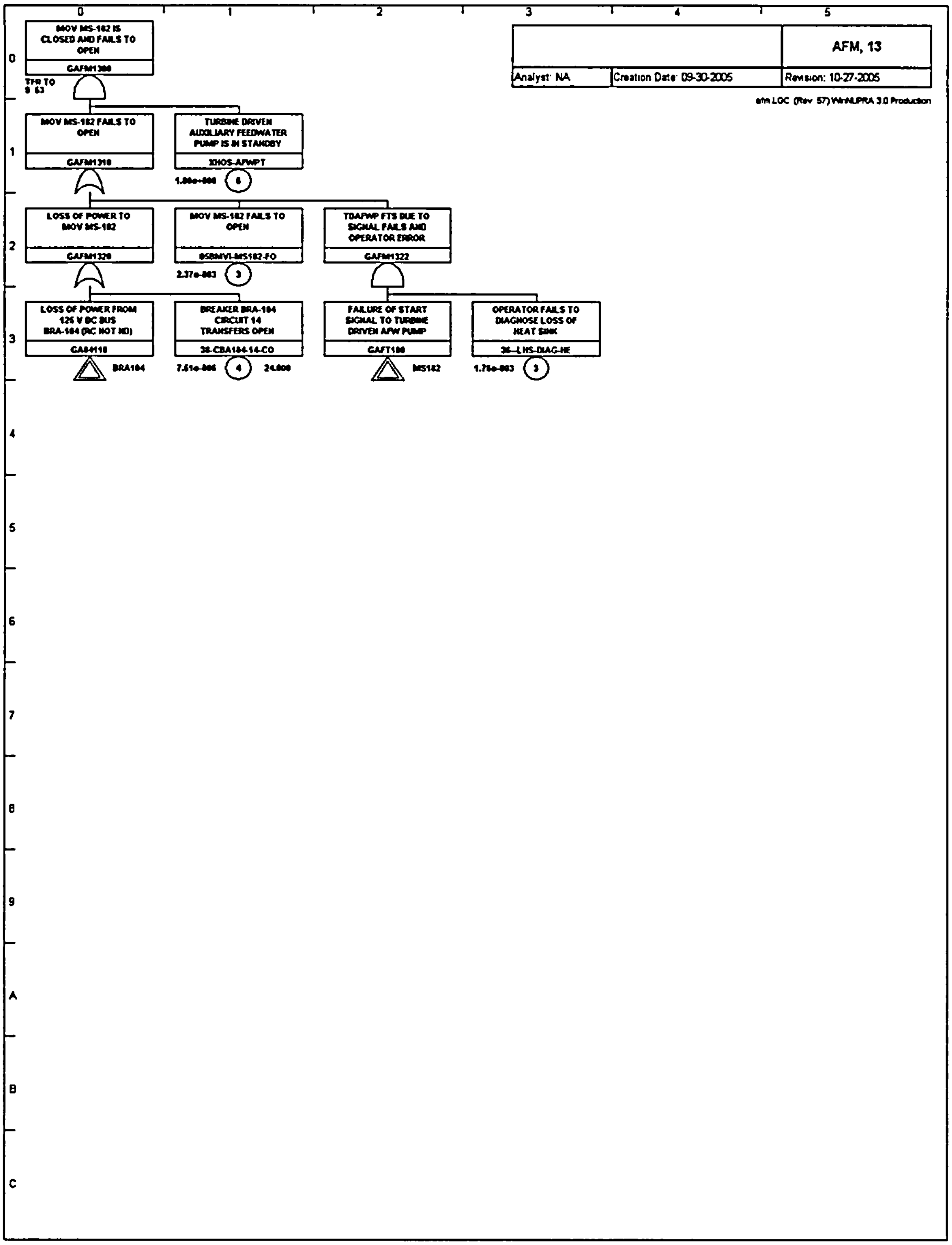


Figure 1 – Fault Tree AFM.LGC (continued)

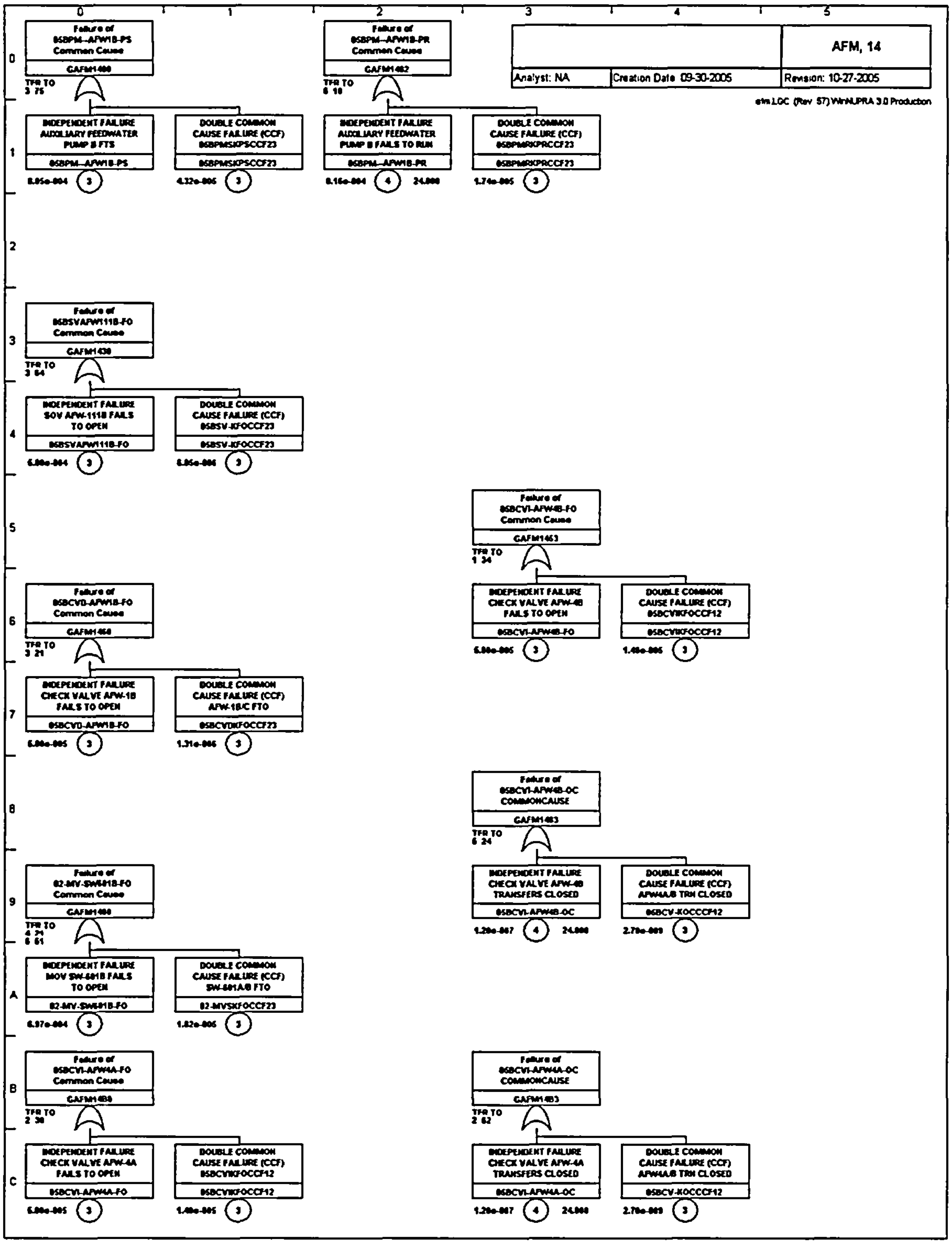
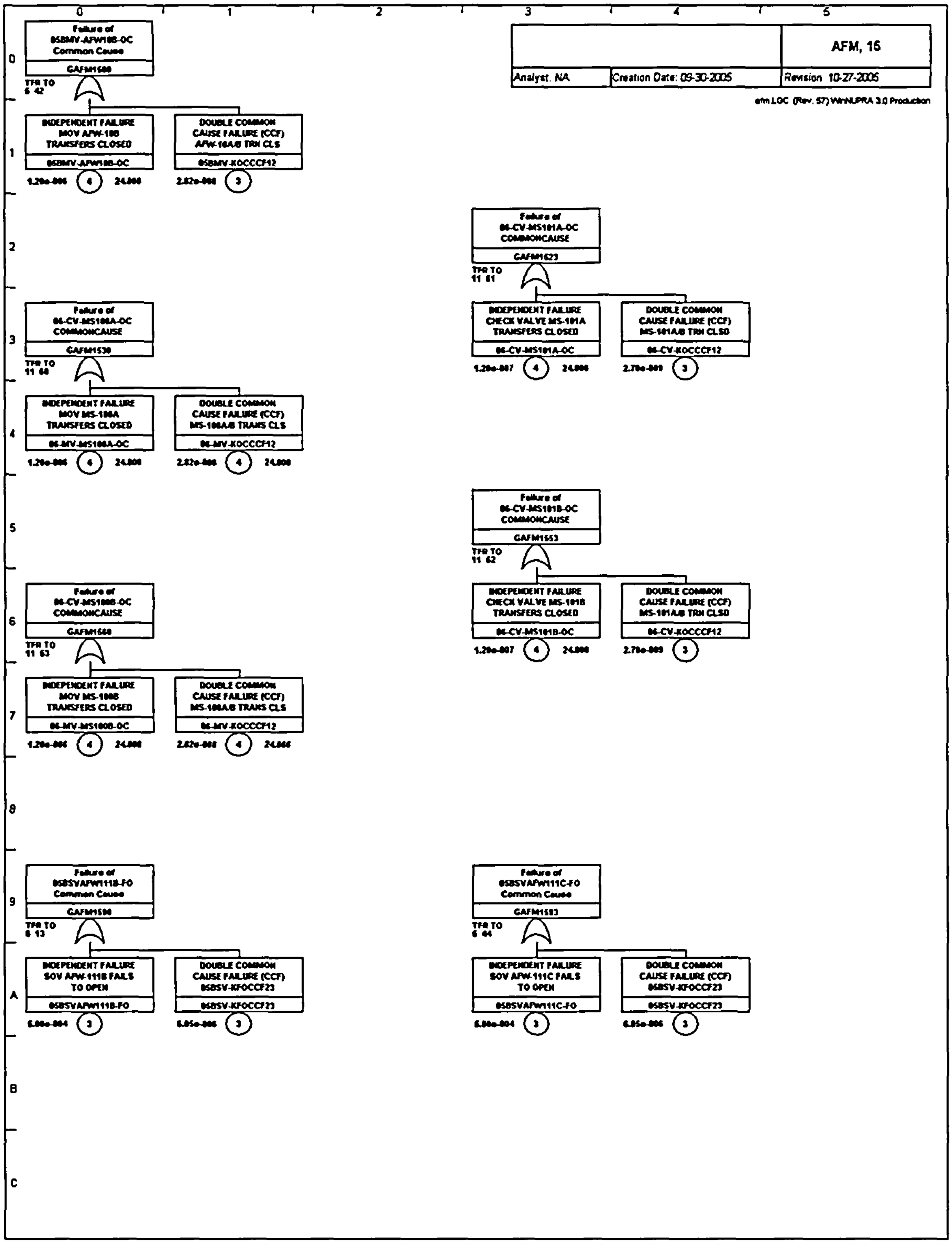


Figure 1 – Fault Tree AFM.LGC (continued)



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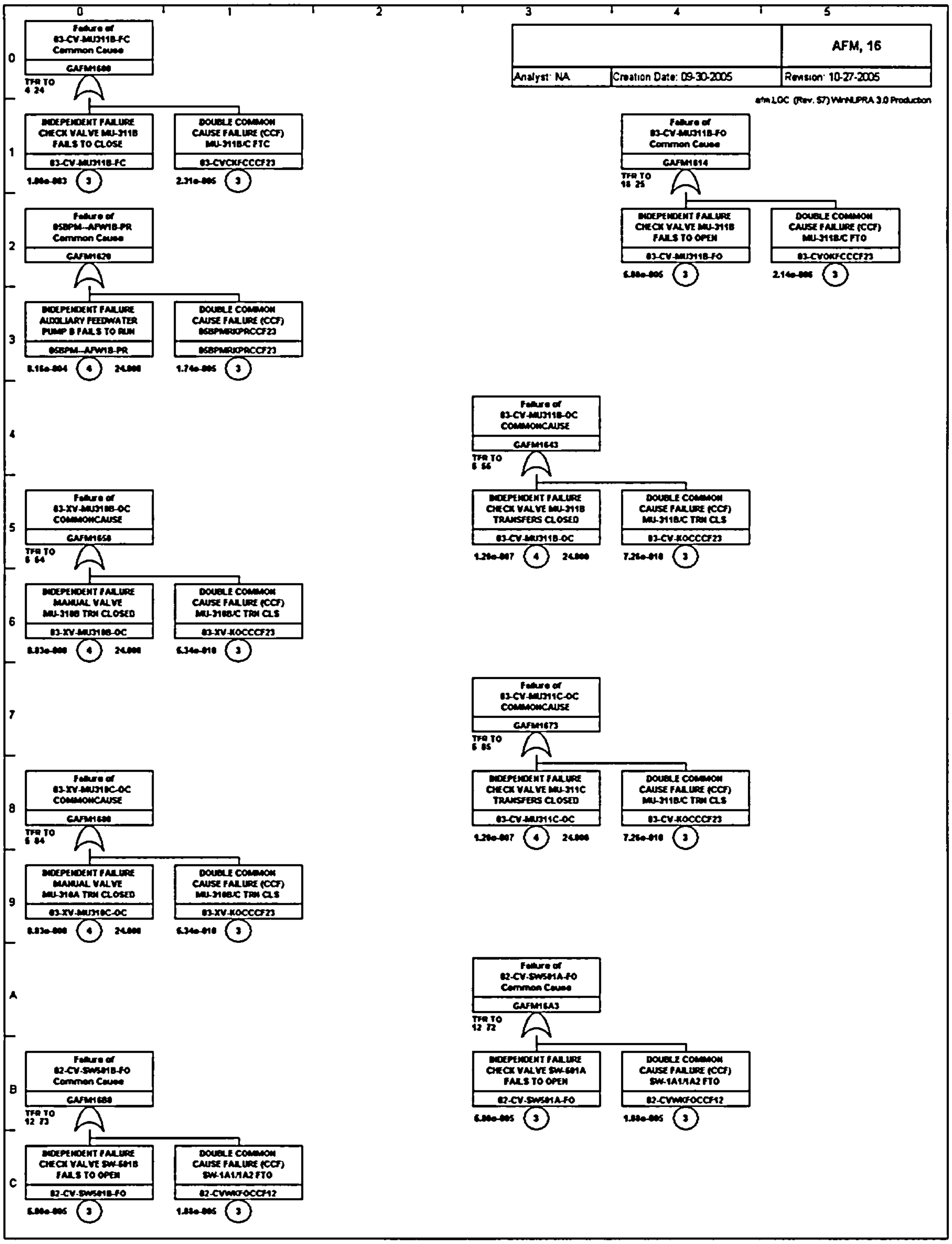


Figure 1 – Fault Tree AFM.LGC (continued)

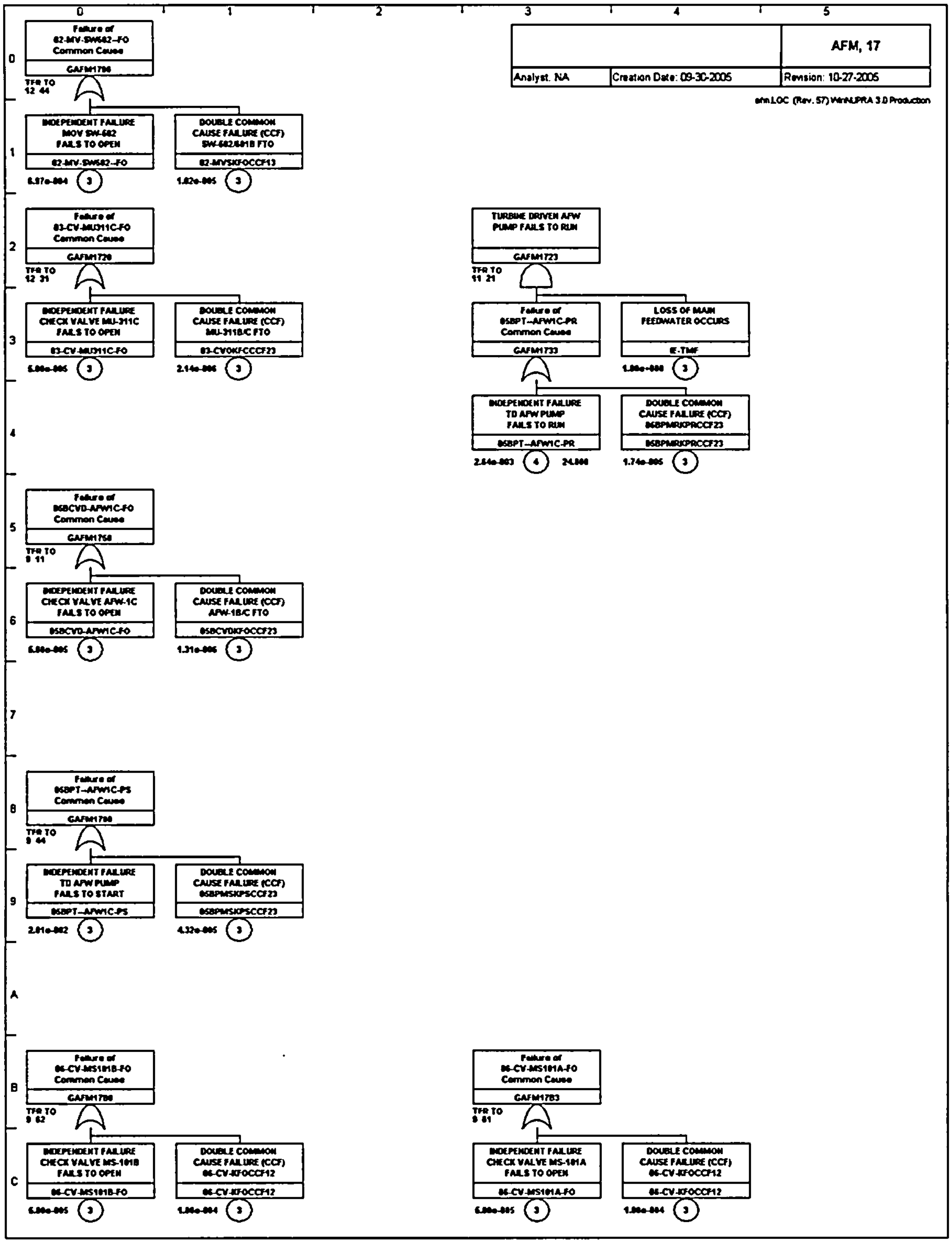


Figure 1 – Fault Tree AFM.LGC (continued)

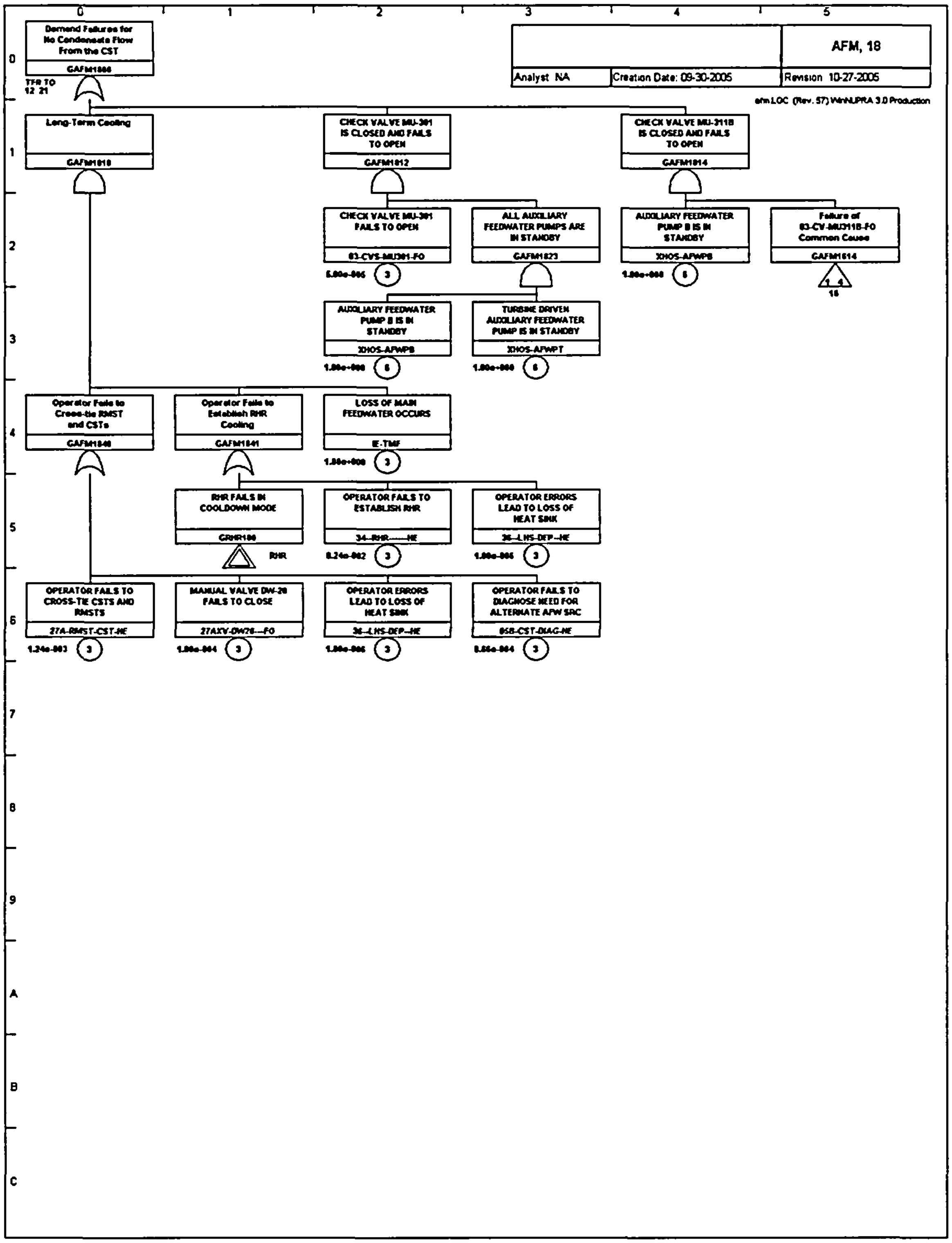


Figure 1 – Fault Tree AFM.LGC (continued)

INTERNAL FLOODING – Fault Tree Analysis for Turbine Building Floods

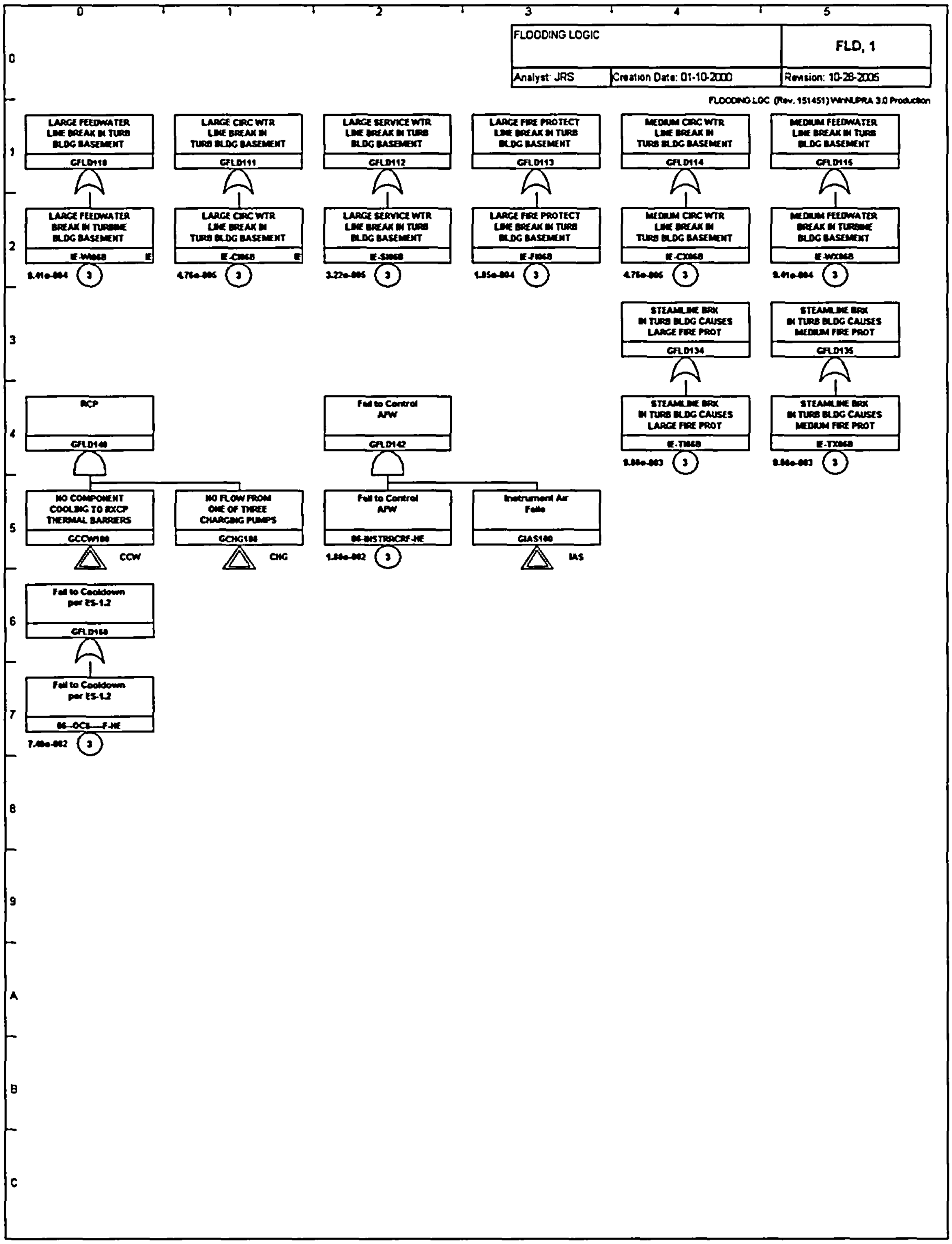


Figure 2 – Fault Tree FLOODING.LGC

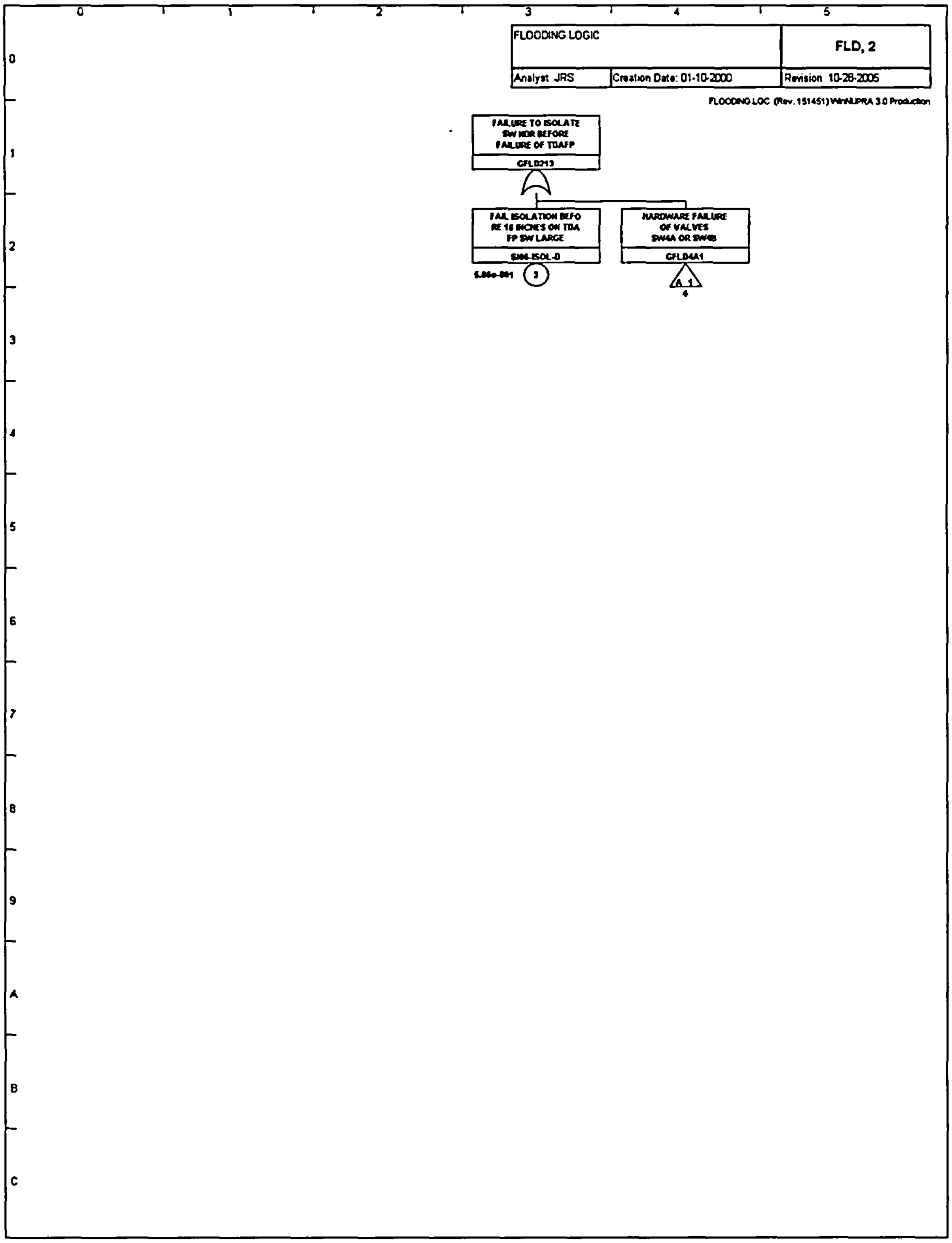


Figure 2 – Fault Tree FLOODING.LGC (continued)

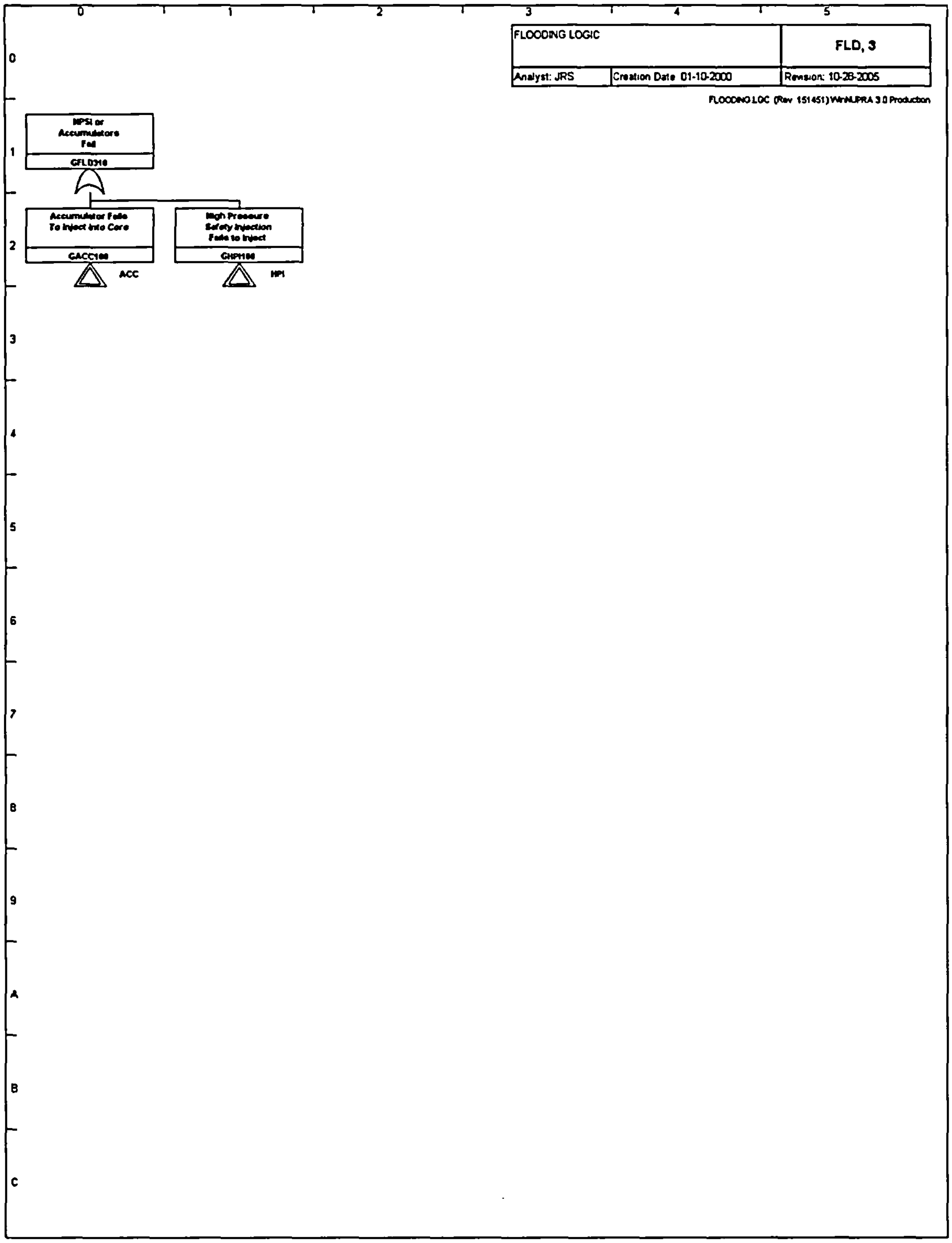


Figure 2 – Fault Tree FLOODING.LGC (continued)

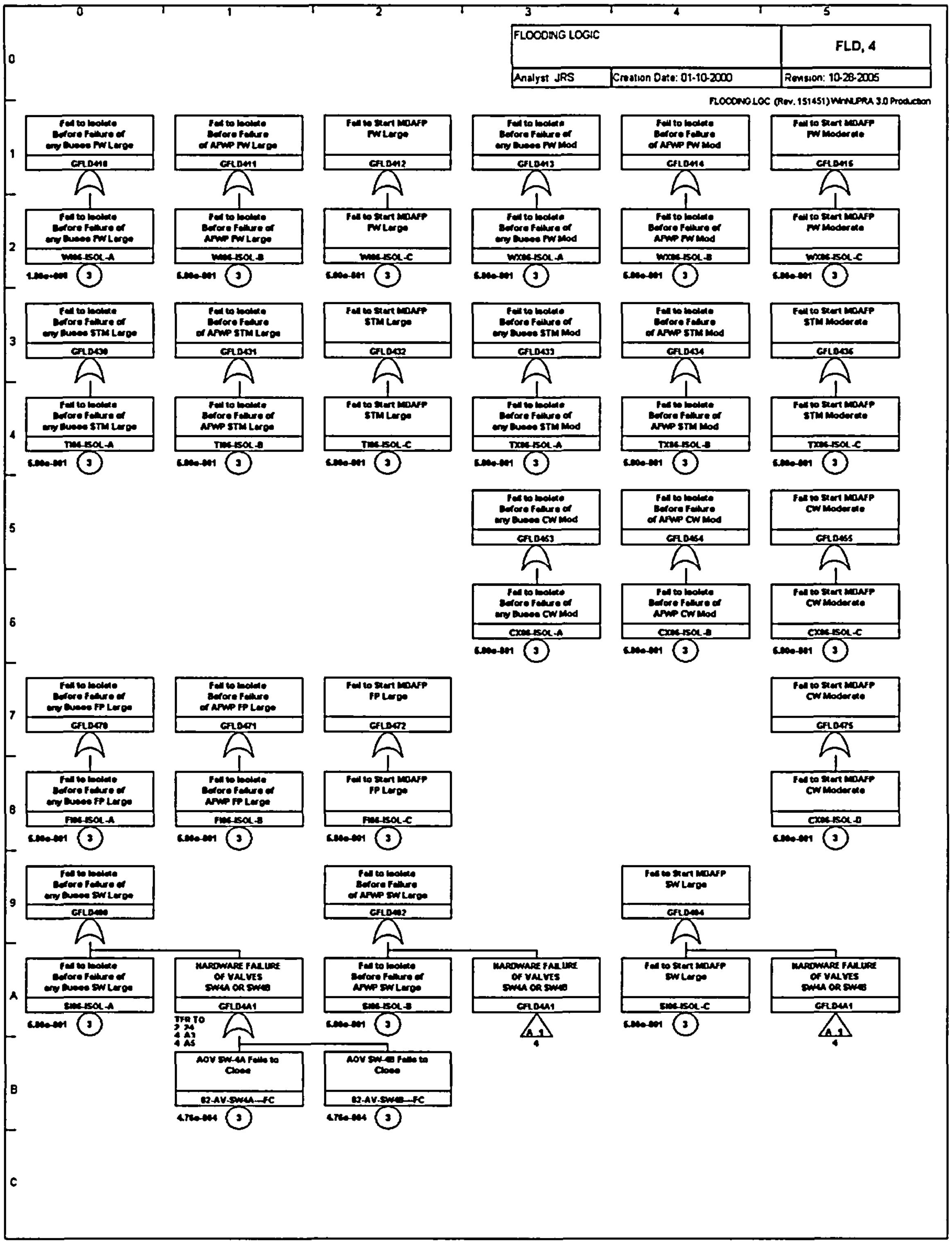


Figure 2 – Fault Tree FLOODING.LGC (continued)

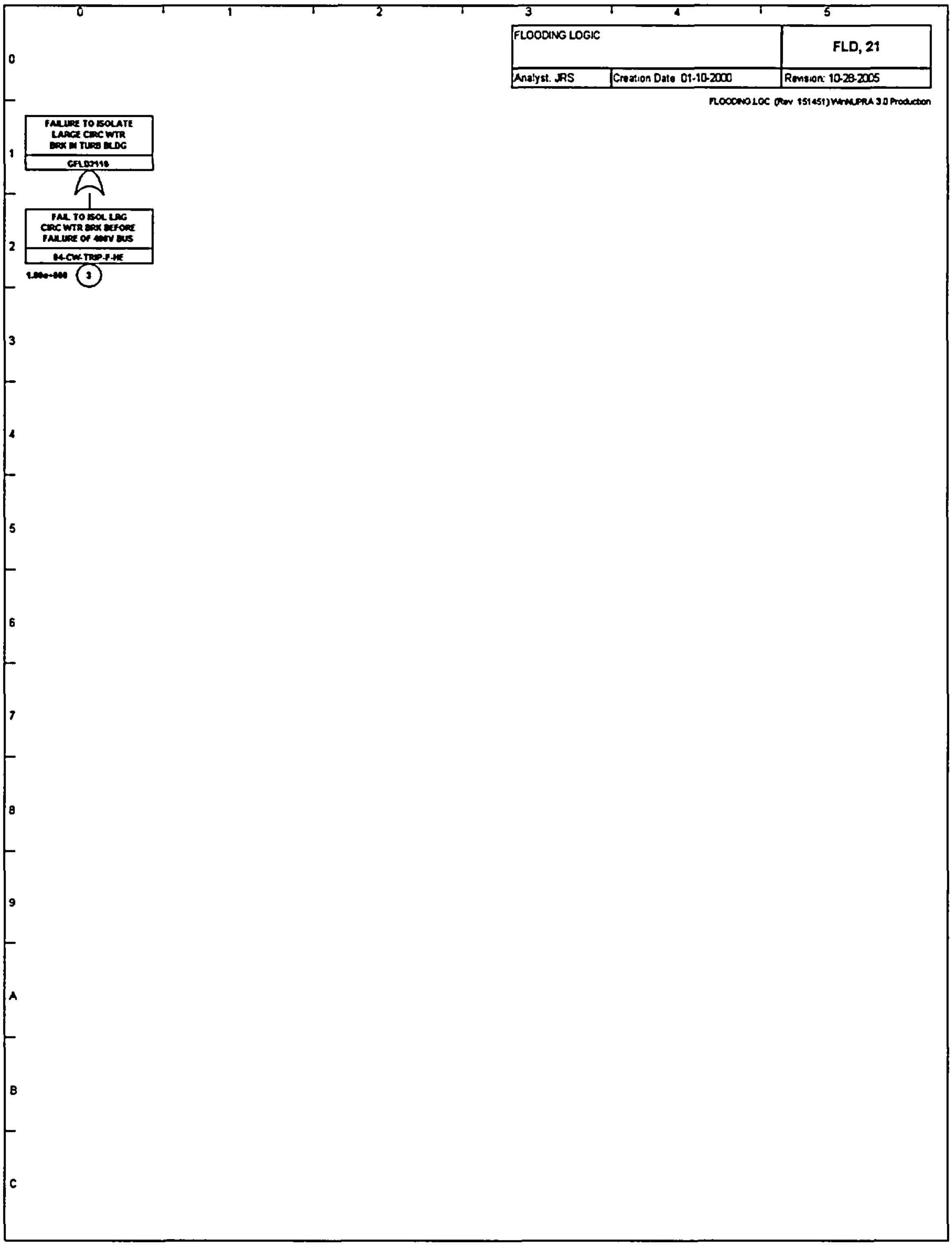


Figure 2 – Fault Tree FLOODING.LGC (continued)

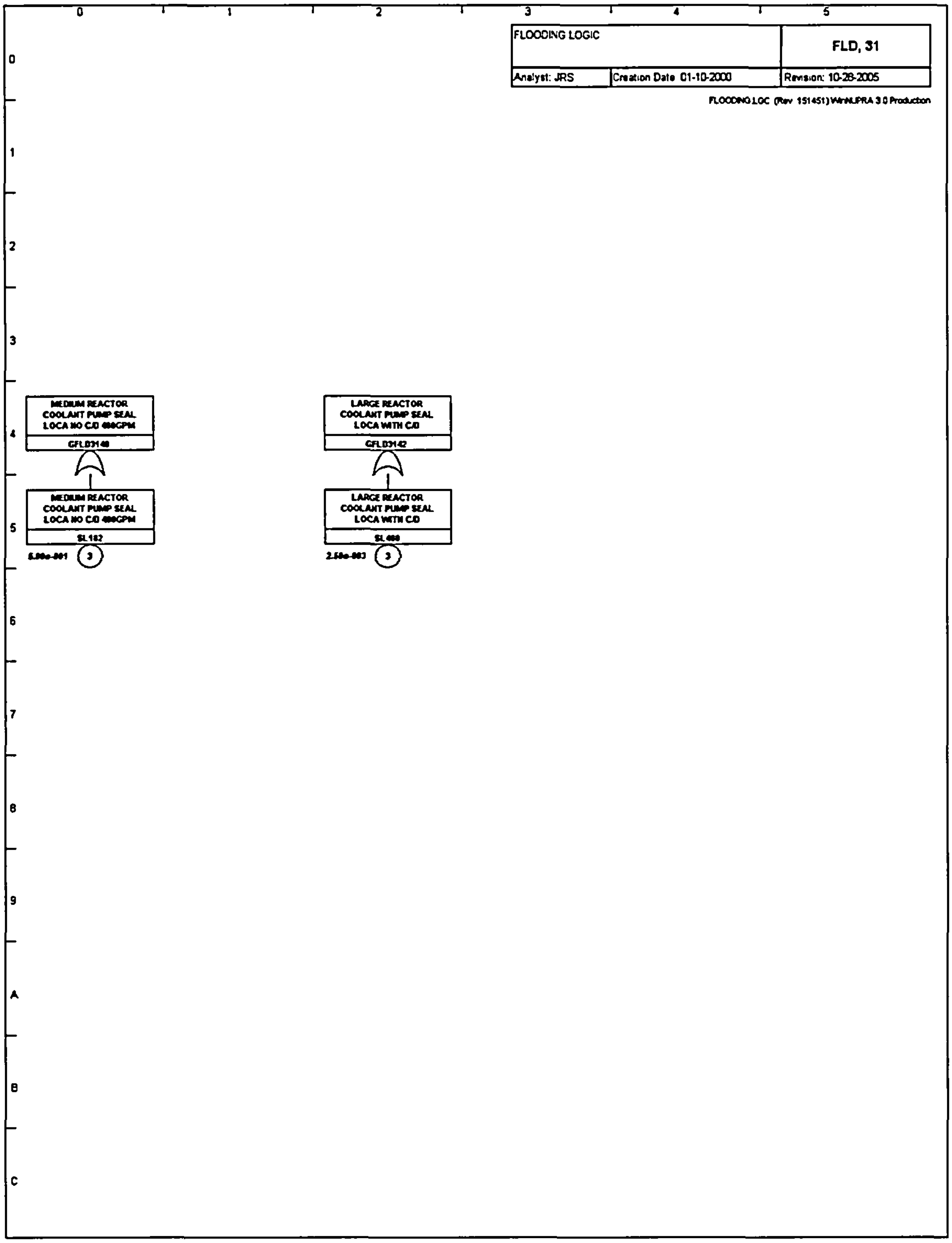


Figure 2 – Fault Tree FLOODING.LGC (continued)

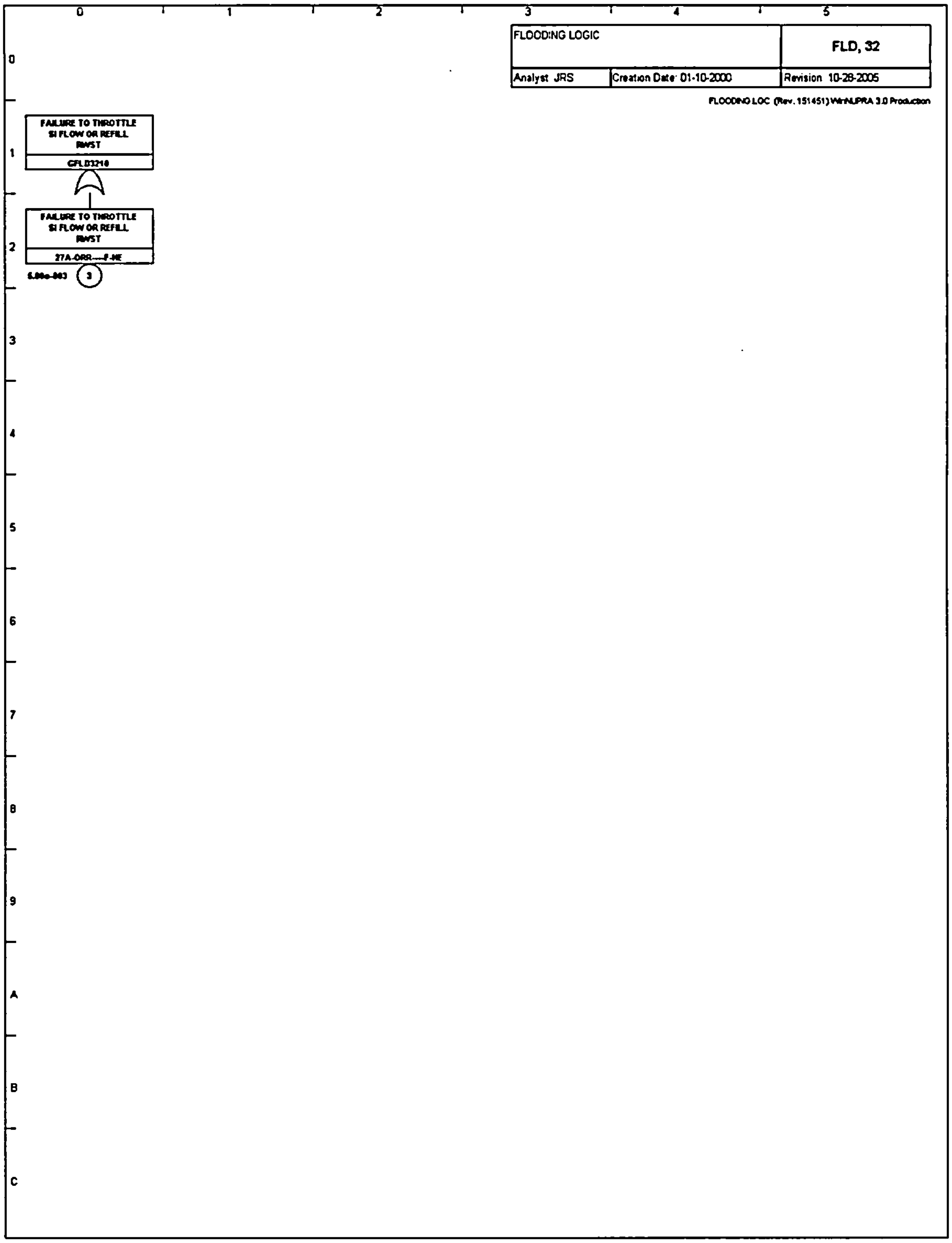


Figure 2 – Fault Tree FLOODING.LGC (continued)

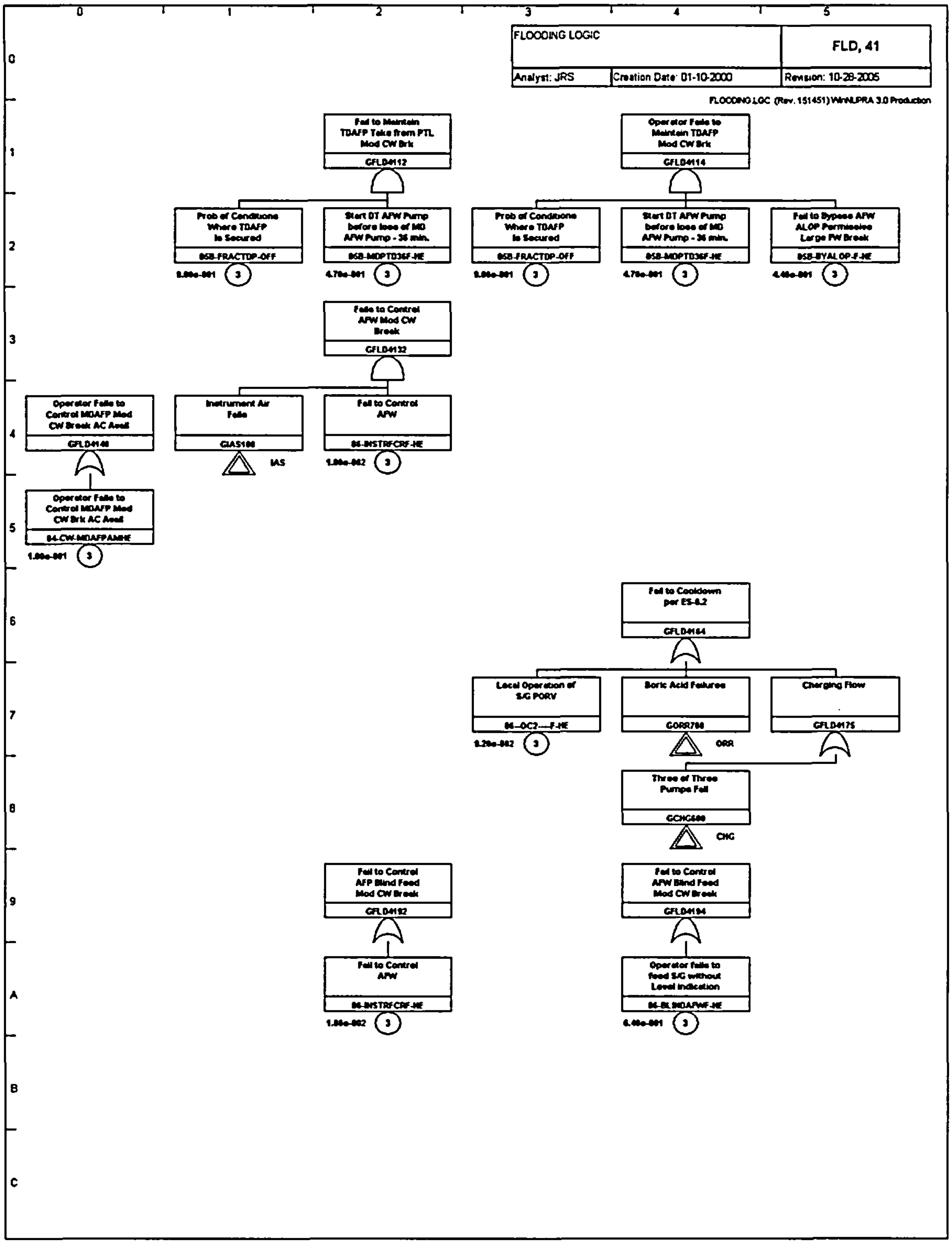


Figure 2 – Fault Tree FLOODING.LGC (continued)

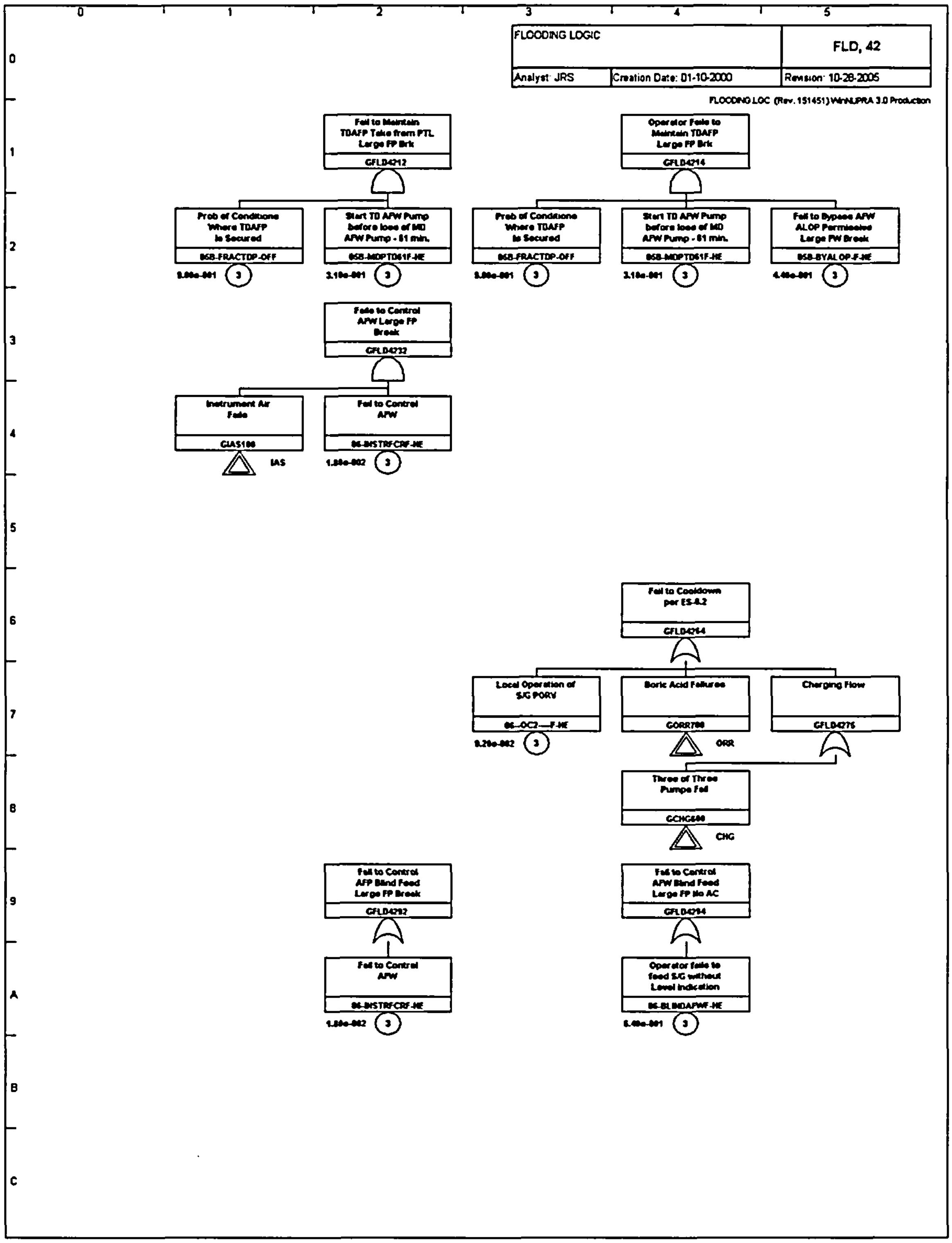


Figure 2 – Fault Tree FLOODING.LGC (continued)

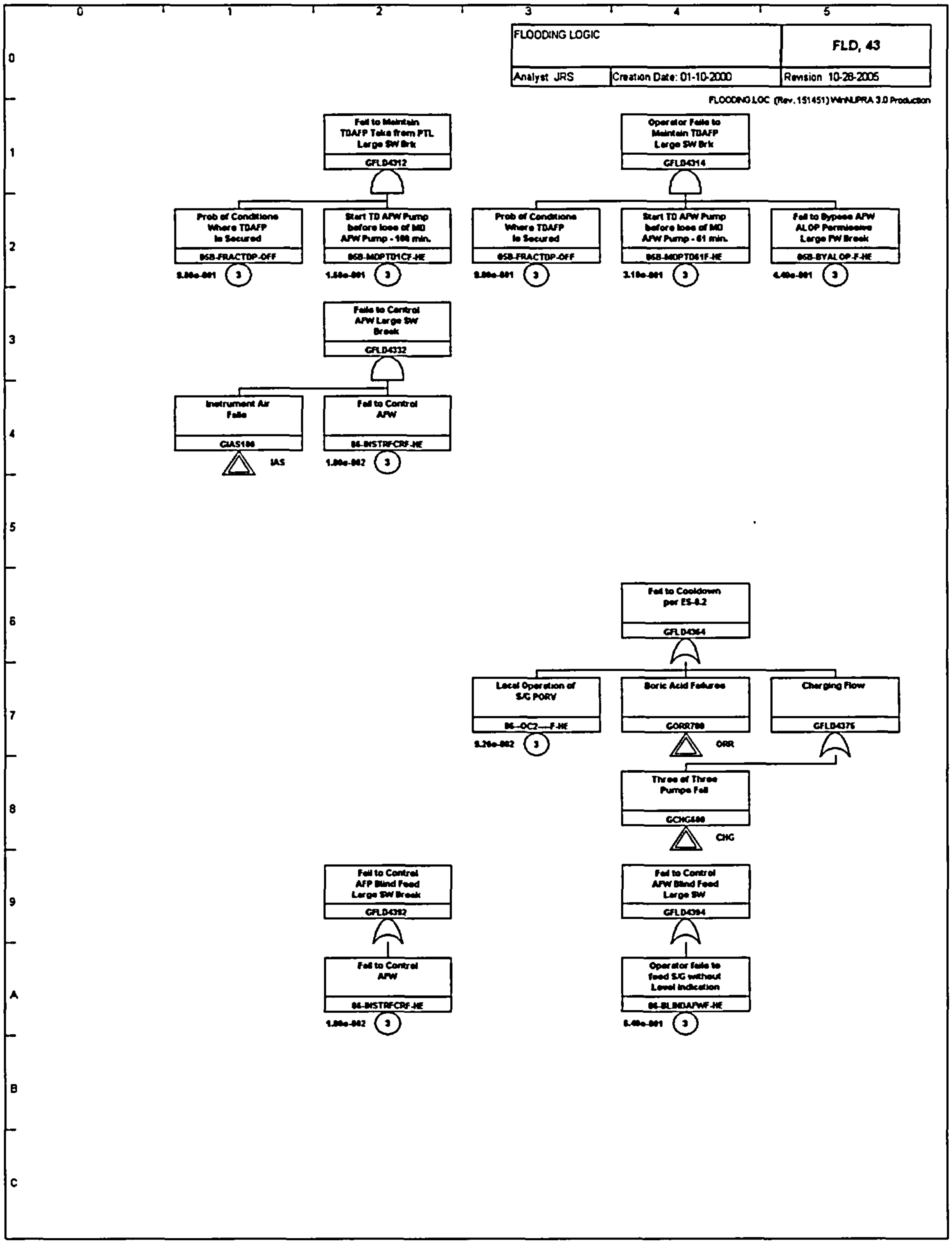


Figure 2 – Fault Tree FLOODING.LGC (continued)

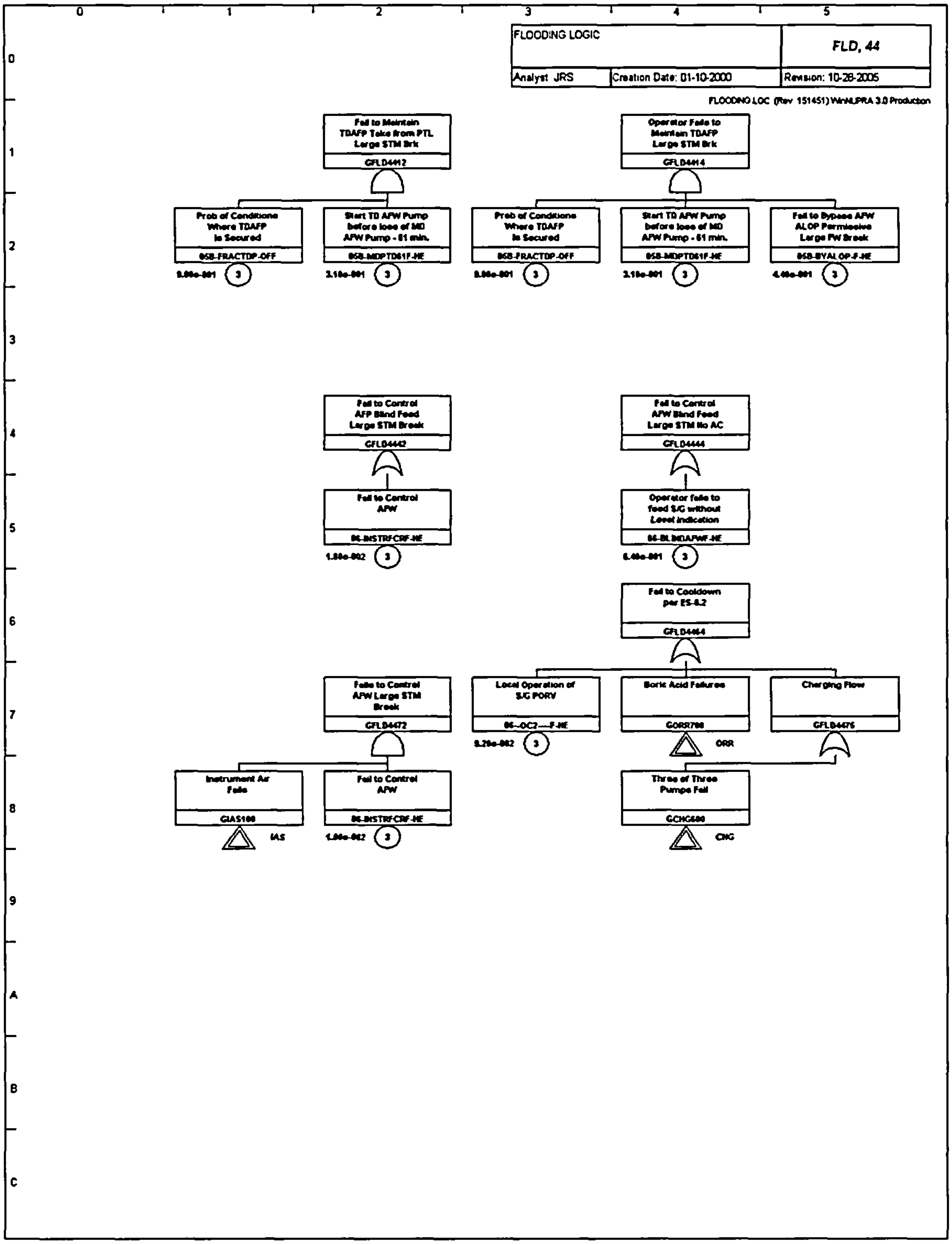


Figure 2 – Fault Tree FLOODING.LGC (continued)

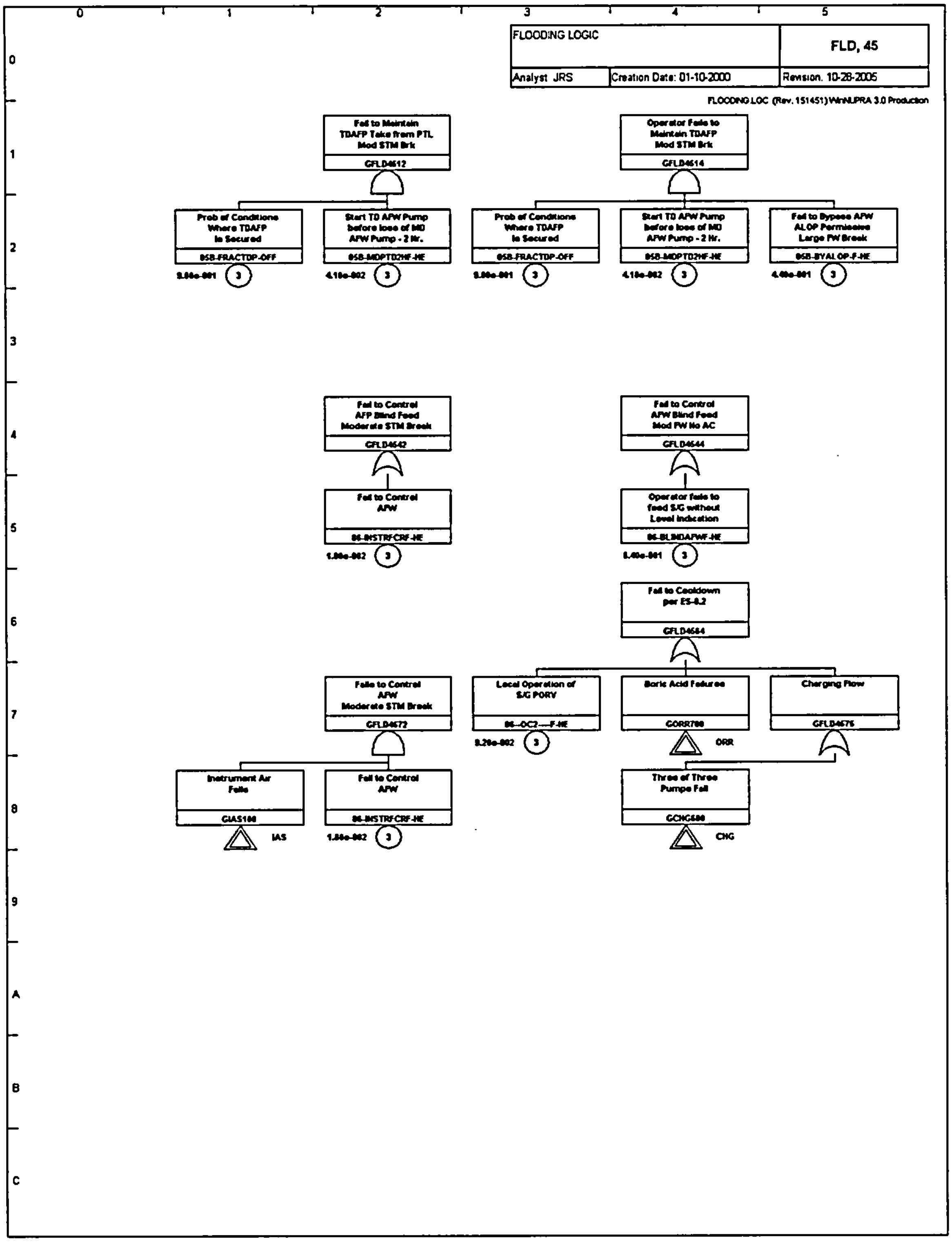


Figure 2 – Fault Tree FLOODING.LGC (continued)

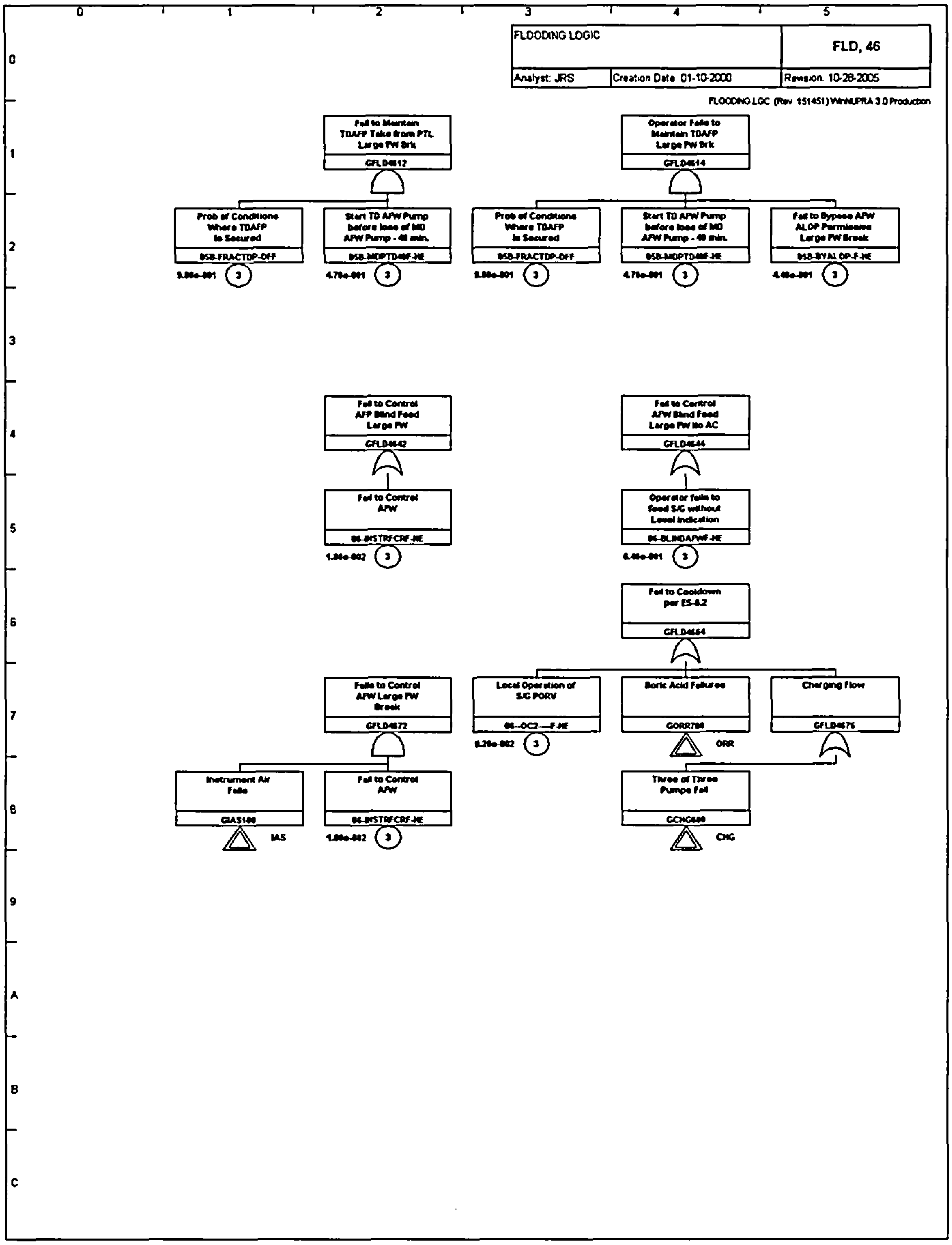


Figure 2 – Fault Tree FLOODING.LGC (continued)

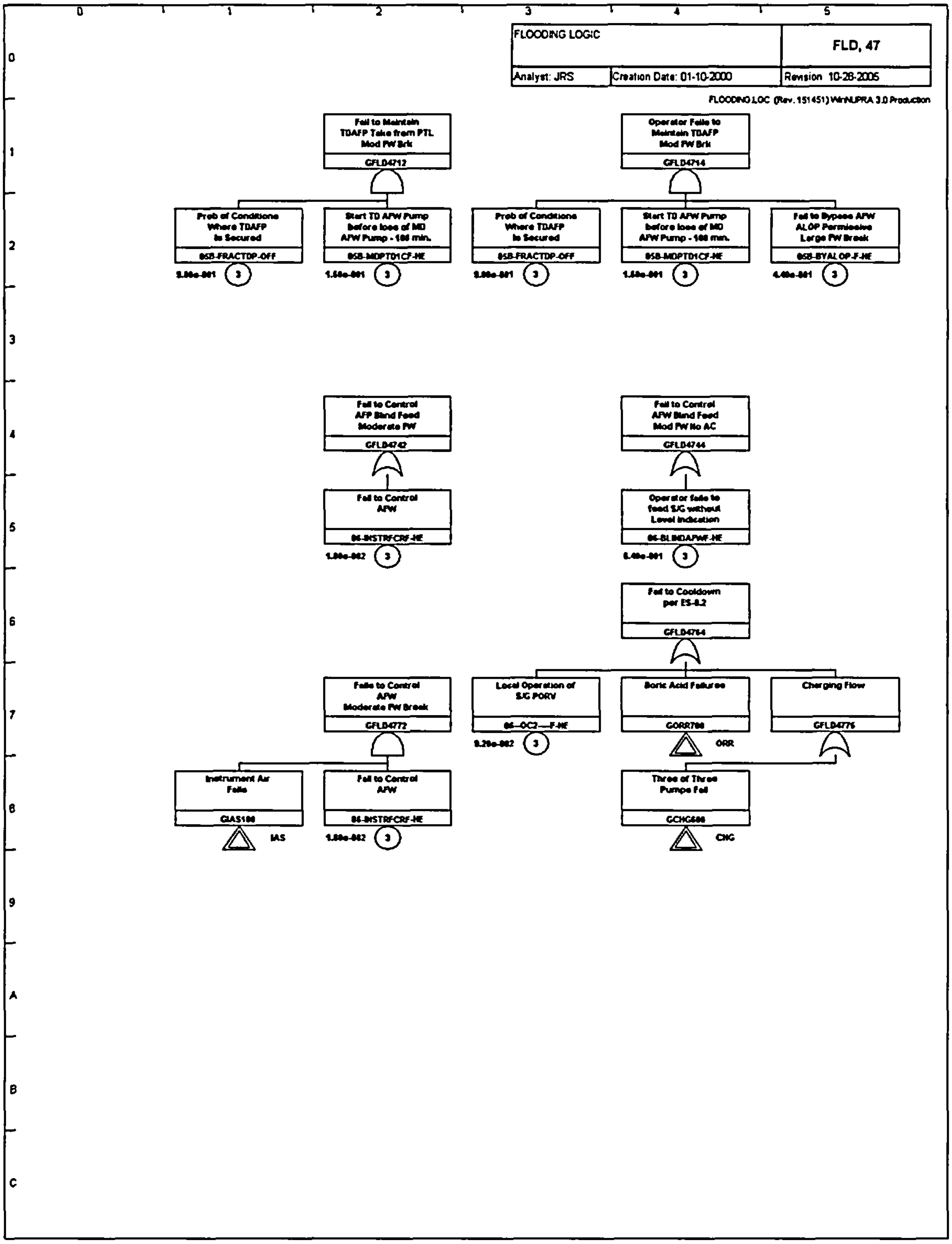


Figure 2 – Fault Tree FLOODING.LGC (continued)

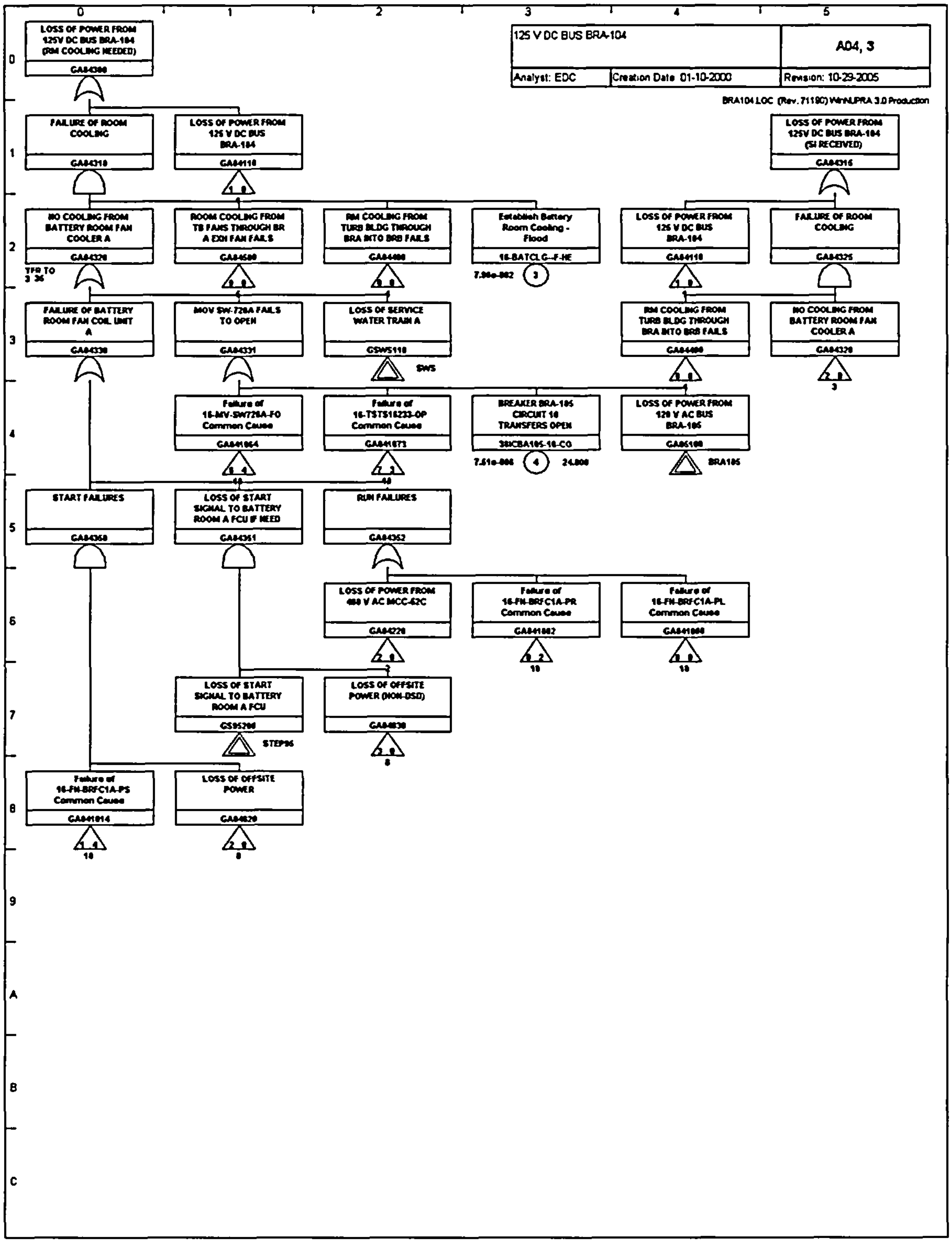


Figure 3 – Placement of New Basic Event 16-BATCLG--F-HE

Appendix C

Fault Tree Analysis

Attachment 1 – Human Error Probabilities

Human Error Probabilities

Prepared by: [signature] George E Baldwin
Signature — Print Name

10/28/05
Date

Reviewed by: [signature] Jeffrey T. Stafford
Signature — Print Name

10-28-05
Date

HEP	02-SW4A-B29F-HE		HEP Description	Close SW-4A & SW-4B During Flood - 29 Min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05		
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.			
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header			
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 13 minutes. The allowed time is 29 minutes.			
Success Criteria	Affected SW header is isolated.			
References Used	A-SW-02			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			
Execution Assumptions	None			
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.			

02-SW4A-B29F-HE, Close SW-4A & SW-4B During Flood - 29 Min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 1: 02-SW4A-B29F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.7e-02	1.7e-02
P_{exe}	3.5e-03	3.5e-03
Total HEP		2.0e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

-   - **None**
- X - **Classroom** Frequency:
- X - **Simulator** Frequency:

Degree of Clarity of Cues & Indications:

- X - **Very Good**
-   - **Average**
-   - **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
-   - **Local Control Panels**
-   - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing

Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

	-	**Skills**
X	-	**Rule**
	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex		-	Complex
	-	Simple	X	-	Simple

Environment:

Lighting			Heat/Humidity		
X	-	Normal	X	-	Normal
	-	Emergency		-	Hot / Humid
	-	Portable		-	Cold
Radiation			**Atmosphere**		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

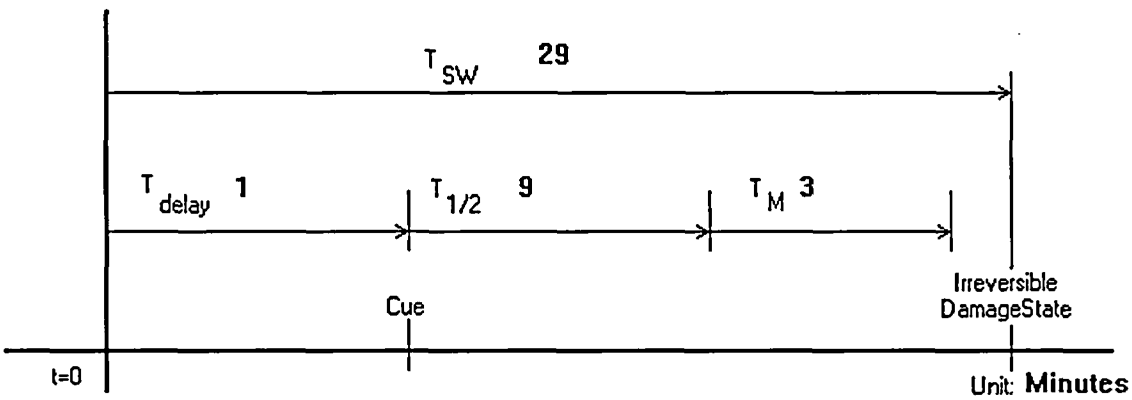
Stress:

	-	**Optimum (Low)**
X	-	**Moderate**
	-	**Extreme (High)**

Cognitive Unrecovered

02-SW4A-B29F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates.
Additional SW Alarms based on event



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 16.00 Minutes

Table 2: 02-SW4A-B29F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	j	1.0e-03
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.7e-02

Cognitive Recovery

02-SW4A-B29F-HE

Table 3: 02-SW4A-B29F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.7e-02

Recovery Factors Identified:
STAR process is assumed.

Execution Unrecovered

02-SW4A-B29F-HE

Table 4: 02-SW4A-B29F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4A-B29F-HE

Table 5: 02-SW4A-B29F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	3.5e-03				
		Total Unrecovered:	3.5e-03			Total Recovered:	3.5e-03

HEP	02-SW4A-B45F-HE	HEP Description	Close SW-4A & SW-4B During Flood - 45 Min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.		
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 13 minutes. The allowed time is 45 minutes.		
Success Criteria	Affected SW header is isolated.		
References Used	A-SW-02		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.		

02-SW4A-B45F-HE, Close SW-4A & SW-4B During Flood - 45 Min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 6: 02-SW4A-B45F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.7e-02	1.7e-02
P_{exe}	3.5e-03	3.5e-03
Total HEP		2.0e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

	-	**None**	
X	-	**Classroom**	Frequency:
X	-	**Simulator**	Frequency:

Degree of Clarity of Cues & Indications:

X	-	**Very Good**
	-	**Average**
	-	**Poor**

Human-Machine Interface:

X	-	**Control Room Panels**
	-	**Local Control Panels**
	-	**Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

	-	**Skills**
X	-	**Rule**
	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex		-	Complex
	-	Simple	X	-	Simple

Environment:

Lighting			Heat/Humidity		
X	-	Normal	X	-	Normal
	-	Emergency		-	Hot / Humid
	-	Portable		-	Cold

Radiation			Atmosphere		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

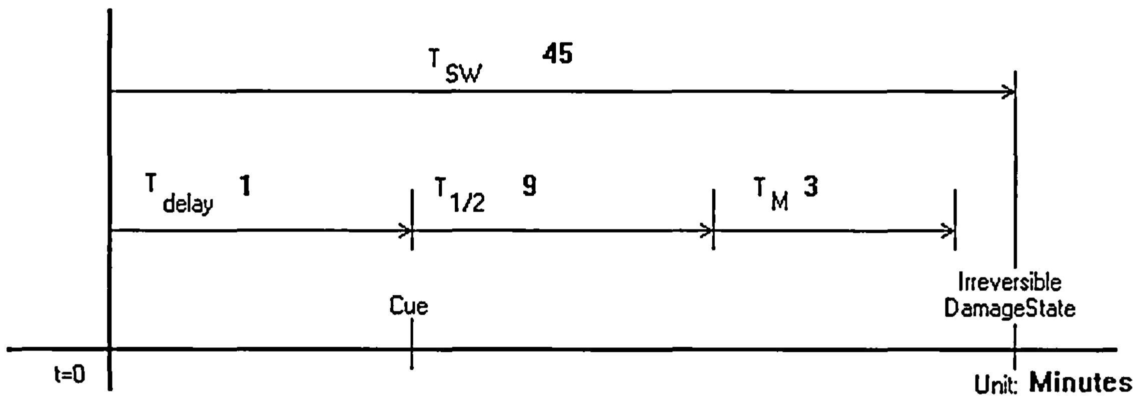
Stress:

	-	**Optimum (Low)**
X	-	**Moderate**
	-	**Extreme (High)**

Cognitive Unrecovered

02-SW4A-B45F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates.
Additional SW Alarms based on event



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 32.00 Minutes

Table 7: 02-SW4A-B45F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	j	1.0e-03
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.7e-02

Cognitive Recovery

02-SW4A-B45F-HE

Table 8: 02-SW4A-B45F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
										Sum of Pc_a through Pc_h = Initial Pc =	1.7e-02

Recovery Factors identified:
STAR process is assumed.

Execution Unrecovered

02-SW4A-B45F-HE

Table 9: 02-SW4A-B45F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4A-B45F-HE

Table 10: 02-SW4A-B45F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	3.5e-03				
		Total Unrecovered:	3.5e-03			Total Recovered:	3.5e-03

HEP	02-SW4A-B51F-HE	HEP Description	Close SW-4A & SW-4B During Flood - 51 Min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.		
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 13 minutes. The allowed time is 51 minutes.		
Success Criteria	Affected SW header is isolated.		
References Used	A-SW-02		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.		

02-SW4A-B51F-HE, Close SW-4A & SW-4B During Flood - 51 Min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 11: 02-SW4A-B51F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.7e-02	1.7e-02
P_{exe}	3.5e-03	3.5e-03
Total HEP		2.0e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

	-	**None**	
X	-	**Classroom**	Frequency:
X	-	**Simulator**	Frequency:

Degree of Clarity of Cues & Indications:

X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing

Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

	-	**Skills**
X	-	**Rule**
	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex		-	Complex
	-	Simple	X	-	Simple

Environment:

Lighting			Heat/Humidity		
X	-	Normal	X	-	Normal
	-	Emergency		-	Hot / Humid
	-	Portable		-	Cold

Radiation			Atmosphere		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

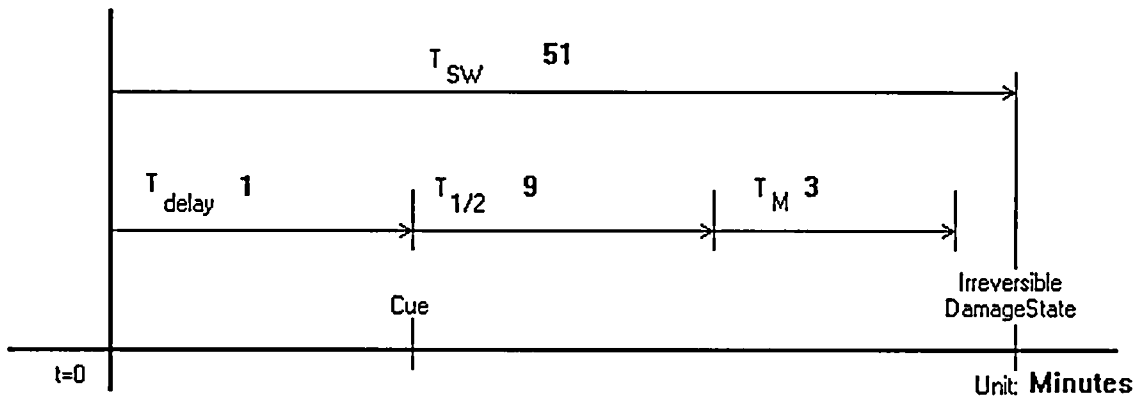
Stress:

	-	**Optimum (Low)**
X	-	**Moderate**
	-	**Extreme (High)**

Cognitive Unrecovered

02-SW4A-B51F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates.
Additional SW Alarms based on event



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 38.00 Minutes

Table 12: 02-SW4A-B51F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	j	1.0e-03
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.7e-02

Cognitive Recovery

02-SW4A-B51F-HE

Table 13: 02-SW4A-B51F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
								Sum of Pc_a through Pc_h = Initial Pc =			1.7e-02

Recovery Factors Identified:
STAR process is assumed.

Execution Unrecovered

02-SW4A-B51F-HE

Table 14: 02-SW4A-B51F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4A-B51F-HE

Table 15: 02-SW4A-B51F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	3.5e-03				
		Total Unrecovered:	3.5e-03			Total Recovered:	3.5e-03

HEP	02-SW4A-B66F-HE		HEP Description	Close SW-4A & SW-4B During Flood - 66 Min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05		
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.			
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header			
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 13 minutes. The allowed time is 66 minutes.			
Success Criteria	Affected SW header is isolated.			
References Used	A-SW-02			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			
Execution Assumptions	None			
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.			

02-SW4A-B66F-HE, Close SW-4A & SW-4B During Flood - 66 Min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 16: 02-SW4A-B66F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.7e-02	1.7e-02
P_{exe}	3.5e-03	3.5e-03
Total HEP		2.0e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

	-	**None**	
X	-	**Classroom**	Frequency:
X	-	**Simulator**	Frequency:

Degree of Clarity of Cues & Indications:

X	-	**Very Good**
	-	**Average**
	-	**Poor**

Human-Machine Interface:

X	-	**Control Room Panels**
	-	**Local Control Panels**
	-	**Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

- Skills
- X - Rule
- Knowledge

Complexity of Response

Cognitive		Execution	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold
Radiation		**Atmosphere**	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- Control Room Front Panels	Accessible
	- Control Room Back Panels	
	- Hot Shutdown Panels	
	- Auxiliary Building	
	- Electrical Building	
	- Containment	
	- Pump house	
	- Switchyard	

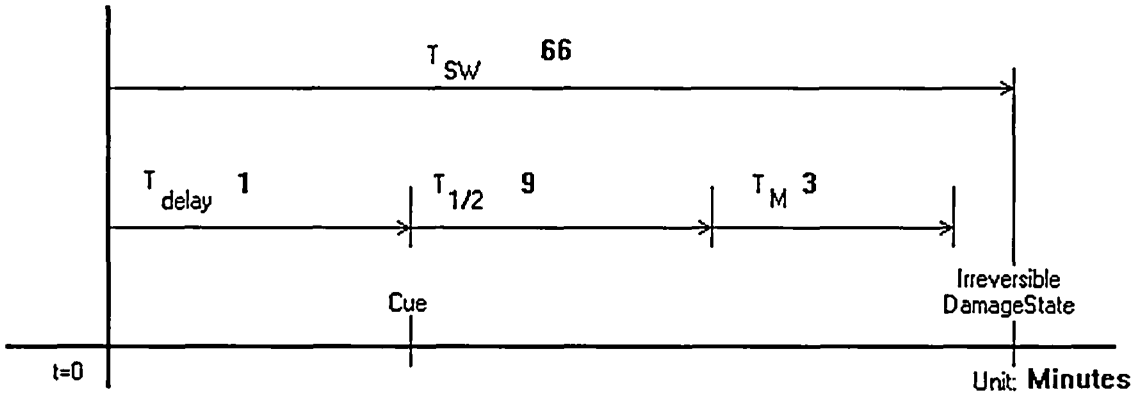
Stress:

- Optimum (Low)
- X - Moderate
- Extreme (High)

Cognitive Unrecovered

02-SW4A-B66F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates.
Additional SW Alarms based on event



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 53.00 Minutes

Table 17: 02-SW4A-B66F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	j	1.0e-03
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.7e-02

Cognitive Recovery

02-SW4A-B66F-HE

Table 18: 02-SW4A-B66F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
										Sum of Pc_a through Pc_h = Initial Pc =	1.7e-02

Recovery Factors identified:
STAR process is assumed.

Execution Unrecovered

02-SW4A-B66F-HE

Table 19: 02-SW4A-B66F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4A-B66F-HE

Table 20: 02-SW4A-B66F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	3.5e-03				
		Total Unrecovered:	3.5e-03			Total Recovered:	3.5e-03

HEP	04-CWSTP13-F-HE,	HEP Description	Trip CW Pump during Flood Event - 13 minutes
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.		
Event Description	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly. The NAO then reports water and rapidly increasing water level in Turbine Building Basement. The CRS directs the tripping of the reactor and then both CW Pumps.		
Assumptions for the Event	The following assumptions are made: • The operators will determine a waterbox boot failure due to the volume and level increase of the water • Operator will trip the CW pumps to put the plant in a safe condition without procedural directive.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At the waterbox boot failure, water enters the Turbine building Sump causing 47033-P, Miscellaneous Sump Level High, to actuate. Approximately 1 minute later the NAO is sent to investigate upon arrival discovers the water with a rapidly increasing level. The NAO then informs the Control room of the situation approximately 5.4 minutes after the alarm. Within 2.4 minute of receiving this information the Control Room personnel decide to trip the CW pumps. The total elapsed time from the waterbox boot failure is approximately 9 minutes. The allowed time is 13 minutes.		
Success Criteria	Both CW pump are stopped.		
References Used	FP-OP-COO-01, A-MDS-30, ARP 47033-P		
Cognitive Assumption	None		
Cognitive Recovery Assumptions	None.		

Execution Assumptions	None
Execution Recovery Assumptions	None

04-CWSTP13-F-HE, Trip CW Pump during Flood Event - 13 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/18/05
Cognitive Method:	HCR/ORE/THERP

Table 21: 04-CWSTP13-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	2.5e-01
P_{exe}	1.0e-02	1.0e-02
Total HEP		2.6e-01
Error Factor		1

HFE Scenario Description:
Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate stress due to magnitude of event. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-MDS-30 directs the investigation of the level and source.
FP-OP-COO-01 is a fleet procedure for the conduct of operations, which directs the operator to take action to maintain the plant in a safe condition.

Training:

- X - **None**
- - **Classroom**
- - **Simulator**

Degree of Clarity of Cues & Indications:

- - **Very Good**
- X - **Average**
- - **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- - **Local Control Panels**
- - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- Rule
- X - Knowledge

Complexity of Response

Cognitive	Execution
- Complex	- Complex
X - Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

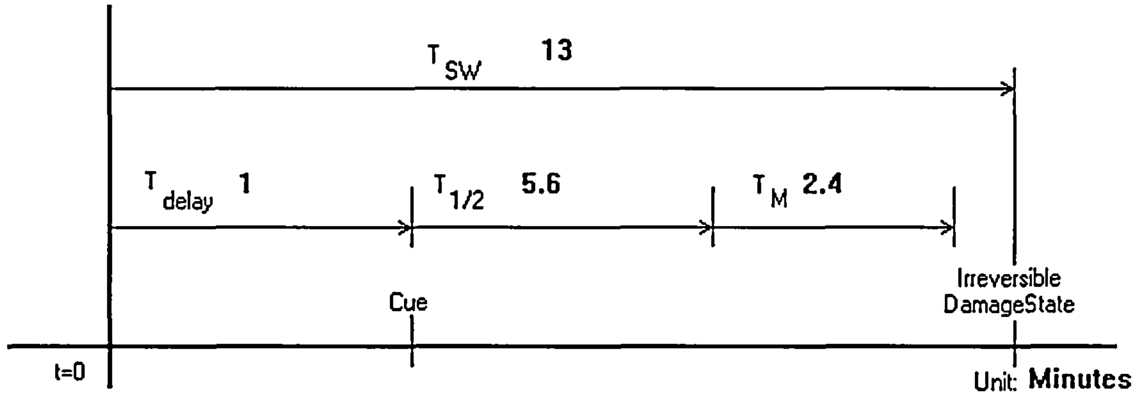
Stress:

- **Optimum (Low)**
- X - **Moderate**
- **Extreme (High)**

Cognitive

04-CWSTP13-F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates. Various equipment alarms on equipment in Turbine Building Basement and Potato Bin area.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 4.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill		Yes	X	Yes		Low
X	Rule	X	No		No	X	High

Sigma: 8.0e-01

HEP: 2.5e-01

Execution Unrecovered

04-CWSTP13-F-HE

Table 22: 04-CWSTP13-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump A						Comments: No Applicable procedure						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump B						Comments: No Applicable procedure						

Execution Recovery

04-CWSTP13-F-HE

Table 23: 04-CWSTP13-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Trip CW Pump A	5.2e-03				
2		Trip CW Pump B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	04-CWSTP19-F-HE	HEP Description	Trip CW Pump during Flood Event - 19 minutes
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.		
Event Description	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly. The NAO then reports water and rapidly increasing water level in Turbine Building Basement. The CRS directs the tripping of the reactor and then both CW Pumps.		
Assumptions for the Event	The following assumptions are made: • The operators will determine a waterbox boot failure due to the volume and level increase of the water • Operator will trip the CW pumps to put the plant in a safe condition without procedural directive.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At the waterbox boot failure, water enters the Turbine building Sump causing 47033-P, Miscellaneous Sump Level High, to actuate. Approximately 1 minute later the NAO is sent to investigate upon arrival discovers the water with a rapidly increasing level. The NAO then informs the Control room of the situation approximately 5.4 minutes after the alarm. Within 2.4 minute of receiving this information the Control Room personnel decide to trip the CW pumps. The total elapsed time from the waterbox boot failure is approximately 9 minutes. The allowed time is 19 minutes.		
Success Criteria	Both CW pump are stopped.		
References Used	FP-OP-COO-01, A-MDS-30, ARP 47033-P		
Cognitive Assumption	None		
Cognitive Recovery Assumptions	None.		

Execution Assumptions	None
Execution Recovery Assumptions	None

04-CWSTP19-F-HE, Trip CW Pump during Flood Event - 19 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	CDBTM/THERP

Table 24: 04-CWSTP19-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.1e-01	1.1e-01
P_{exe}	1.0e-02	1.0e-02
Total HEP		1.2e-01
Error Factor		1

HFE Scenario Description:
Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme stress due to magnitude of event.

Procedure and step governing HI:
A-MDS-30 directs the investigation of the level and source.
FP-OP-COO-01 is a fleet procedure for the conduct of operations, which directs the operator to take action to maintain the plant in a safe condition.

Training:

- **None**
- X - **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
- X - **Average**
- **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- **Rule**
X - **Knowledge**

Complexity of Response

Cognitive		Execution	
	- Complex		- Complex
X	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold

Radiation		Atmosphere	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

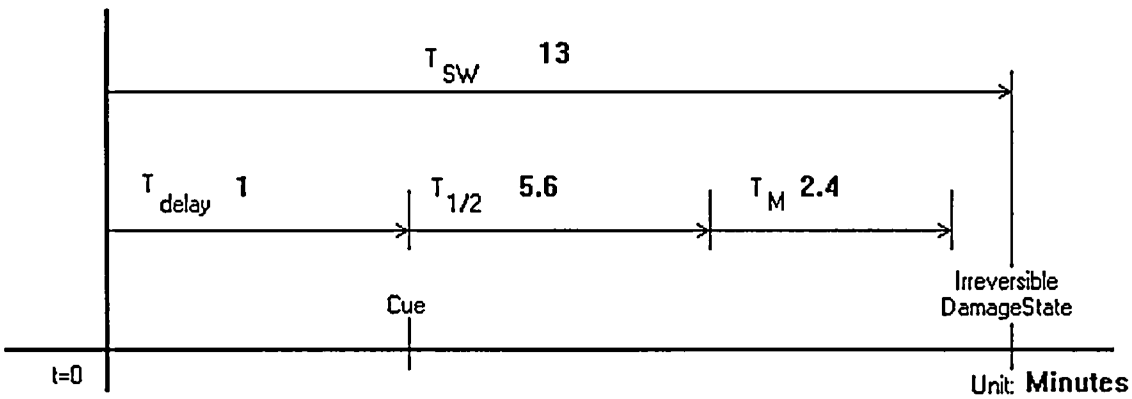
Stress:

- **Optimum (Low)**
X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

04-CWSTP19-F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates. Various equipment alarms on equipment in Turbine Building Basement and Potato Bin area.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 4.00 Minutes

Table 25: 04-CWSTP19-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	I	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.1e-01

Cognitive Recovery

04-CWSTP19-F-HE

Table 26: 04-CWSTP19-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC		1.0		
Pc_b:	neg.	-	-	-	-	-	NC		1.0		
Pc_c:	neg.	-	-	-	-	-	NC		1.0		
Pc_d:	1.0e-01	-	-	-	-	-	NC		1.0		1.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC		1.0		
Pc_h:	neg.	-	-	-	-	-	NC		1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.1e-01

Recovery Factors identified:

Execution Unrecovered

04-CWSTP19-F-HE

Table 27: 04-CWSTP19-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump A						Comments: No Applicable procedure						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump B						Comments: No Applicable procedure						

Execution Recovery

04-CWSTP19-F-HE

Table 28: 04-CWSTP19-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Trip CW Pump A	5.2e-03				
2		Trip CW Pump B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	04-CWSTP22-F-HE,	HEP Description	Trip CW Pump during Flood Event - 22 minutes
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.		
Event Description	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly. The NAO then reports water and rapidly increasing water level in Turbine Building Basement. The CRS directs the tripping of the reactor and then both CW Pumps.		
Assumptions for the Event	The following assumptions are made: • The operators will determine a waterbox boot failure due to the volume and level increase of the water • Operator will trip the CW pumps to put the plant in a safe condition without procedural directive.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At the waterbox boot failure, water enters the Turbine building Sump causing 47033-P, Miscellaneous Sump Level High, to actuate. Approximately 1 minute later the NAO is sent to investigate upon arrival discovers the water with a rapidly increasing level. The NAO then informs the Control room of the situation approximately 5.4 minutes after the alarm. Within 2.4 minute of receiving this information the Control Room personnel decide to trip the CW pumps. The total elapsed time from the waterbox boot failure is approximately 9 minutes. The allowed time is 22 minutes.		
Success Criteria	Both CW pump are stopped.		
References Used	FP-OP-COO-01, A-MDS-30, ARP 47033-P		
Cognitive Assumption	None		
Cognitive Recovery Assumptions	None.		

Execution Assumptions	None
Execution Recovery Assumptions	None

04-CWSTP22-F-HE, Trip CW Pump during Flood Event - 22 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 29: 04-CWSTP22-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.1e-01	1.1e-01
P_{exe}	1.0e-02	1.0e-02
Total HEP		1.2e-01
Error Factor		1

HFE Scenario Description:
Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme stress due to magnitude of event.

Procedure and step governing HI:
A-MDS-30 directs the investigation of the level and source.
FP-OP-COO-01 is a fleet procedure for the conduct of operations, which directs the operator to take action to maintain the plant in a safe condition.

Training:

	-	**None**	
X	-	**Classroom**	Frequency:
	-	**Simulator**	

Degree of Clarity of Cues & Indications:

	-	**Very Good**
X	-	**Average**
	-	**Poor**

Human-Machine Interface:

X	-	**Control Room Panels**
	-	**Local Control Panels**
	-	**Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- **Rule**

X - **Knowledge**

Complexity of Response

Cognitive	Execution
- Complex	- Complex
X - Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

Stress:

- **Optimum (Low)**

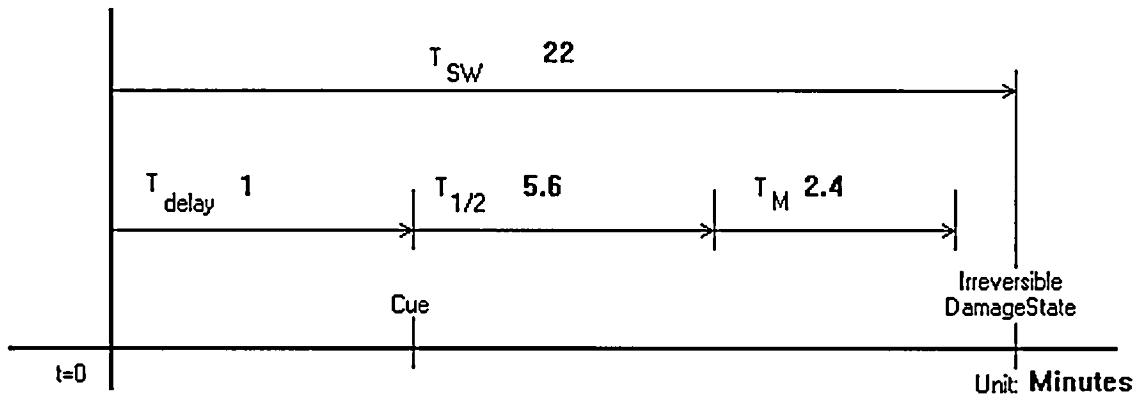
X - **Moderate**

- **Extreme (High)**

Cognitive Unrecovered

04-CWSTP22-F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates. Various equipment alarms on equipment in Turbine Building Basement and Potato Bin area.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 13.00 Minutes

Table 30: 04-CWSTP22-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.1e-01

Cognitive Recovery

04-CWSTP22-F-HE

Table 31: 04-CWSTP22-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC		1.0		
Pc_b:	neg.	-	-	-	-	-	NC		1.0		
Pc_c:	neg.	-	-	-	-	-	NC		1.0		
Pc_d:	1.0e-01	-	-	-	-	-	NC		1.0		1.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC		1.0		
Pc_h:	neg.	-	-	-	-	-	NC		1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.1e-01

Recovery Factors Identified:

Execution Unrecovered

04-CWSTP22-F-HE

Table 32: 04-CWSTP22-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump A						Comments: No Applicable procedure						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump B						Comments: No Applicable procedure						

Execution Recovery

04-CWSTP22-F-HE

Table 33: 04-CWSTP22-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Trip CW Pump A	5.2e-03				
2		Trip CW Pump B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	04-CWSTP25-F-HE,		HEP Description	Trip CW Pump during Flood Event - 25 minutes
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05		
Scenario	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.			
Event Description	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly. The NAO then reports water and rapidly increasing water level in Turbine Building Basement. The CRS directs the tripping of the reactor and then both CW Pumps.			
Assumptions for the Event	The following assumptions are made: • The operators will determine a waterbox boot failure due to the volume and level increase of the water • Operator will trip the CW pumps to put the plant in a safe condition without procedural directive.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At the waterbox boot failure, water enters the Turbine building Sump causing 47033-P, Miscellaneous Sump Level High, to actuate. Approximately 1 minute later the NAO is sent to investigate upon arrival discovers the water with a rapidly increasing level. The NAO then informs the Control room of the situation approximately 5.4 minutes after the alarm. Within 2.4 minute of receiving this information the Control Room personnel decide to trip the CW pumps. The total elapsed time from the waterbox boot failure is approximately 9 minutes. The allowed time is 25 minutes.			
Success Criteria	Both CW pump are stopped.			
References Used	FP-OP-COO-01, A-MDS-30, ARP 47033-P			
Cognitive Assumption	None			
Cognitive Recovery Assumptions	None.			

Execution Assumptions	None
Execution Recovery Assumptions	None

04-CWSTP25-F-HE, Trip CW Pump during Flood Event - 25 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 34: 04-CWSTP25-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.1e-01	1.1e-01
P_{exe}	1.0e-02	1.0e-02
Total HEP		1.2e-01
Error Factor		1

HFE Scenario Description:
Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme stress due to magnitude of event.

Procedure and step governing HI:
A-MDS-30 directs the investigation of the level and source.
FP-OP-COO-01 is a fleet procedure for the conduct of operations, which directs the operator to take action to maintain the plant in a safe condition.

Training:

- **None**
- X **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
- X **Average**
- **Poor**

Human-Machine Interface:

- X **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- **Rule**

X - **Knowledge**

Complexity of Response

Cognitive		Execution	
	- Complex		- Complex
X	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold
Radiation		**Atmosphere**	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

Stress:

- **Optimum (Low)**

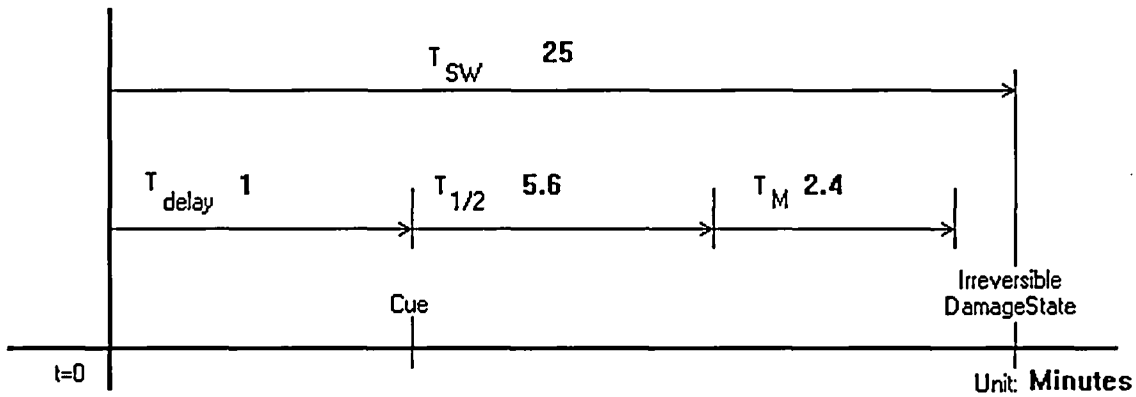
X - **Moderate**

- **Extreme (High)**

Cognitive Unrecovered

04-CWSTP25-F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates. Various equipment alarms on equipment in Turbine Building Basement and Potato Bin area.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 16.00 Minutes

Table 35: 04-CWSTP25-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	**Branch**	**HEP**
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	I	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.1e-01

Cognitive Recovery

04-CWSTP25-F-HE

Table 36: 04-CWSTP25-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC		1.0		
Pc_b:	neg.	-	-	-	-	-	NC		1.0		
Pc_c:	neg.	-	-	-	-	-	NC		1.0		
Pc_d:	1.0e-01	-	-	-	-	-	NC		1.0		1.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC		1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC		1.0		
Pc_h:	neg.	-	-	-	-	-	NC		1.0		
								Sum of Pc_a through Pc_h = Initial Pc =			1.1e-01

Recovery Factors Identified:

Execution Unrecovered

04-CWSTP25-F-HE

Table 37: 04-CWSTP25-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump A						Comments: No Applicable procedure						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump B						Comments: No Applicable procedure						

Execution Recovery

04-CWSTP25-F-HE

Table 38: 04-CWSTP25-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Trip CW Pump A	5.2e-03				
2		Trip CW Pump B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	05B-BYALOP-F-HE	HEP Description	Operators fail to bypass AFW Aux Lube Oil Pump permissive
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a flooding event, Motor Driven AFW pumps lose their Aux. Lube Oil Pump while stopped. The operator tries to restart the all the AFW pumps.		
Event Description	After a flooding event, Motor Driven AFW pumps lose their Aux. Lube Oil Pump while stopped. The operator tries to restart the all the AFW pumps. The Technical Support Center is contacted to restore AFW Pump		
Assumptions for the Event	The following assumptions are made: • Emergency response organization is manned • TD AFW pump aux lube oil permissive switch is bypassed. • Main Feedwater and Condensate Pumps are not available due to flooding. • Steam Generator level and decay heat are such that 3 hours are available to restart the AFW Pumps.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The pump demand would provide cue to operators that a problem existed. The Operators would contact TSC for assist. The TSC would determine how to restart the pump. Based on flood analysis, the condition would not be reached for approximately 1 hour. It would take the TCS approximately 1.5 hours to address the problem and develop a solution. Based on the I&C procedure time it is estimated that this evolution would take 1 hour to bypass the switch. The allowed time is 4 hours.		
Success Criteria	AFW pump restarted and feeding the Steam Generator with in 3 hours from the stopping of the pumps.		
References Used	ICP-05B-16		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		

Execution Recovery Assumptions	None

05B-BYALOP-F-HE, Operators fail to bypass AFW Aux Lube Oil Pump permissive

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/25/05
Cognitive Method:	HCR/ORE/THERP

Table 39: 05B-BYALOP-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	4.3e-01
P_{exe}	1.4e-02	1.4e-02
Total HEP		4.4e-01
Error Factor		1

HFE Scenario Description:
After a flooding event, Motor Driven AFW pumps lose their Aux. Lube Oil Pump while stopped. The operator tries to restart the all the AFW pumps.

Related Human Interactions:
none

Performance Shaping Factors:
Extreme stress due to event and additional loss of needed equipment

Procedure and step governing HI:
A-FW-05B

Training:

X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
- **Average**

X - **Poor**

Human-Machine Interface:

- **Control Room Panels**

X - **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

	-	**Skills**
	-	**Rule**
X	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex	X	-	Complex
	-	Simple		-	Simple

Environment:

Lighting			Heat/Humidity		
	-	Normal		-	Normal
X	-	Emergency	X	-	Hot / Humid
	-	Portable		-	Cold
Radiation			**Atmosphere**		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
	-	**Control Room Front Panels**	
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
X	-	**Electrical Building**	With Difficulty
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

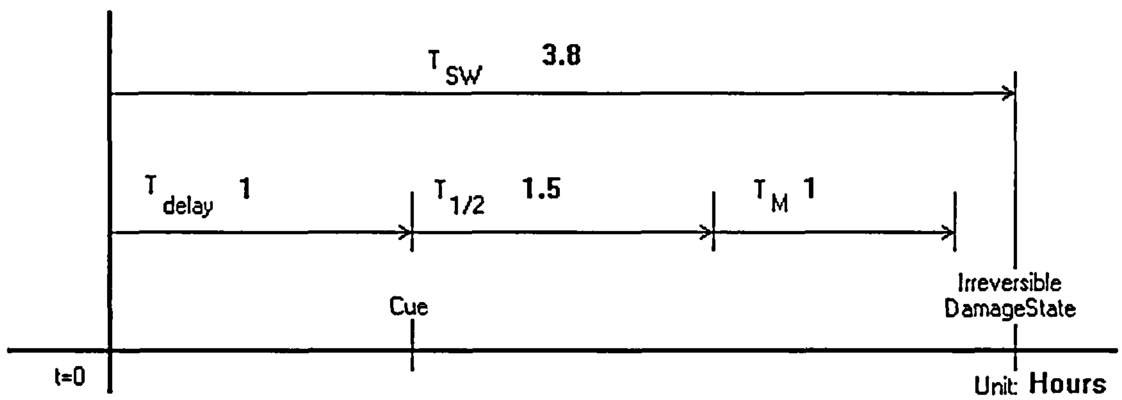
Stress:

	-	**Optimum (Low)**
X	-	**Moderate**
	-	**Extreme (High)**

Cognitive

05B-BYALOP-F-HE

Cue:
AFW Pump Will not restart due to loss of Aux. Lube Oil Pump 47061-L (M), AFW Pump A (B) Low oil Press. activated



Reference for System Time: Maracor Data 10/25/05

Reference for Manipulation Time: Operator interview - 10/25/05

Duration of time window available for action (TW): 0.30 Hours

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill		Yes		Yes		Low
X	Rule	X	No	X	No	X	High

Sigma: 1.0e+00

HEP: 4.3e-01

Execution Unrecovered

05B-BYALOP-F-HE

Table 40: 05B-BYALOP-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	O	1	1.3E-2	20-12	13	O	1		1.4e-02
Actions: I&C bypass lube oil pressure switch						Comments:						

Execution Recovery

05B-BYALOP-F-HE

Table 41: 05B-BYALOP-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		I&C bypass lube oil pressure switch	1.4e-02				
		Total Unrecovered:	1.4e-02			Total Recovered:	1.4e-02

HEP	06-BLINDAFWF-HE		HEP Description	Operator fails to feed S/G without Level indication
Revision Date	10/25/2005		Evaluator	GE Baldwin
Operations Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05		
Scenario	Hours into the event, all DC power is lost due to a loss of 480V power. S/G level indication is lost with last known S/G level was lower end of band (4-50%). Operator decides to feed S/G.			
Event Description	Hours into the event, all DC power is lost due to a loss of 480V power. S/G level indication is lost with last known S/G level was lower end of band (4-50%). Operator decides to feed S/G.			
Assumptions for the Event	The following assumptions are made: • The decision is made and approved with input from others. • Operators are aware of the pending loss of instrumentation.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. No action other then discussion is required.			
Success Criteria	Steam Generator feed flow is maintained.			
References Used	ES-0.1			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			
Execution Assumptions	None			
Execution Recovery Assumptions	None			

06-BLINDAFWF-HE, Operator fails to feed S/G without Level indication

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/19/05
Cognitive Method:	CDBTM/THERP

Table 42: 06-BLINDAFWF-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	6.3e-01	6.3e-01
P_{exe}	8.7e-03	8.7e-03
Total HEP		6.4e-01
Error Factor		1

HFE Scenario Description:
Hours into the event, all DC power is lost due to a loss of 480V power. S/G level indication is lost with last known S/G level was lower end of band (4-50%). Operator decides to feed S/G.

Related Human Interactions:
none

Performance Shaping Factors:
Extreme due to the loss of all DC power for instrumentation.

Procedure and step governing HI:
ES-0.1, step 6

Training:

- X - **None**
- \- **Classroom**
- \- **Simulator**

Degree of Clarity of Cues & Indications:

- X - **Very Good**
- \- **Average**
- \- **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- \- **Local Control Panels**
- \- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

-   - **Skills**
-   - **Rule**
- X - **Knowledge**

Complexity of Response

Cognitive		Execution	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
	- Normal	X	- Normal
X	- Emergency		- Hot / Humid
	- Portable		- Cold

Radiation		Atmosphere	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Inaccessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

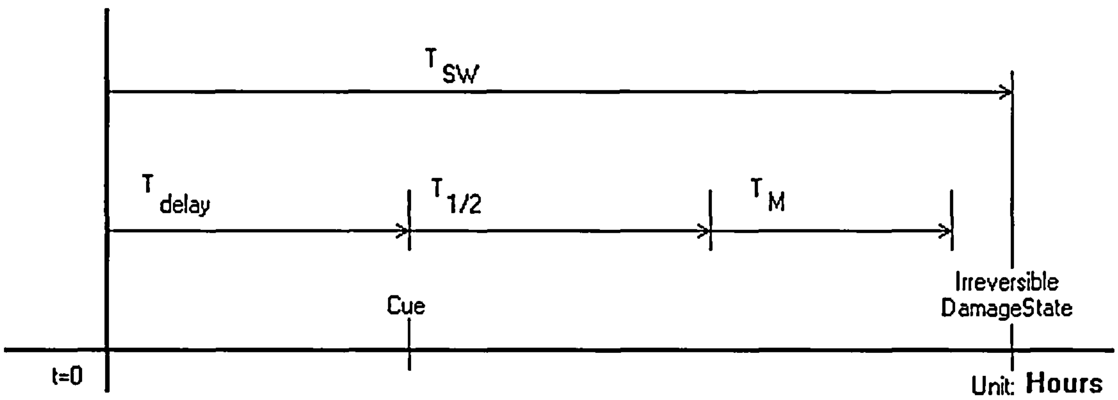
Stress:

-   - **Optimum (Low)**
-   - **Moderate**
- X - **Extreme (High)**

Cognitive Unrecovered

06-BLINDAFWF-HE

Cue:
Loss of S/G level indication due to loss of DC power



Reference for System Time:

Reference for Manipulation Time:

Duration of time window available for action (TW): 0.00 Hours

Table 43: 06-BLINDAFWF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	f	5.0e-01
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	c	3.0e-02
Pc_g: Misinterpret decision logic	I	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		6.3e-01

Cognitive Recovery

06-BLINDAFWF-HE

Table 44: 06-BLINDAFWF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-01	-	-	-	-	-	NC	-	1.0		5.0e-01
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-01	-	-	-	-	-	NC	-	1.0		1.0e-01
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	-	1.0e-01		3.0e-04
Pc_f:	3.0e-02	-	-	-	-	-	NC	-	1.0		3.0e-02
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
									Sum of Pc_a through Pc_h = Initial Pc =		6.3e-01

Recovery Factors Identified:

Execution Unrecovered

06-BLINDAFWF-HE

Table 45: 06-BLINDAFWF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	4.3E-4	20-7b	1	E	5	1.3E-3	20-12	4	E	5		8.7e-03
Actions: Start AFW Pump						Comments:						

Execution Recovery

06-BLINDAFWF-HE

Table 46: 06-BLINDAFWF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start AFW Pump	8.7e-03				
		Total Unrecovered:	8.7e-03			Total Recovered:	8.7e-03

<table>
<tr><td>HEP</td><td colspan="2">08-FPISO29-F-HE</td><td>HEP Description</td><td>Isol Fire Pump during Flood Event -29 minutes</td></tr>
<tr><td>Revision Date</td><td colspan="2">10/25/2005</td><td>Evaluator</td><td>GE Baldwin</td></tr>
<tr><td>Operation Reviewer</td><td colspan="2">P. Rappel</td><td>Reviewer</td><td>S. Shen</td></tr>
<tr><td rowspan="2">Operations Input</td><td>I</td><td colspan="3" rowspan="2">Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April and September 2005.</td></tr>
<tr><td>S</td></tr>
<tr><td>Scenario</td><td colspan="4">Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.</td></tr>
<tr><td>Event Description</td><td colspan="4">Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO walks down the Fire Header to discover a ruptured Fire header. The CRS use prints to determine the isolation valve for the ruptured header and directs the NAO to close them.</td></tr>
<tr><td>Assumptions for the Event</td><td colspan="4">No additional assumptions made</td></tr>
<tr><td>Timing Analysis</td><td colspan="4">Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Additional input from Simulator runs of April 2005 was also used. The Fire header rupture will cause 47054-L, Fire Pump Abnormal, actuation immediately. The NAO is directed to investigate approximately 2 minutes into the event, the NAO proceeds to the Turbine Building Basement and then starts a Fire header walk down discovering the pipe rupture. The report to the Control Room is made at the time of discovery. NCO and CRS identify the desired isolation valves approximately 18.6 minutes into the event and direct the NAO to close the isolations. The isolation valves are closed approximately 29.6 minutes after the start of the event. When the rupture is isolated the NAO is instructed to stop the Fire Pumps. The operator has 29 minutes to complete this action. The action is unsuccessful in this time period.</td></tr>
<tr><td>Success Criteria</td><td colspan="4">Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.</td></tr>
<tr><td>References Used</td><td colspan="4">ARP 47033-P, ARP 47054-L, ARP 47052-L</td></tr>
<tr><td>Cognitive Assumption</td><td colspan="4">It is assumed proper place keeping is used.</td></tr>
<tr><td>Cognitive Recovery Assumptions</td><td colspan="4">It is assumed STAR self-checking is used.</td></tr>
</table>

Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPISO29-F-HE, Isol Fire Pump during Flood Event -29 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	CDBTM/THERP

Table 47: 08-FPISO29-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.0e+00	1.0e+00
P_{exe}	1.0e-02	1.0e-02
Total HEP		1.0e+00
Error Factor		1

HFE Scenario Description:
Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
N-FP-08

Training:

- **None**

X - **Classroom** Frequency:

- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

X - **Skills**
- **Rule**
- **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	With Difficulty
	- **Switchyard**	

Stress:

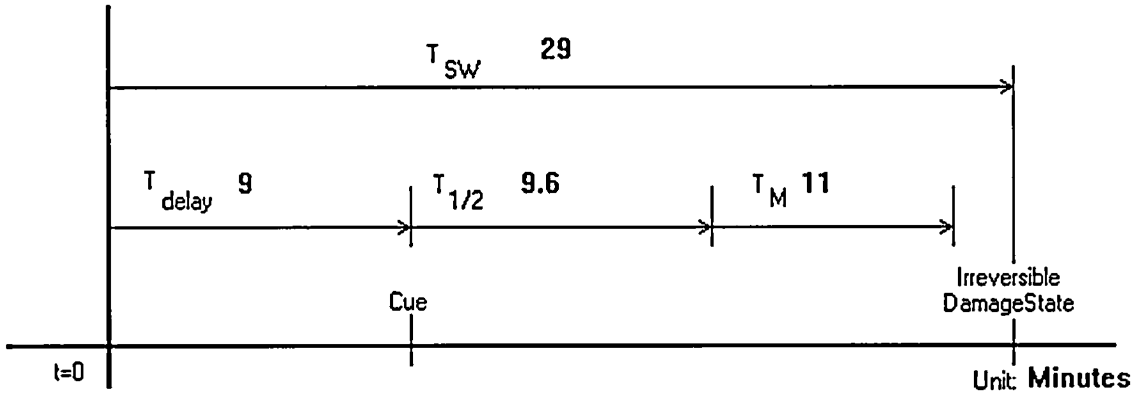
- **Optimum (Low)**

X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

08-FPISO29-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High alarms



Reference for System Time: Maracor Data 10/21/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): -0.60 Minutes

Table 48: 08-FPISO29-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	e	1.0
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.0e+00

Cognitive Recovery

08-FPISO29-F-HE

Table 49: 08-FPISO29-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0	-	-	-	-	-	NC	-	1.0		1.0e+00
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.0e+00

Recovery Factors Identified:
Star process is used.

Execution Unrecovered

08-FPISO29-F-HE

Table 50: 08-FPISO29-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO29-F-HE

Table 51: 08-FPISO29-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	5.2e-03				
2		Close FP-2B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	08-FPISO45-F-HE	HEP Description	Isol Fire Pump during Flood Event -45 minutes
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen

Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April and September 2005.
Scenario		Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.
Event Description		Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO walks down the Fire Header to discover a ruptured Fire header. The CRS use prints to determine the isolation valve for the ruptured header and directs the NAO to close them.
Assumptions for the Event		No additional assumptions made
Timing Analysis		Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Additional input from Simulator runs of April 2005 was also used. The Fire header rupture will cause 47054-L, Fire Pump Abnormal, actuation immediately. The NAO is directed to investigate approximately 2 minutes into the event, the NAO proceeds to the Turbine Building Basement and then starts a Fire header walk down discovering the pipe rupture. The report to the Control Room is made at the time of discovery. NCO and CRS identify the desired isolation valves approximately 18.6 minutes into the event and direct the NAO to close the isolations. The isolation valves are closed approximately 29.6 minutes after the start of the event. When the rupture is isolated the NAO is instructed to stop the Fire Pumps. The operator has 45 minutes to complete this action.
Success Criteria		Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.
References Used		ARP 47033-P, ARP 47054-L, ARP 47052-L
Cognitive Assumption		It is assumed proper place keeping is used.
Cognitive Recovery Assumptions		It is assumed STAR self-checking is used.

Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPISO45-F-HE, Isol Fire Pump during Flood Event -45 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	HCR/ORE/THERP

Table 52: 08-FPISO45-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	5.5e-02
P_{exe}	1.0e-02	1.0e-02
Total HEP		6.6e-02
Error Factor		5

HFE Scenario Description:
Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
N-FP-08

Training:

- None
X - **Classroom** Frequency:
- Simulator

Degree of Clarity of Cues & Indications:

- Very Good
X - **Average**
- Poor

Human-Machine Interface:

- Control Room Panels
- Local Control Panels
X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

X - **Skills**
- **Rule**
- **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- **Control Room Front Panels**	
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
X - **Pump house**	With Difficulty
- **Switchyard**	

Stress:

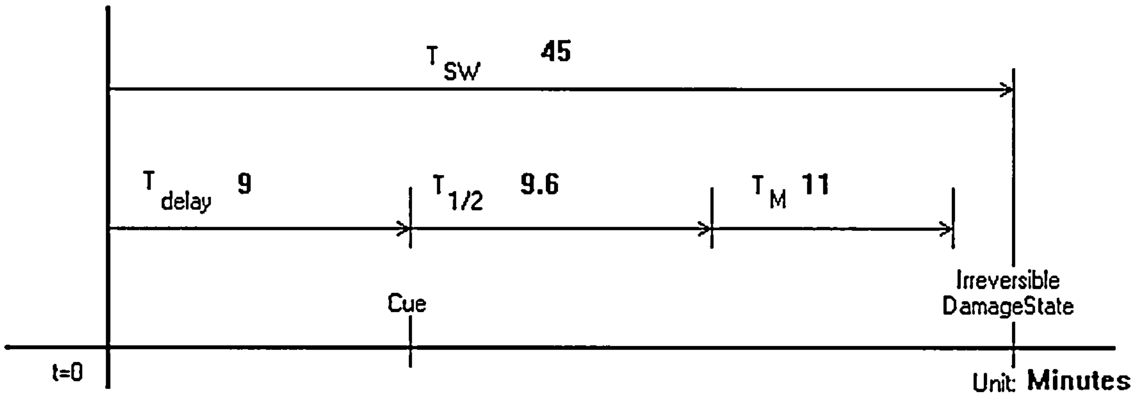
- **Optimum (Low)**

X - **Moderate**
- **Extreme (High)**

Cognitive

08-FPISO45-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High alarms



Reference for System Time: Maracor Data 10/21/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 15.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes		Yes		Low
X	Rule		No	X	No	X	High

Sigma: 6.0e-01

HEP: 5.5e-02

Execution Unrecovered

08-FPISO45-F-HE

Table 53: 08-FPISO45-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO45-F-HE

Table 54: 08-FPISO45-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	5.2e-03				
2		Close FP-2B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	08-FPISO56-F-HE		HEP Description	Isol Fire Pump during Flood Event -56 minutes
Revision Date	10/25/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April and September 2005.		
Scenario	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.			
Event Description	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO walks down the Fire Header to discover a ruptured Fire header. The CRS use prints to determine the isolation valve for the ruptured header and directs the NAO to close them.			
Assumptions for the Event	No additional assumptions made			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Additional input from Simulator runs of April 2005 was also used. The Fire header rupture will cause 47054-L, Fire Pump Abnormal, actuation immediately. The NAO is directed to investigate approximately 2 minutes into the event, the NAO proceeds to the Turbine Building Basement and then starts a Fire header walk down discovering the pipe rupture. The report to the Control Room is made at the time of discovery. NCO and CRS identify the desired isolation valves approximately 18.6 minutes into the event and direct the NAO to close the isolations. The isolation valves are closed approximately 29.6 minutes after the start of the event. When the rupture is isolated the NAO is instructed to stop the Fire Pumps. The operator has 56 minutes to complete this action.			
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.			
References Used	ARP 47033-P, ARP 47054-L, ARP 47052-L			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			

Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPISO56-F-HE, Isol Fire Pump during Flood Event -56 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	HCR/ORE/THERP

Table 55: 08-FPISO56-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	1.4e-02
P_{exe}	1.0e-02	1.0e-02
Total HEP		2.4e-02
Error Factor		5

HFE Scenario Description:
Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
N-FP-08

Training:

- **None**
- X - **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
- X - **Average**
- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**
- X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

X - **Skills**
- **Rule**
- **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	With Difficulty
	- **Switchyard**	

Stress:

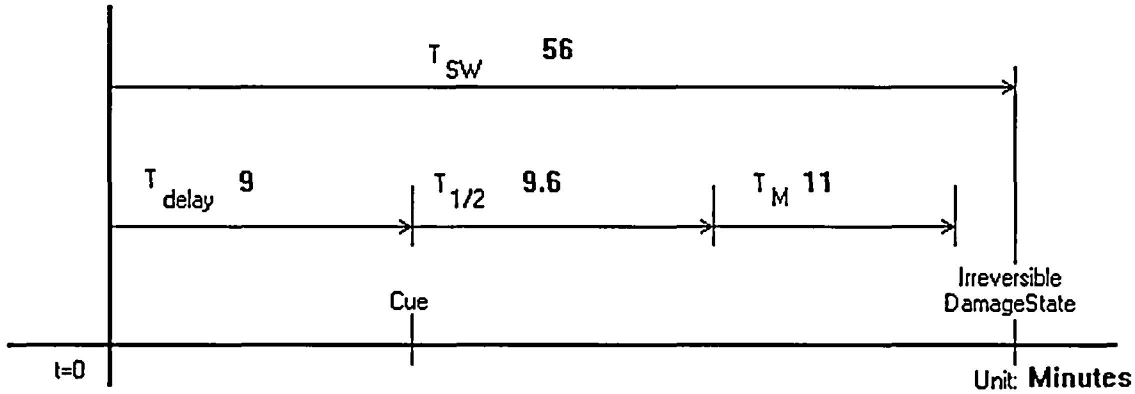
- **Optimum (Low)**

X - **Moderate**
- **Extreme (High)**

Cognitive

08-FPISO56-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High alarms



Reference for System Time: Maracor Data 10/21/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 26.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes		Yes		Low
X	Rule		No	X	No	X	High

Sigma: 6.0e-01

HEP: 1.4e-02

Execution Unrecovered

08-FPISO56-F-HE

Table 56: 08-FPISO56-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO56-F-HE

Table 57: 08-FPISO56-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	5.2e-03				
2		Close FP-2B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

HEP	08-FPSISO1CF-HE		HEP Description	Isolate Fire sprinklers during Flood/MS Event (Sm) -100 min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.			
Event Description	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.			
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 100 minutes to complete this action.			
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.			
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08			
Cognitive Assumption	It is assumed proper place keeping is used.			

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO1CF-HE, Isolate Fire sprinklers during Flood/MS Event (Sm) -100 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 58: 08-FPSISO1CF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- Control Room Panels
- Local Control Panels

X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	Accessible
	- **Switchyard**	

Stress:

- **Optimum (Low)**

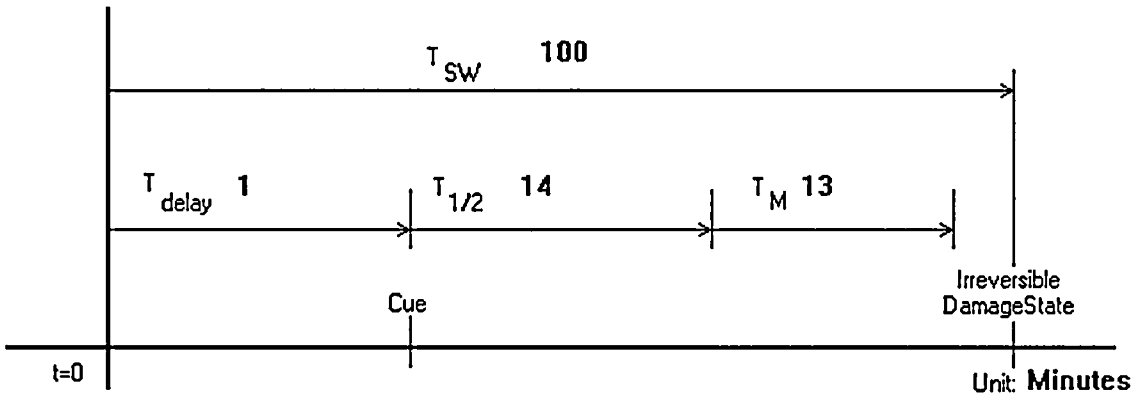
X - **Moderate**

- **Extreme (High)**

Cognitive Unrecovered

08-FPSISO1CF-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 72.00 Minutes

Table 59: 08-FPSISO1CF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-FPSISO1CF-HE

Table 60: 08-FPSISO1CF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors identified:
Star process is used.

Execution Unrecovered

08-FPSISO1CF-HE

Table 61: 08-FPSISO1CF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO1CF-HE

Table 62: 08-FPSISO1CF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-FPSISO29F-HE	HEP Description	Isolate Fire sprinklers during Flood/MS Event - 29 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Event Description	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 29 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08		
Cognitive Assumption	It is assumed proper place keeping is used.		

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO29F-HE, Isolate Fire sprinklers during Flood/MS Event - 29 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	HCR/ORE/THERP

Table 63: 08-FPSISO29F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	4.3e-01
P_{exe}	1.6e-02	1.6e-02
Total HEP		4.5e-01
Error Factor		1

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive		Execution	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal		- Normal
	- Emergency	X	- Hot / Humid
	- Portable		- Cold
Radiation		**Atmosphere**	
X	- Background		- Normal
	- Green	X	- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- Control Room Front Panels	
	- Control Room Back Panels	
	- Hot Shutdown Panels	
	- Auxiliary Building	
	- Electrical Building	
	- Containment	
X	- Pump house	Accessible
	- Switchyard	

Stress:

- **Optimum (Low)**

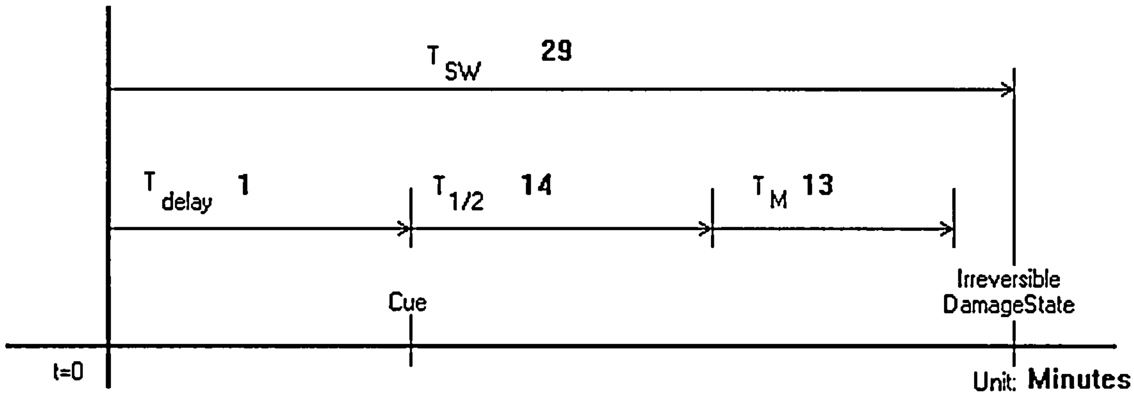
X - **Moderate**

- **Extreme (High)**

Cognitive

08-FPSISO29F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 1.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 4.3e-01

Execution Unrecovered

08-FPSISO29F-HE

Table 64: 08-FPSISO29F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO29F-HE

Table 65: 08-FPSISO29F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-FPSISO2CF-HE	HEP Description	Isolate Fire sprinklers during Flood/MS Event (Sm) -150 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Event Description	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 150 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08		
Cognitive Assumption	It is assumed proper place keeping is used.		

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO2CF-HE, Isolate Fire sprinklers during Flood/MS Event (Sm)- 150 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 66: 08-FPSISO2CF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- **None**
- **Classroom**
- X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**
- X - **Average**
- **Poor**

Human-Machine Interface:

- Control Room Panels
- Local Control Panels

X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills

X - Rule

- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
- Electrical Building	
- Containment	
X - Pump house	Accessible
- Switchyard	

Stress:

- Optimum (Low)

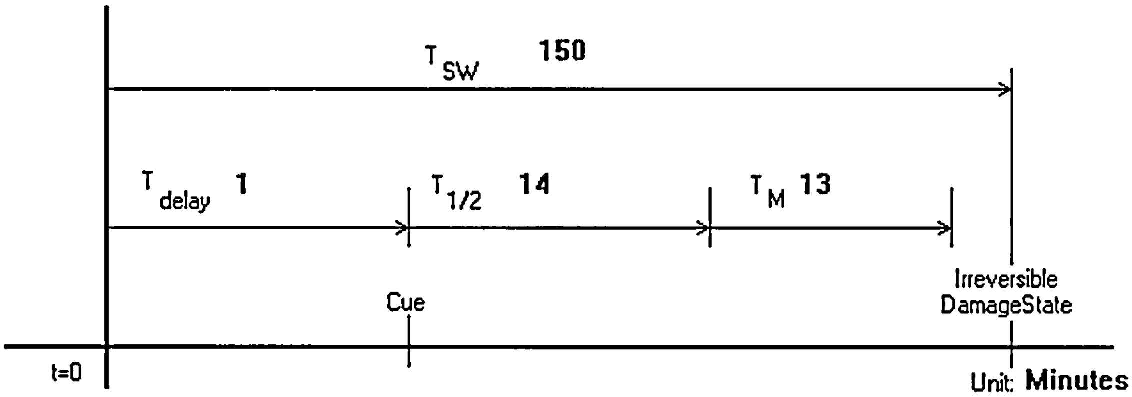
X - Moderate

- Extreme (High)

Cognitive Unrecovered

08-FPSISO2CF-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 122.00 Minutes

Table 67: 08-FPSISO2CF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-FPSISO2CF-HE

Table 68: 08-FPSISO2CF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors identified:
Star process is used.

Execution Unrecovered

08-FPSISO2CF-HE

Table 69: 08-FPSISO2CF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO2CF-HE

Table 70: 08-FPSISO2CF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-FPSISO3CF-HE		HEP Description	Isolate Fire sprinklers during Flood/MS Event (Sm) -170 min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.			
Event Description	A Small Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.			
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 170 minutes to complete this action.			
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.			
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08			
Cognitive Assumption	It is assumed proper place keeping is used.			

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO3CF-HE, Isolate Fire sprinklers during Flood/MS Event (Sm) -170 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 71: 08-FPSISO3CF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive	**Execution**
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	**Heat/Humidity**
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold

Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	**Accessibility**
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	Accessible
	- **Switchyard**	

Stress:

- **Optimum (Low)**

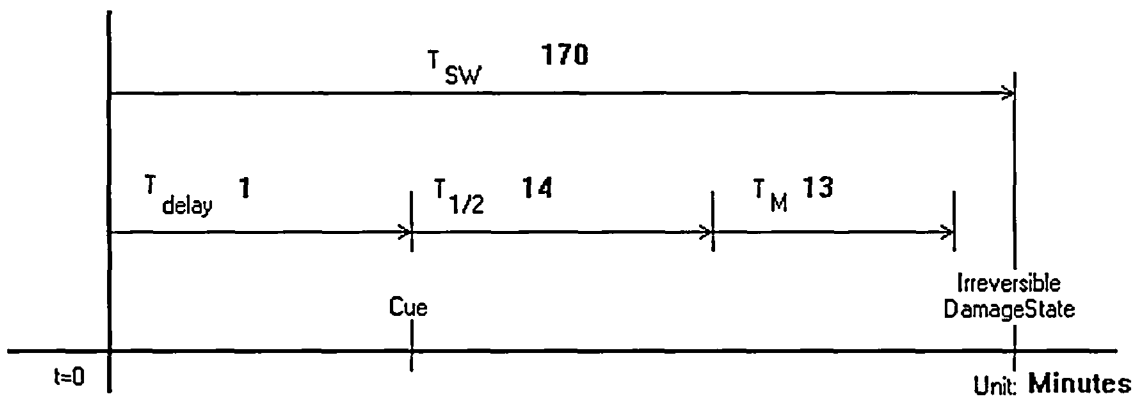
X - **Moderate**

- **Extreme (High)**

Cognitive Unrecovered

08-FPSISO3CF-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 142.00 Minutes

Table 72: 08-FPSISO3CF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-FPSISO3CF-HE

Table 73: 08-FPSISO3CF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors identified:
Star process is used.

Execution Unrecovered

08-FPSISO3CF-HE

Table 74: 08-FPSISO3CF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO3CF-HE

Table 75: 08-FPSISO3CF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-FPSISO45F-HE	HEP Description	Isolate Fire sprinklers during Flood/MS Event – 45 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Event Description	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 45 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08		
Cognitive Assumption	It is assumed proper place keeping is used.		

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO45F-HE, Isolate Fire sprinklers during Flood/MS Event - 45 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/22/05
Cognitive Method:	HCR/ORE/THERP

Table 76: 08-FPSISO45F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	2.3e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.9e-02
Error Factor		5

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- Control Room Panels
- Local Control Panels
- X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
- Electrical Building	
- Containment	
X - Pump house	Accessible
- Switchyard	

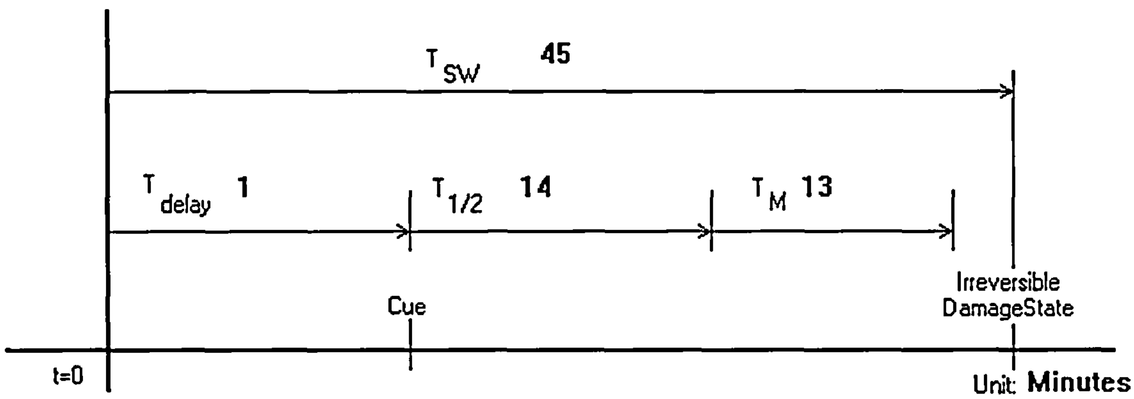
Stress:

- Optimum (Low)
- X - Moderate
- Extreme (High)

Cognitive

08-FPSISO45F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 17.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 2.3e-02

Execution Unrecovered

08-FPSISO45F-HE

Table 77: 08-FPSISO45F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per.
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO45F-HE

Table 78: 08-FPSISO45F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-FPSISO56F-HE	HEP Description	Isolate Fire sprinklers during Flood/MS Event – 56 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S — Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Event Description	Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000 gpm flow to Turbine Building Basement.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Steam Line rupture would activate the fire sprinklers approximately one minute after the Steam Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 56 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, E-FP-08, N-FP-08		
Cognitive Assumption	It is assumed proper place keeping is used.		

Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.
Execution Assumptions	None
Execution Recovery Assumptions	None

08-FPSISO56F-HE, Isolate Fire sprinklers during Flood/MS Event - 56 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 79: 08-FPSISO56F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Steam Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-1.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire sprinklers.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
E-FP-08

Training:

- None
- Classroom
- X - Simulator Frequency: .5

Degree of Clarity of Cues & Indications:

- Very Good
- X - Average
- Poor

Human-Machine Interface:

- Control Room Panels
- Local Control Panels
- X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
- Electrical Building	
- Containment	
X - Pump house	Accessible
- Switchyard	

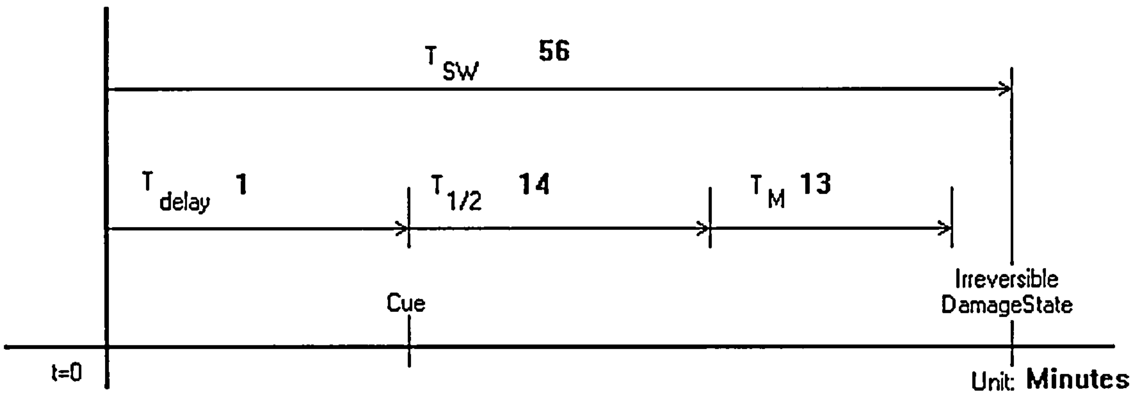
Stress:

- Optimum (Low)
- X - Moderate
- Extreme (High)

Cognitive Unrecovered

08-FPSISO56F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High. Additionally Feedwater and Steam Generator alarms from the Steamline break.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 28.00 Minutes

Table 80: 08-FPSISO56F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-FPSISO56F-HE

Table 81: 08-FPSISO56F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors identified:
Star process is used.

Execution Unrecovered

08-FPSISO56F-HE

Table 82: 08-FPSISO56F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-FPSISO56F-HE

Table 83: 08-FPSISO56F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS18F-HE	HEP Description	Isolate Sprinklers during Flood/FW Event in 18 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 18 minutes to complete this action. This action is unsuccessful.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS18F-HE, Isolate Sprinklers during Flood/FW Event in 18 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/18/05
Cognitive Method:	HCR/ORE/THERP

Table 84: 08-ISO-FS18F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	1.0e+00
P_{exe}	1.6e-02	1.6e-02
Total HEP		1.0e+00
Error Factor		1

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - Local Equipment

Special Requirements:

Tools	**Parts**	**Clothing**
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive	**Execution**
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	**Heat/Humidity**
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	**Accessibility**
- **Control Room Front Panels**	
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
X - **Pump house**	Accessible
- **Switchyard**	

Stress:

- **Optimum (Low)**

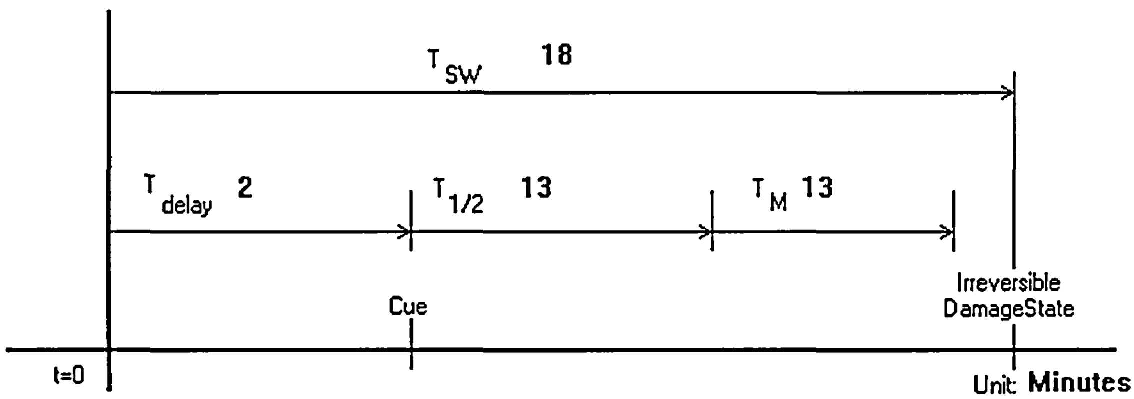
X - **Moderate**

- **Extreme (High)**

Cognitive

08-ISO-FS18F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): -10.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 1.0e+00

Execution Unrecovered

08-ISO-FS18F-HE

Table 85: 08-ISO-FS18F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS18F-HE

Table 86: 08-ISO-FS18F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS2HF-HE	HEP Description	Isolate Sprinklers during Flood/FW Event in 2 Hr.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S — Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 2 or more hours to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS2HF-HE, Isolate Sprinklers during Flood/FW Event in 2 Hr.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 87: 08-ISO-FS2HF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.3e-03
P_{exe}	1.6e-02	1.6e-02
Total HEP		1.7e-02
Error Factor		5

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051
E-FP-08

Training:

- **None**

X - **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**
- **Poor**

Human-Machine Interface:

- **Control Room Panels**

- Local Control Panels

X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills

X - Rule

- Knowledge

Complexity of Response

Cognitive		Execution	
X	Complex		Complex
	Simple	X	Simple

Environment:

Lighting		Heat/Humidity	
	Normal		Normal
X	Emergency	X	Hot / Humid
	Portable		Cold

Radiation		Atmosphere	
X	Background		Normal
	Green	X	Steam
	Yellow		Smoke
	Red		Respirator required

Equipment Accessibility:

	Location	Accessibility
	Control Room Front Panels	
	Control Room Back Panels	
	Hot Shutdown Panels	
	Auxiliary Building	
X	Electrical Building	With Difficulty
	Containment	
	Pump house	
	Switchyard	

Stress:

- Optimum (Low)

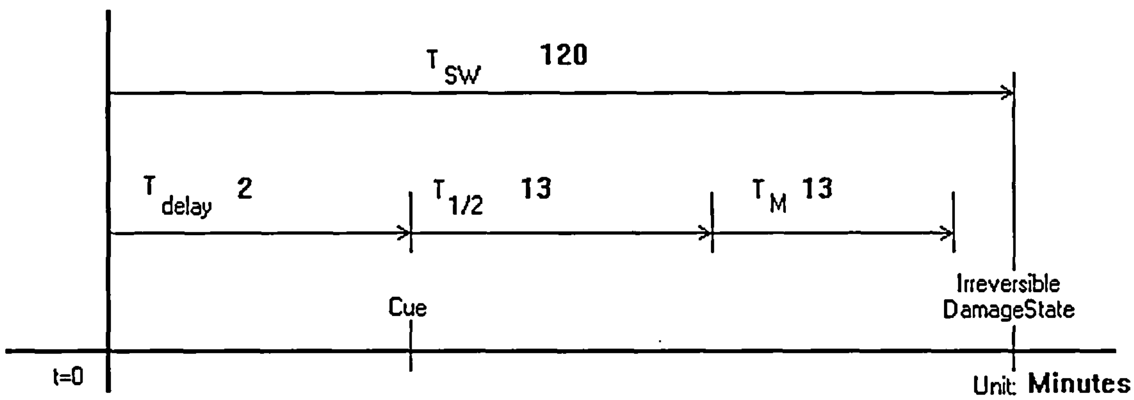
X - Moderate

- Extreme (High)

Cognitive Unrecovered

08-ISO-FS2HF-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 92.00 Minutes

Table 88: 08-ISO-FS2HF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-ISO-FS2HF-HE

Table 89: 08-ISO-FS2HF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	X	1.0e-01	-	1.0e-01		1.0e-03
Pc_e:	3.0e-03	-	-	-	-	X	1.0e-01	LD	5.3e-02		1.6e-04
Pc_f:	3.0e-03	-	-	-	-	X	1.0e-01	LD	5.3e-02		1.6e-04
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.3e-03

Recovery Factors Identified:
Star process is used.

Execution Unrecovered

08-ISO-FS2HF-HE

Table 90: 08-ISO-FS2HF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS2HF-HE

Table 91: 08-ISO-FS2HF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS33F-HE	HEP Description	Isolate Sprinklers during Flood/FW Event in 33 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S — Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 33 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS33F-HE, Isolate Sprinklers during Flood/FW Event in 33 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/18/05
Cognitive Method:	HCR/ORE/THERP

Table 92: 08-ISO-FS33F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	2.1e-01
P_{exe}	1.6e-02	1.6e-02
Total HEP		2.2e-01
Error Factor		1

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**
- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive	**Execution**
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	**Heat/Humidity**
X - Normal	- Normal
- Emergency	X - Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	**Accessibility**
- **Control Room Front Panels**	
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
X - **Pump house**	Accessible
- **Switchyard**	

Stress:

- **Optimum (Low)**

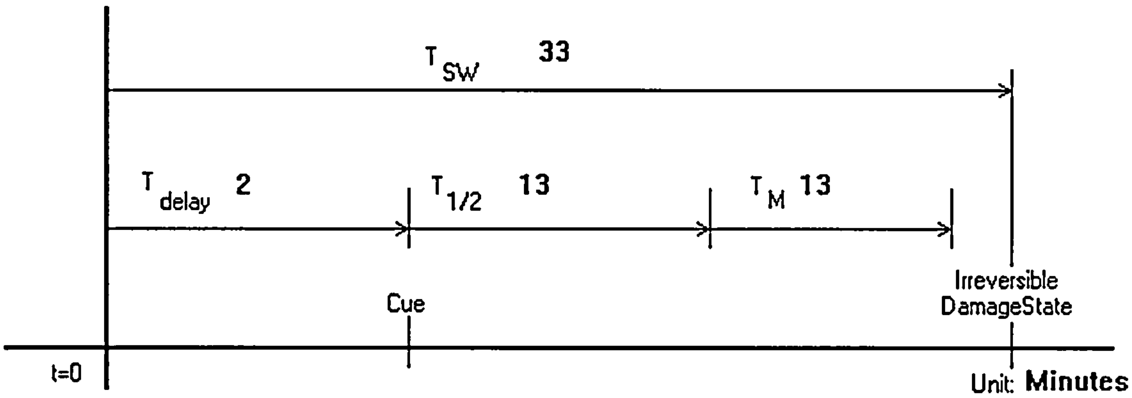
X - **Moderate**

- **Extreme (High)**

Cognitive

08-ISO-FS33F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 5.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 2.1e-01

Execution Unrecovered

08-ISO-FS33F-HE

Table 93: 08-ISO-FS33F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS33F-HE

Table 94: 08-ISO-FS33F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS40F-HE	HEP Description	Isolate Sprinklers during Flood/FW Event in 40 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 40 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS40F-HE, Isolate Sprinklers during Flood/FW Event in 40 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/18/05
Cognitive Method:	HCR/ORE/THERP

Table 95: 08-ISO-FS40F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	5.1e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		6.7e-02
Error Factor		5

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive		Execution	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal		- Normal
	- Emergency	X	- Hot / Humid
	- Portable		- Cold
Radiation		**Atmosphere**	
X	- Background		- Normal
	- Green	X	- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- Control Room Front Panels	
	- Control Room Back Panels	
	- Hot Shutdown Panels	
	- Auxiliary Building	
	- Electrical Building	
	- Containment	
X	- Pump house	Accessible
	- Switchyard	

Stress:

- **Optimum (Low)**

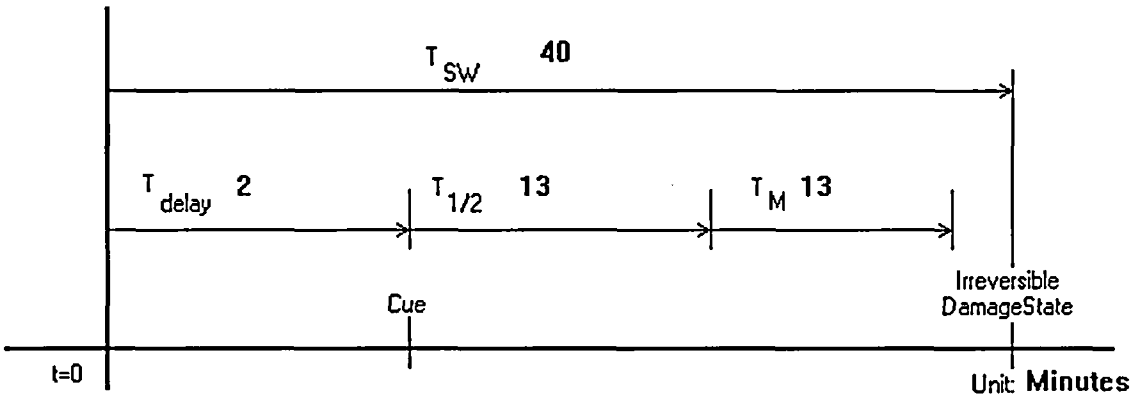
X - **Moderate**

- **Extreme (High)**

Cognitive

08-ISO-FS40F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 12.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 5.1e-02

Execution Unrecovered

08-ISO-FS40F-HE

Table 96: 08-ISO-FS40F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS40F-HE

Table 97: 08-ISO-FS40F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS54F-HE		HEP Description	Isolate Sprinklers during Flood/FW Event in 54 min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.			
Event Description	Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.			
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 6000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 54 minutes to complete this action.			
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.			
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS54F-HE, Isolate Sprinklers during Flood/FW Event in 54 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 98: 08-ISO-FS54F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051
E-FP-08

Training:

- **None**
X - **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
X - **Average**
- **Poor**

Human-Machine Interface:

- **Control Room Panels**

- Local Control Panels
X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	- Normal
X - Emergency	X - Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
X - Electrical Building	With Difficulty
- Containment	
- Pump house	
- Switchyard	

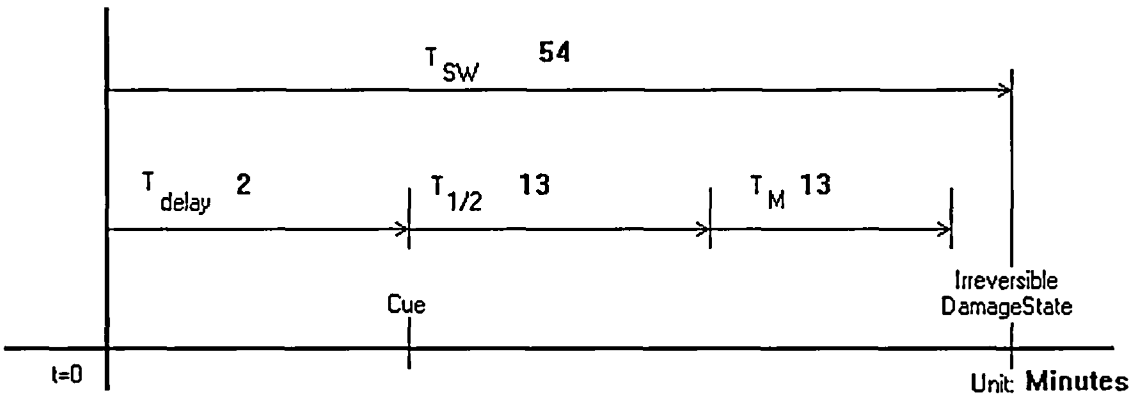
Stress:

- Optimum (Low)
X - Moderate
- Extreme (High)

Cognitive Unrecovered

08-ISO-FS54F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 26.00 Minutes

Table 99: 08-ISO-FS54F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-ISO-FS54F-HE

Table 100: 08-ISO-FS54F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors Identified:
Star process is used.

Execution Unrecovered

08-ISO-FS54F-HE

Table 101: 08-ISO-FS54F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS54F-HE

Table 102: 08-ISO-FS54F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS55F-HE	HEP Description	Isolate Sprinklers during Flood/FW Event (Sm) - 55 min.
Revision Date	10/17/2005	Evaluator	GE Baldwin
Operation Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.	
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	A small Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.		
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 55 minutes to complete this action.		
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.		
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS55F-HE, Isolate Sprinklers during Flood/FW Event (Sm) - 55 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 103: 08-ISO-FS55F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051
E-FP-08

Training:

- **None**

X - **Classroom** Frequency:

- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- Control Room Panels
- Local Control Panels

X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills

X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	- Normal
X - Emergency	X - Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
X - Electrical Building	With Difficulty
- Containment	
- Pump house	
- Switchyard	

Stress:

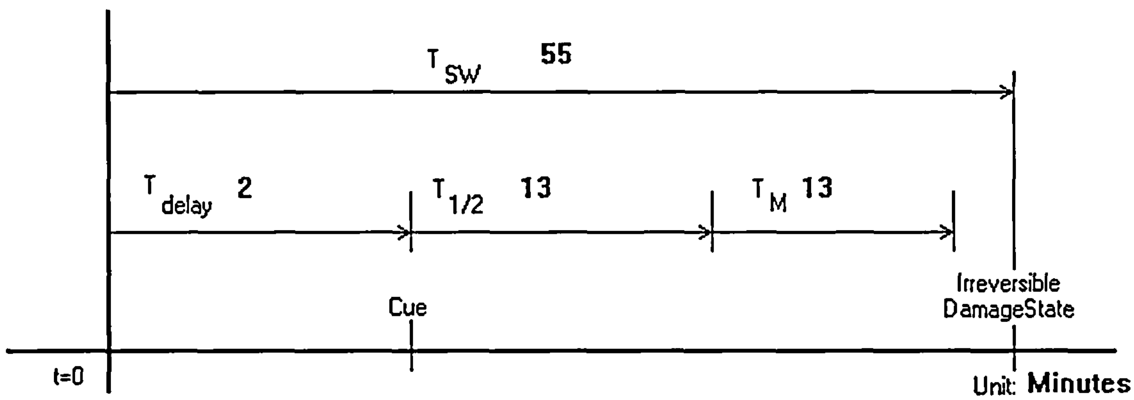
- Optimum (Low)

X - Moderate
- Extreme (High)

Cognitive Unrecovered

08-ISO-FS55F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 27.00 Minutes

Table 104: 08-ISO-FS55F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	I	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-ISO-FS55F-HE

Table 105: 08-ISO-FS55F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors Identified:
Star process is used.

Execution Unrecovered

08-ISO-FS55F-HE

Table 106: 08-ISO-FS55F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS55F-HE

Table 107: 08-ISO-FS55F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	08-ISO-FS97F-HE		HEP Description	Isolate Sprinklers during Flood/FW Event (Sm) - 97 min.
Revision Date	10/17/2005		Evaluator	GE Baldwin
Operation Reviewer	P. Rappel		Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05.		
Scenario	Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.			
Event Description	A small Feedwater Line ruptures setting off fire sprinklers thus causing flooding in the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The Control room Operators move through procedures E-0 and ES-0.1 when the plant is stabilized. The Shift Manager would respond to the fire alarms and direct an investigation. The NAO would investigate then discover there is no fire. The Shift Manager would direct the isolation of the fire sprinklers. The NAO proceeds to the Turbine Building and isolates the fire header.			
Assumptions for the Event	The following assumptions are made: • Fire sprinklers do not activate for 1 minute and provide 2000-gpm flow to Turbine Building Basement. • Turbine building would be accessible in 15 minutes.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The Feedwater Line rupture would activate the fire sprinklers approximately one minute after the Feedwater Line rupture. The Operators would enter E-0 in response to the Reactor trip due to the Feedwater line rupture and then transition to ES-0.1 while the Shift Manager directed the response to the fire alarms. The Shift Manager (SM) would direct the NAO to investigate the fire alarms approximately 2 minutes into the event. The NAO would determine the fire sprinklers were not required and report it to the Control Room. The SM would then direct the isolation of the sprinklers. The NAO would complete the isolation approximately 13 minutes later, which is 28 minutes after the start of the event. The operator has 97 minutes to complete this action.			
Success Criteria	Flooding is stopped by either stopping the Fire Pumps or isolating the fire sprinkler.			
References Used	ARP 47033-P, ARP 47054-L, A-MDS-30, N-FP-08, ARP 47051			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			

Execution Assumptions	None
Execution Recovery Assumptions	None

08-ISO-FS97F-HE, Isolate Sprinklers during Flood/FW Event (Sm) - 97 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 108: 08-ISO-FS97F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.6e-02	1.4e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		3.0e-02
Error Factor		5

HFE Scenario Description:
Feedwater Header ruptures flooding the Turbine Building Basement and setting off the fire sprinklers causing 47033-P, Miscellaneous Sump Level High. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
A-MDS-30
N-FP-08
ARP 47051
E-FP-08

Training:

- **None**
X - **Classroom** Frequency:
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**
X - **Average**
- **Poor**

Human-Machine Interface:

- Control Room Panels
- Local Control Panels
X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	- Normal
X - Emergency	X - Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	- Normal
- Green	X - Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
X - Electrical Building	With Difficulty
- Containment	
- Pump house	
- Switchyard	

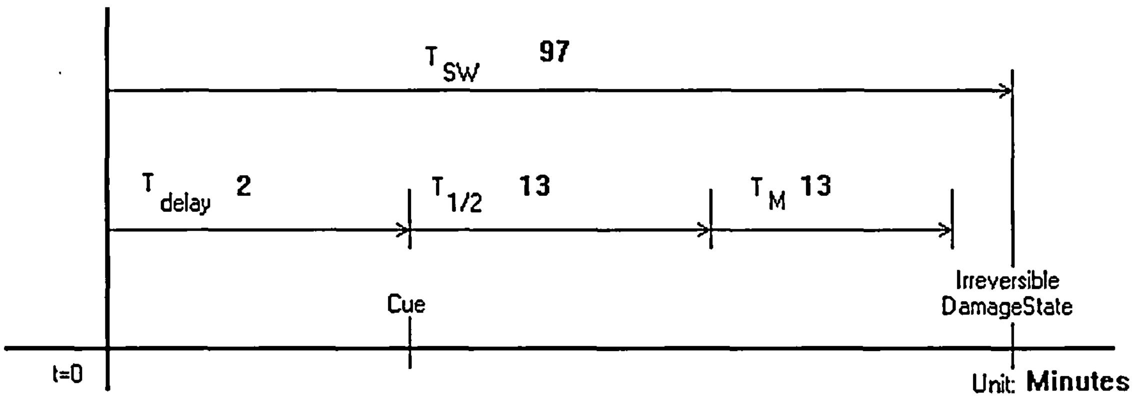
Stress:

- Optimum (Low)
X - Moderate
- Extreme (High)

Cognitive Unrecovered

08-ISO-FS97F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High; and other fire system alarms. Additionally Feedwater and Steam Generator alarms from the feedline break.



Reference for System Time: Maracor memo 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 69.00 Minutes

Table 109: 08-ISO-FS97F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

08-ISO-FS97F-HE

Table 110: 08-ISO-FS97F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.4e-02

Recovery Factors Identified:
Star process is used.

Execution Unrecovered

08-ISO-FS97F-HE

Table 111: 08-ISO-FS97F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-278 & FP-276						Comments:						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-348 & FP-346						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Close FP-335 & FP-270						Comments:						

Execution Recovery

08-ISO-FS97F-HE

Table 112: 08-ISO-FS97F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-278 & FP-276	5.2e-03				
2		Close FP-348 & FP-346	5.2e-03				
3		Close FP-335 & FP-270	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	16-BATCLG--F-HE	HEP Description	Establish Battery Room Cooling - Flood
Revision Date	10/22/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S	Operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	Due to a loss of 480V buses, All Battery Room Cooling is lost. Alternate cooling is provided via Air Trunks.		
Event Description	Due to a loss of 480V buses, All Battery Room Cooling is lost and Annunciator 47052-D, Battery Room A/B Exhaust Flow Low, activates. Using the fire brigade/team training, alternate cooling is provided via Air Trunks.		
Assumptions for the Event	The following assumptions are made: • Air trunks will be aligned to a cool source of air • Operators will identify the loss of fan coils when checking Battery Exhaust Fans		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The operators respond to the Annunciator 47052-D actuation and investigate as soon as possible. At 47 meets after the loss of ventilation, the operator are directed to use the fire equipment to ventilate the Battery Rooms, the air trunks and fans are then rigged in approximately 30 minutes. The time element is 180 minutes to perform this task.		
Success Criteria	Battery Room air temperature is maintained below the equipment failure point.		
References Used	ARP-47052D, A-TAV-16		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

16-BATCLG--F-HE, Establish Battery Room Cooling - Flood

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/21/05
Cognitive Method:	CDBTM/THERP

Table 113: 16-BATCLG--F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	6.3e-02	6.3e-02
P_{exe}	1.6e-02	1.6e-02
Total HEP		7.9e-02
Error Factor		5

HFE Scenario Description:
Due to a loss of 480V buses, All Battery Room Cooling is lost. Alternate cooling is provided via Air Trunks.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-TAV-16

Training:

- None
- X - Classroom Frequency:
- Simulator

Degree of Clarity of Cues & Indications:

- X - Very Good
- Average
- Poor

Human-Machine Interface:

- Control Room Panels
- Local Control Panels
- X - Local Equipment

Special Requirements:

Tools		Parts	Clothing
X	Required	Required	Required
	Adequate	Adequate	Adequate
	Available	Available	Available

Type of Response:

X - **Skills**
- **Rule**
- **Knowledge**

Complexity of Response

Cognitive		Execution	
	- Complex		- Complex
X	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
	- Normal		- Normal
X	- Emergency	X	- Hot / Humid
	- Portable		- Cold

Radiation		Atmosphere	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
X	- **Auxiliary Building**	Accessible
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

Stress:

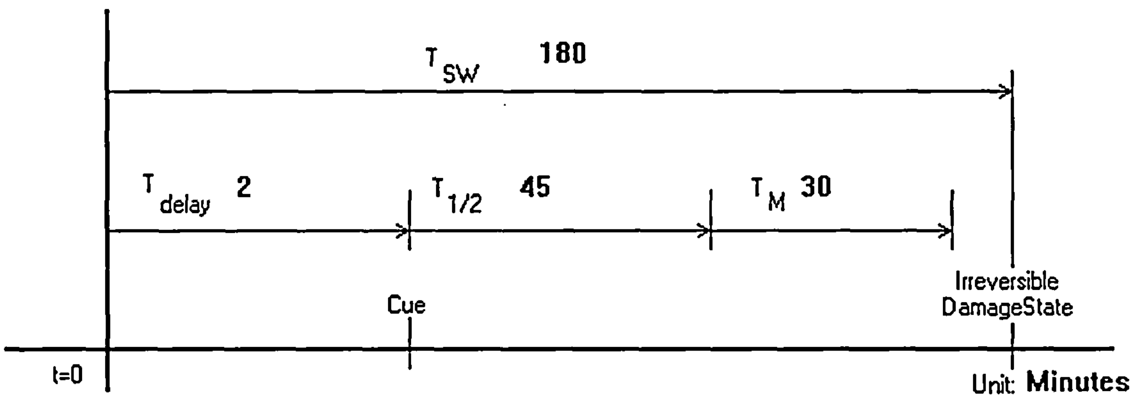
- **Optimum (Low)**

X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

16-BATCLG--F-HE

Cue:
Annunciator 47052-D, Battery Room A/B Exhaust Flow Low, activates.



Reference for System Time:

Reference for Manipulation Time:

Duration of time window available for action (TW): 103.00 Minutes

Table 114: 16-BATCLG--F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	k	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		6.3e-02

Cognitive Recovery

16-BATCLG--F-HE

Table 115: 16-BATCLG--F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	-	NC	-	1.0		5.0e-02
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											6.3e-02

Recovery Factors Identified:

Execution Unrecovered

16-BATCLG--F-HE

Table 116: 16-BATCLG--F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Position Fan						Comments: Fan may be gas or electric. Fire brigade training covers the use of these fans and air trunks.						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Position air trunk to Battery Room						Comments:						
3	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Start Fan						Comments:						

Execution Recovery

16-BATCLG--F-HE

Table 117: 16-BATCLG--F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Position Fan	5.2e-03				
2		Position air trunk to Battery Room	5.2e-03				
3		Start Fan	5.2e-03				
		Total Unrecovered:	1.6e-02			Total Recovered:	1.6e-02

HEP	27A-ORR----F-HE	HEP Description	Limit SI flow - Flood
Revision Date	7/2/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow.		
Event Description	The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow. The Operator will direct the throttling of SI-7B to reduce SI flow to the minimum allowed.		
Assumptions for the Event	The following assumptions are made: • Subcooling was lost and not regained prior to entry into ECA-1.1 due to RXCP Seal Leak • A loss of Component Cooling caused the operators to secure the RXCPs • SI Pump B is operating; RHR is not injecting/running; and ICS has not initiated. • Only Bus 6 has power from offsite or Diesel Generator B. • Communications between Control Room and NAO is via PCS phone.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Additionally Simulator observation of 11/4/02 was used to assist in the time line. It is assumed that the operators proceeded in ECA-1.1 at step 17 of E-1 when recirculation capabilities are discovered to be not available. Step 17 of E-1 is reached in approximately 45. The NAO will be dispatched to throttle approximately 2.4 minutes later to throttle SI-7B. It is estimated that it will take the operators approximately 5 minutes to start throttling SI flow and have it positioned in 10 minutes.		
Success Criteria	SI flow is throttled to minimum flow.		
References Used	ECA-1.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	The operators use STAR self-checking process.		

Execution Assumptions	None
Execution Recovery Assumptions	None

27A-ORR----F-HE, Limit SI flow - Flood

Basic Event Summary

Analyst:	GEB
Rev. Date:	10/21/05
Cognitive Method:	CDBTM/THERP

Table 118: 27A-ORR----F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	3.0e-03	1.5e-03
P_{exe}	3.5e-03	3.5e-03
Total HEP		5.0e-03
Error Factor		5

HFE Scenario Description:
The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate stress, even though a ECA procedure is entered, it is a procedure that is trained on routinely and the operator is familiar with using as while as time after initiating event.

Procedure and step governing HI:
ECA-1.1, Steps 14

Training:

- None
- Classroom
- X - Simulator Frequency: .5

Degree of Clarity of Cues & Indications:

- X - Very Good
- Average
- Poor

Human-Machine Interface:

- X - Control Room Panels
- Local Control Panels
- X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- X - **Rule**
- **Knowledge**

Complexity of Response

Cognitive		Execution	
X	Complex	X	Complex
	Simple		Simple

Environment:

Lighting		Heat/Humidity	
X	Normal	X	Normal
	Emergency		Hot / Humid
	Portable		Cold
Radiation		**Atmosphere**	
	Background	X	Normal
	Green		Steam
X	Yellow		Smoke
	Red		Respirator required

Equipment Accessibility:

	Location	Accessibility
X	**Control Room Front Panels**	Accessible
	Control Room Back Panels	
	Hot Shutdown Panels	
X	**Auxiliary Building**	Accessible
	Electrical Building	
	Containment	
	Pump house	
	Switchyard	

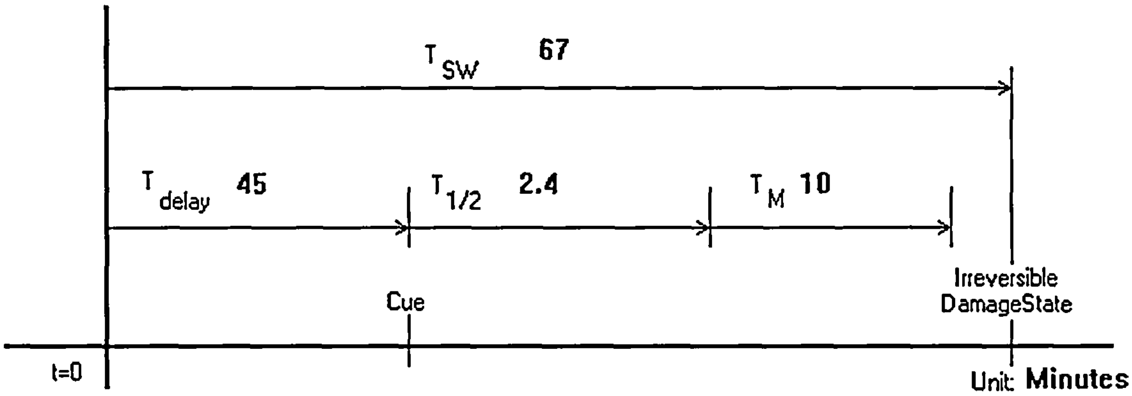
Stress:

- **Optimum (Low)**
- X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

27A-ORR---F-HE

Cue:
Unable to establish recirculation criteria in step 17 of E-1



Reference for System Time: MAAP run KE1MLO05

Reference for Manipulation Time: Simulator observation and interviews from 9/02 to 6/03

Duration of time window available for action (TW): 9.60 Minutes

Table 119: 27A-ORR---F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	a	neg.
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	k	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		3.0e-03

Cognitive Recovery

27A-ORR----F-HE

Table 120: 27A-ORR----F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
							Sum of Pc_a through Pc_h = Initial Pc =				1.5e-03

Recovery Factors identified:
Trained to perform self-review of step prior to transition to next procedure

Execution Unrecovered

27A-ORR----F-HE

Table 121: 27A-ORR----F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 14.a RNO b.3	4.3E-4	20-7b	1	M	2	1.3E-3	20-13	1	M	2		3.5e-03
Actions: Locally throttle SI-7A(B)						Comments:						

Execution Recovery

27A-ORR----F-HE

Table 122: 27A-ORR----F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 14.a RNO b.3		Locally throttle SI-7A(B)	3.5e-03				
		Total Unrecovered:	3.5e-03			Total Recovered:	3.5e-03

HEP	05B-MDPTD36F-HE	HEP Description	Start TD AFW Pump before loss of MD AFW Pump - 36 min.
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).		
Event Description	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%). To prevent damage to the motor driven AFW pump, the operator restarts the Turbine Driven AFW pump.		
Assumptions for the Event	The following assumptions are made: • Operators recognize the potential of greater damage to the motor if left running.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The switching between pumps require positioning 2 switches in the Control Room and should be performed in <3 minutes. The Operator has 36 minutes to accomplish this task.		
Success Criteria	TD AFW pump operating before MD pumps Failure.		
References Used	ES-0.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

05B-MDPTD36F-HE, Start TD AFW Pump before loss of MD AFW Pump - 36 min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 123: 05B-MDPTD36F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.5e-01	4.6e-01
P_{exe}	5.2e-03	5.2e-03
Total HEP		4.7e-01
Error Factor		1

HFE Scenario Description:
After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G and time into event.

Procedure and step governing HI:
ES-0.1, step 6

Training:

X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

-   - **Skills**
-   - **Rule**
- X - **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	X - Normal
X - Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

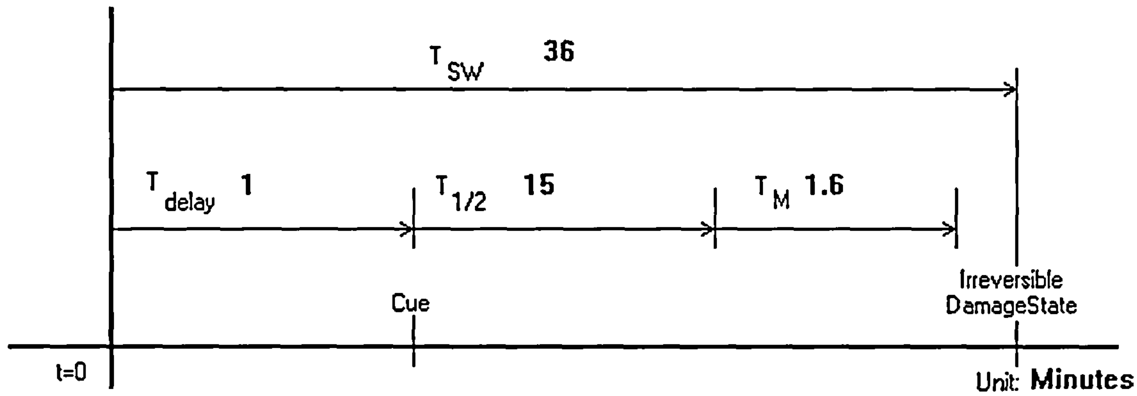
Stress:

-   - **Optimum (Low)**
- X - **Moderate**
-   - **Extreme (High)**

Cognitive Unrecovered

05B-MDPTD36F-HE

Cue:
Increasing water level in AFW Pump rooms



Reference for System Time: Maracor Data 10/24/05

Reference for Manipulation Time: Simulator observation and operator interviews

Duration of time window available for action (TW): 18.40 Minutes

Table 124: 05B-MDPTD36F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.5e-01

Cognitive Recovery

05B-MDPTD36F-HE

Table 125: 05B-MDPTD36F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	-	NC	-	1.0	3	1.5e-01
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	-	NC	-	1.0	3	3.0e-03
Pc_d:	1.0e-01	-	-	-	-	-	NC	-	1.0	3	3.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0	3	9.0e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											4.6e-01

Recovery Factors Identified:
Factor of 3 is used due operational judgment used during simulator run 9/29/05.

Execution Unrecovered

05B-MDPTD36F-HE

Table 126: 05B-MDPTD36F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start TD AFW Pump						Comments:						

Execution Recovery

05B-MDPTD36F-HE

Table 127: 05B-MDPTD36F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start TD AFW Pump	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

HEP	05B-MDPTD49F-HE	HEP Description	Start TD AFW Pump before loss of MD AFW Pump - 49 min.
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).		
Event Description	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%). To prevent damage to the motor driven AFW pump, the operator restarts the Turbine Driven AFW pump.		
Assumptions for the Event	The following assumptions are made: • Operators recognize the potential of greater damage to the motor if left running.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The switching between pumps require positioning 2 switches in the Control Room and should be performed in <3 minutes. The Operator has 49 minutes to accomplish this task.		
Success Criteria	TD AFW pump operating before MD pumps Failure.		
References Used	ES-0.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

05B-MDPTD49F-HE, Start TD AFW Pump before loss of MD AFW Pump- 49 min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 128: 05B-MDPTD49F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.5e-01	4.6e-01
P_{exe}	5.2e-03	5.2e-03
Total HEP		4.7e-01
Error Factor		1

HFE Scenario Description:
After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G and time into event.

Procedure and step governing HI:
ES-0.1, step 6

Training:

- X - None
- \- Classroom
- \- Simulator

Degree of Clarity of Cues & Indications:

- X - Very Good
- \- Average
- \- Poor

Human-Machine Interface:

- X - Control Room Panels
- \- Local Control Panels
- \- Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- **Rule**

X - **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	X - Normal
X - Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

Stress:

- **Optimum (Low)**

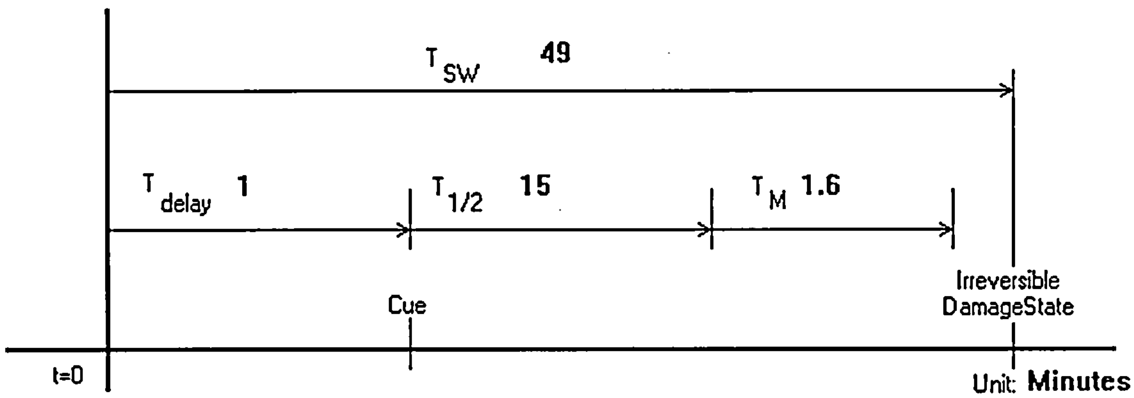
X - **Moderate**

- **Extreme (High)**

Cognitive Unrecovered

05B-MDPTD49F-HE

Cue:
Increasing water level in AFW Pump rooms



Reference for System Time: Maracor Data 10/24/05

Reference for Manipulation Time: Simulator observation and operator interviews

Duration of time window available for action (TW): 31.40 Minutes

Table 129: 05B-MDPTD49F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.5e-01

Cognitive Recovery

05B-MDPTD49F-HE

Table 130: 05B-MDPTD49F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	-	NC	-	1.0	3	1.5e-01
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	-	NC	-	1.0	3	3.0e-03
Pc_d:	1.0e-01	-	-	-	-	-	NC	-	1.0	3	3.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0	3	9.0e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											4.6e-01

Recovery Factors Identified:
Factor of 3 is used due operational judgment used during simulator run 9/29/05.

Execution Unrecovered

05B-MDPTD49F-HE

Table 131: 05B-MDPTD49F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start TD AFW Pump						Comments:						

Execution Recovery

05B-MDPTD49F-HE

Table 132: 05B-MDPTD49F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start TD AFW Pump	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

HEP	05B-MDPTD61F-HE	HEP Description	Start TD AFW Pump before loss of MD AFW Pump - 61 min.
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).		
Event Description	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%). To prevent damage to the motor driven AFW pump, the operator restarts the Turbine Driven AFW pump.		
Assumptions for the Event	The following assumptions are made: • Operators recognize the potential of greater damage to the motor if left running.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The switching between pumps require positioning 2 switches in the Control Room and should be performed in <3 minutes. The Operator has 61 minutes to accomplish this task.		
Success Criteria	TD AFW pump operating before MD pumps Failure.		
References Used	ES-0.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

05B-MDPTD61F-HE, Start TD AFW Pump before loss of MD AFW Pump- 61 min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 133: 05B-MDPTD61F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.5e-01	3.1e-01
P_{exe}	5.2e-03	5.2e-03
Total HEP		3.1e-01
Error Factor		1

HFE Scenario Description:
After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G and time into event.

Procedure and step governing HI:
ES-0.1, step 6

Training:

X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- Rule
X - Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	X - Normal
X - Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

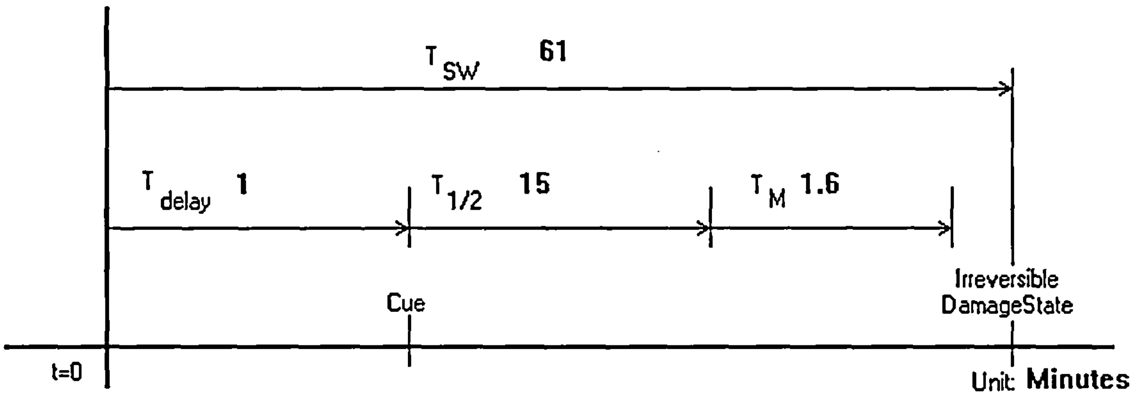
Stress:

- Optimum (Low)
X - Moderate
- Extreme (High)

Cognitive Unrecovered

05B-MDPTD61F-HE

Cue:
Increasing water level in AFW Pump rooms



Reference for System Time: Maracor Data 10/24/05

Reference for Manipulation Time: Simulator observation and operator interviews

Duration of time window available for action (TW): 43.40 Minutes

Table 134: 05B-MDPTD61F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.5e-01

Cognitive Recovery

05B-MDPTD61F-HE

Table 135: 05B-MDPTD61F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	-	NC	-	1.0	2	1.0e-01
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	-	NC	-	1.0	2	2.0e-03
Pc_d:	1.0e-01	-	-	-	-	-	NC	-	1.0	2	2.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0	2	6.0e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											3.1e-01

Recovery Factors Identified:
Factor of 2 is used due operational judgment used during simulator run 9/29/05.

Execution Unrecovered

05B-MDPTD61F-HE

Table 136: 05B-MDPTD61F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start TD AFW Pump						Comments:						

Execution Recovery

05B-MDPTD61F-HE

Table 137: 05B-MDPTD61F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start TD AFW Pump	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

HEP	05B-MDPTD1C-HE	HEP Description	Start TD AFW Pump before loss of MD AFW Pump - 108 min.
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).		
Event Description	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%). To prevent damage to the motor driven AFW pump, the operator restarts the Turbine Driven AFW pump.		
Assumptions for the Event	The following assumptions are made: • Operators recognize the potential of greater damage to the motor if left running.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The switching between pumps require positioning 2 switches in the Control Room and should be performed in <3 minutes. The Operator has 108 minutes to accomplish this task.		
Success Criteria	TD AFW pump operating before MD pumps Failure.		
References Used	ES-0.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

05B-MDPTD1CF-HE, Start TD AFW Pump before loss of MD AFW Pump- 108 min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 138: 05B-MDPTD1CF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.5e-01	1.5e-01
P_{exe}	5.2e-03	5.2e-03
Total HEP		1.6e-01
Error Factor		1

HFE Scenario Description:
After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G and time into event.

Procedure and step governing HI:
ES-0.1, step 6

Training:

- X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

- X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

-   - **Skills**
-   - **Rule**
- X - **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
- Normal	X - Normal
X - Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

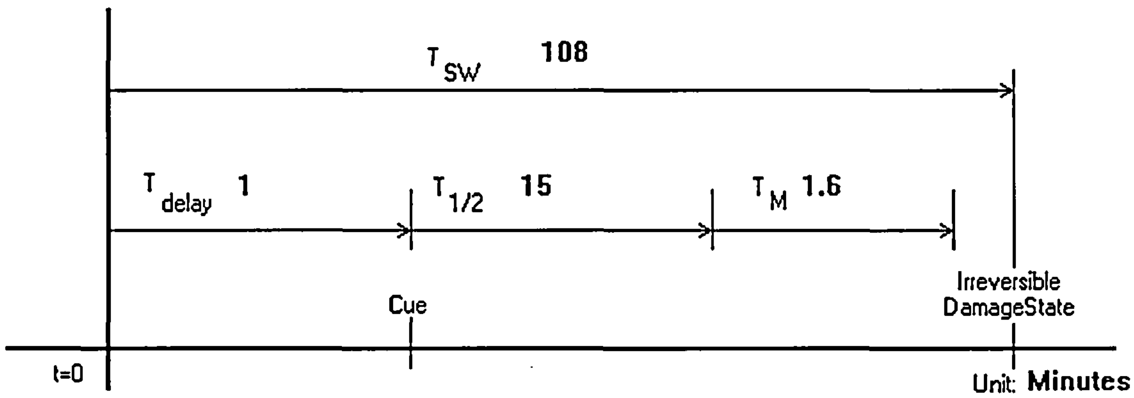
Stress:

-   - **Optimum (Low)**
- X - **Moderate**
-   - **Extreme (High)**

Cognitive Unrecovered

05B-MDPTD1CF-HE

Cue:
Increasing water level in AFW Pump rooms



Reference for System Time: Maracor Data 10/24/05

Reference for Manipulation Time: Simulator observation and operator interviews

Duration of time window available for action (TW): 90.40 Minutes

Table 139: 05B-MDPTD1CF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.5e-01

Cognitive Recovery

05B-MDPTD1CF-HE

Table 140: 05B-MDPTD1CF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	-	NC	-	1.0		5.0e-02
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_d:	1.0e-01	-	-	-	-	-	NC	-	1.0		1.0e-01
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
							Sum of Pc_a through Pc_h = Initial Pc =				1.5e-01

Recovery Factors Identified:
Factor of 3 is used due operational judgment used during simulator run 9/29/05.

Execution Unrecovered

05B-MDPTD1CF-HE

Table 141: 05B-MDPTD1CF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start TD AFW Pump						Comments:						

Execution Recovery

05B-MDPTD1CF-HE

Table 142: 05B-MDPTD1CF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start TD AFW Pump	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

HEP	05B-MDPTD2HF-HE	HEP Description	Start TD AFW Pump before loss of MD AFW Pump – 2 hr.
Revision Date	10/25/2005	Evaluator	GE Baldwin
Operations Reviewer	P. Rappel	Reviewer	S. Shen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).		
Event Description	After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%). To prevent damage to the motor driven AFW pump, the operator restarts the Turbine Driven AFW pump.		
Assumptions for the Event	The following assumptions are made: • Operators recognize the potential of greater damage to the motor if left running.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The switching between pumps require positioning 2 switches in the Control Room and should be performed in <3 minutes. The Operator has 2 or more hours to accomplish this task.		
Success Criteria	TD AFW pump operating before MD pumps Failure.		
References Used	ES-0.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

05B-MDPTD2HF-HE, Start TD AFW Pump before loss of MD AFW Pump- 2 hr.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/24/05
Cognitive Method:	CDBTM/THERP

Table 143: 05B-MDPTD2HF-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	1.5e-01	3.5e-02
P_{exe}	5.2e-03	5.2e-03
Total HEP		4.1e-02
Error Factor		5

HFE Scenario Description:
After a reactor trip during a flooding event, the TD AFW pump is the stopped and water level is increasing in Motor Driven AFW pump rooms. S/G feed flow is required to reach S/G required level band (4-50%).

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G and time into event.

Procedure and step governing HI:
ES-0.1, step 6

Training:

X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

	-	**Skills**
	-	**Rule**
X	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex		-	Complex
	-	Simple	**X**	-	Simple

Environment:

Lighting			Heat/Humidity		
	-	Normal	**X**	-	Normal
X	-	Emergency		-	Hot / Humid
	-	Portable		-	Cold
Radiation			**Atmosphere**		
X	-	Background	**X**	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

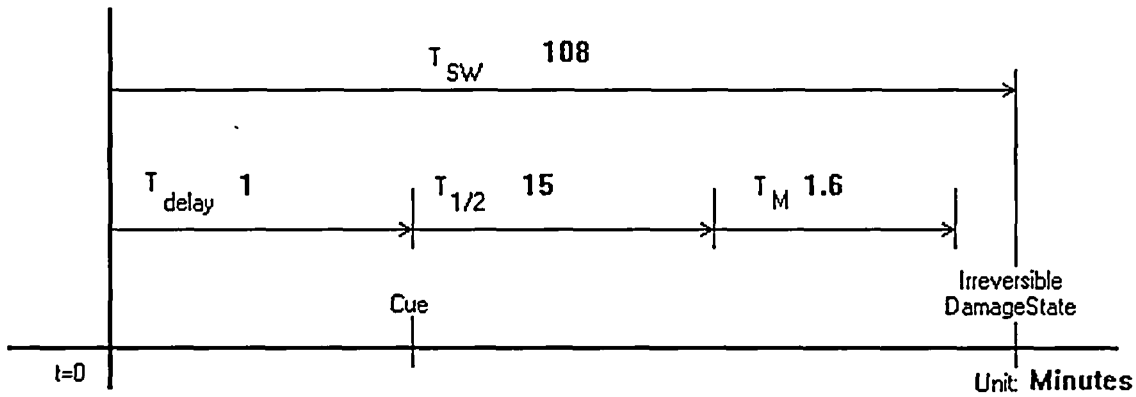
Stress:

	-	**Optimum (Low)**
X	-	**Moderate**
	-	**Extreme (High)**

Cognitive Unrecovered

05B-MDPTD2HF-HE

Cue:
Increasing water level in AFW Pump rooms



Reference for System Time: Maracor Data 10/24/05

Reference for Manipulation Time: Simulator observation and operator interviews

Duration of time window available for action (TW): 90.40 Minutes

Table 144: 05B-MDPTD2HF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	e	5.0e-02
Pc_b: Failure of Attention	i	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.5e-01

Cognitive Recovery

05B-MDPTD2HF-HE

Table 145: 05B-MDPTD2HF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	5.0e-02	-	-	-	-	X	5.0e-01	-	5.0e-01		2.5e-02
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	X	1.0e-01	-	1.0e-01		1.0e-04
Pc_d:	1.0e-01	-	-	-	-	X	1.0e-01	-	1.0e-01		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	X	1.0e-01	-	1.0e-01		3.0e-04
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											3.5e-02

Recovery Factors Identified:

Execution Unrecovered

05B-MDPTD2HF-HE

Table 146: 05B-MDPTD2HF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start TD AFW Pump						Comments:						

<table>
<tr><td>HEP</td><td colspan="2">06--OC6----F-HE</td><td>HEP Description</td><td>Cooldown and Depressurize the RCS for Charging- flood</td></tr>
<tr><td>Revision Date</td><td colspan="2">10/27/2005</td><td>Evaluator</td><td>GE Baldwin</td></tr>
<tr><td>Operations Reviewer</td><td colspan="2">J. Stafford</td><td>Review</td><td>E. Coen</td></tr>
<tr><td rowspan="2">Operations Input</td><td>I</td><td colspan="3" rowspan="2">Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April, 2005 and simulator observation 9/29/05.</td></tr>
<tr><td>S</td></tr>
<tr><td>Scenario</td><td colspan="4">During a flooding event, the RXCP seals fail causing a LOCA to occur leading to a Safety Injection to actuate. The operators enter E-0 and then transition to E-1 at step 23 of E-0. E-1 is performed to step 18 where the operator transition to ES-1.2.</td></tr>
<tr><td>Event Description</td><td colspan="4">During a flooding event, the RXCP seals fail causing a LOCA to occur leading to a Safety Injection to actuate. The operators enter E-0 and then transition to E-1 at step 23 of E-0. E-1 is performed to step 18 where the operator transition to ES-1.2. The operator than cools down and depressurizes until SI is not required and Charging can meet makeup requirements.</td></tr>
<tr><td>Assumptions for the Event</td><td colspan="4">The following conditions are assumed:
- Two SI Pumps are running until stopped by operator
- RWST level has remained above 37%
- Component Cooling has remained in operation throughout the event
- Steam Generator level is being controlled by the operator or the operator has taken no action so AFW flow remains at >200 gpm.
- RCS Subcooling has remained above 30°F and RCS pressure has stabilized at <2200 psig (at the SI pump head)</td></tr>
<tr><td>Timing Analysis</td><td colspan="4">Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The operator would reach and complete diagnosis of E-1 step 18 in approximately 40 minutes. The operator actions of ES-1.2 would take approximately 15 minutes to reach ES-1.2 step 16. It is estimated that the RCS depressurization would take 10 minutes or less and the cooldown would be continuous once started until cold shutdown was reached. The estimated total time to reach success criteria is 1 hour and 5 minutes. MAAP run KE1SLO01 indicates the cues should be reached in 1 minutes and success criteria should be reached in 2 hours 1 minute.</td></tr>
<tr><td>Success Criteria</td><td colspan="4">SI pumps are stopped and PRZR level is stable at >5%.</td></tr>
<tr><td>References Used</td><td colspan="4">E-1, ES-1.2, E-0, E-0 QRF</td></tr>
<tr><td>Cognitive Assumption</td><td colspan="4">It is assumed proper place keeping is used.</td></tr>
<tr><td>Cognitive Recovery Assumptions</td><td colspan="4">It is assumed the operator will fully repeat the steps when in a procedural loop.</td></tr>
</table>

Execution Assumptions	None
Execution Recovery Assumptions	None

06--OC6----F-HE, Cooldown and Depressurize the RCS for Charging-flood

Basic Event Summary

Analyst:	GEB
Rev. Date:	10/27/05
Cognitive Method:	CDBTM/THERP

Table 147: 06--OC6----F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	3.0e-03	1.5e-03
P_{exe}	1.0e-01	9.1e-02
Total HEP		9.2e-02
Error Factor		5

HFE Scenario Description:
During a flooding event, the RXCP seals fail causing a LOCA to occur leading to a Safety Injection to actuate. The operators enter E-0 and then transition to E-1 at step 23 of E-0. E-1 is performed to step 18 where the operator transition to ES-1.2.

Related Human Interactions:
06--OC6-DIAG-HE

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
E-1, step 18, ES-1.2, steps 1-11

Training:

- **None**
- X - **Classroom** Frequency:
- X - **Simulator** Frequency:

Degree of Clarity of Cues & Indications:

- X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- X - Rule
- Knowledge

Complexity of Response

Cognitive		Execution	
	- *Complex*		- *Complex*
X	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold
Radiation		**Atmosphere**	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

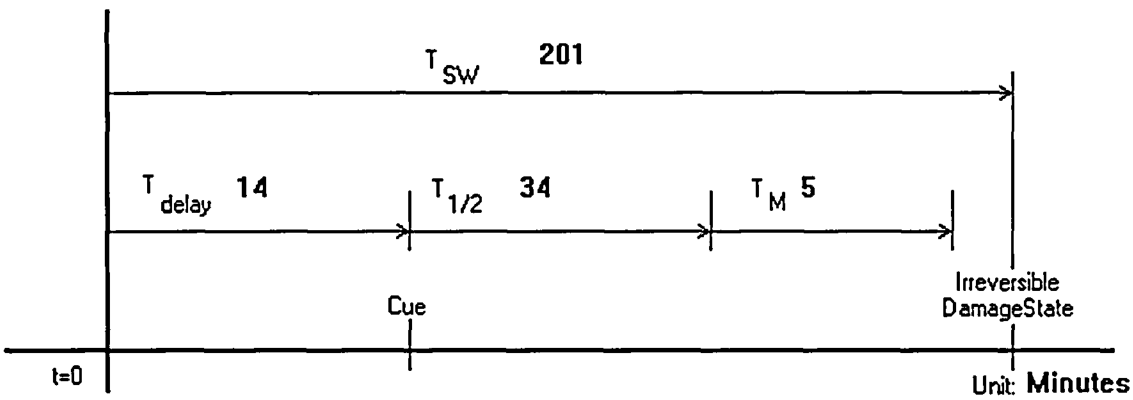
Stress:

- Optimum (Low)
- X - Moderate
- Extreme (High)

Cognitive Unrecovered

06--OC6----F-HE

Cue:
Completion of E-1 through step 17.



Reference for System Time: MAAP Run

Reference for Manipulation Time: Simulator Observation and Operator interviews

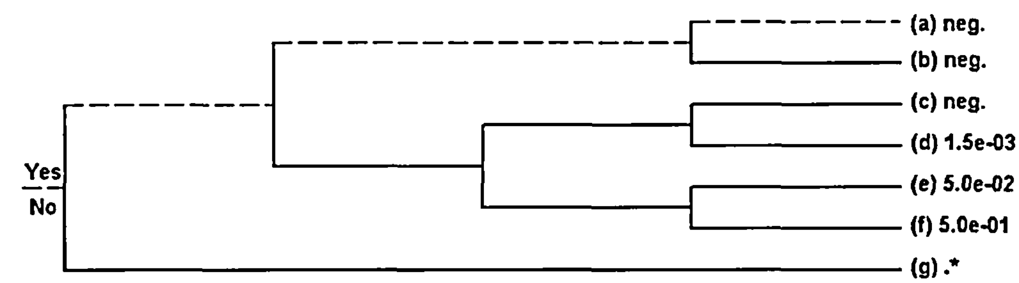
Duration of time window available for action (TW): 148.00 Minutes

Table 148: 06--OC6----F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	a	neg.
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	k	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		3.0e-03

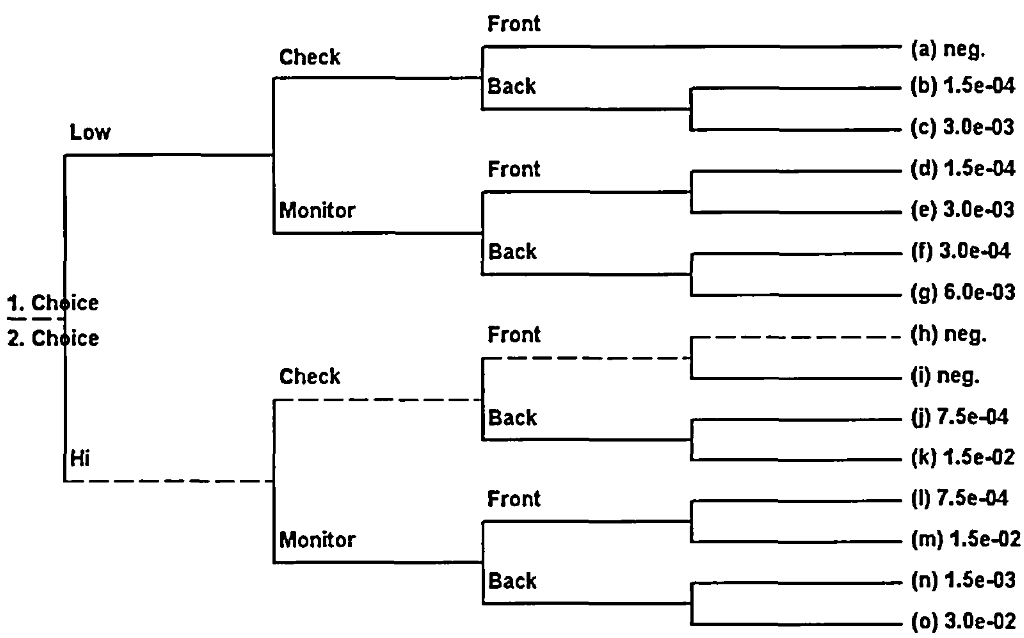
pca: Availability of information

Indication Avail in CR	CR Indication Accurate	Warning/Alternate in Procedure	Training on Indicators

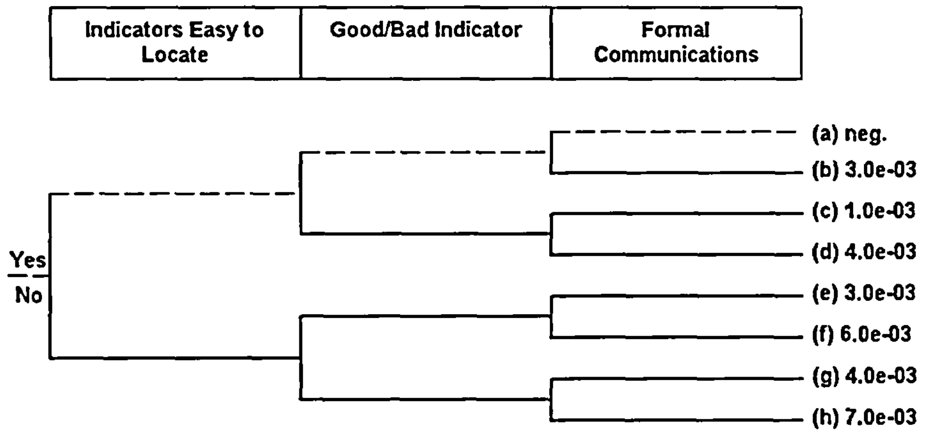


pcb: Failure of attention

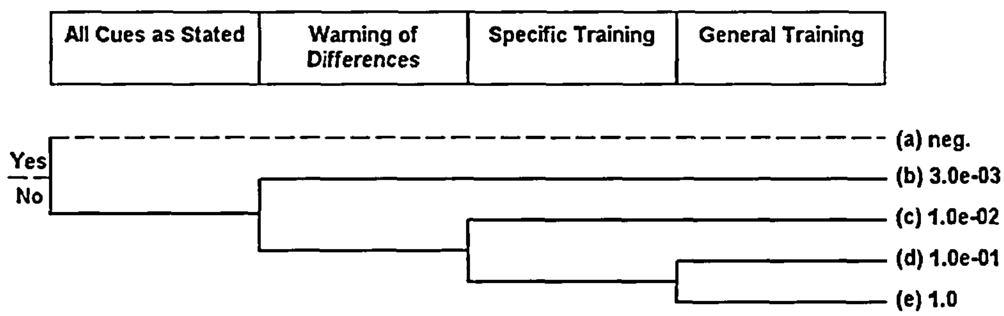
Low vs. Hi Workload	Check vs. Monitor	Front vs. Back Panel	Alarmed vs.Not Alarmedn



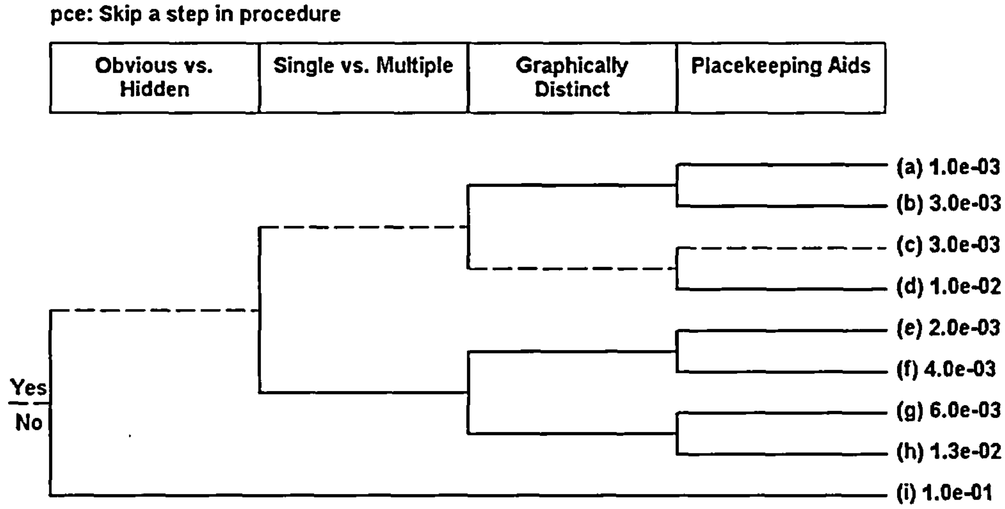
pcc: Misread/miscommunicate data



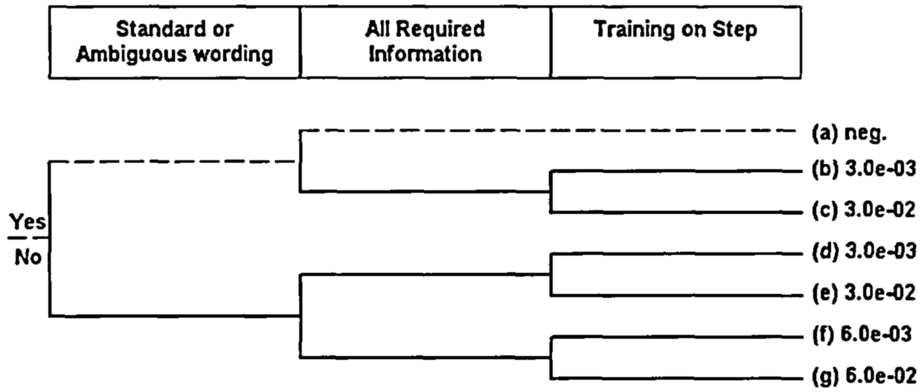
pcd: Information misleading



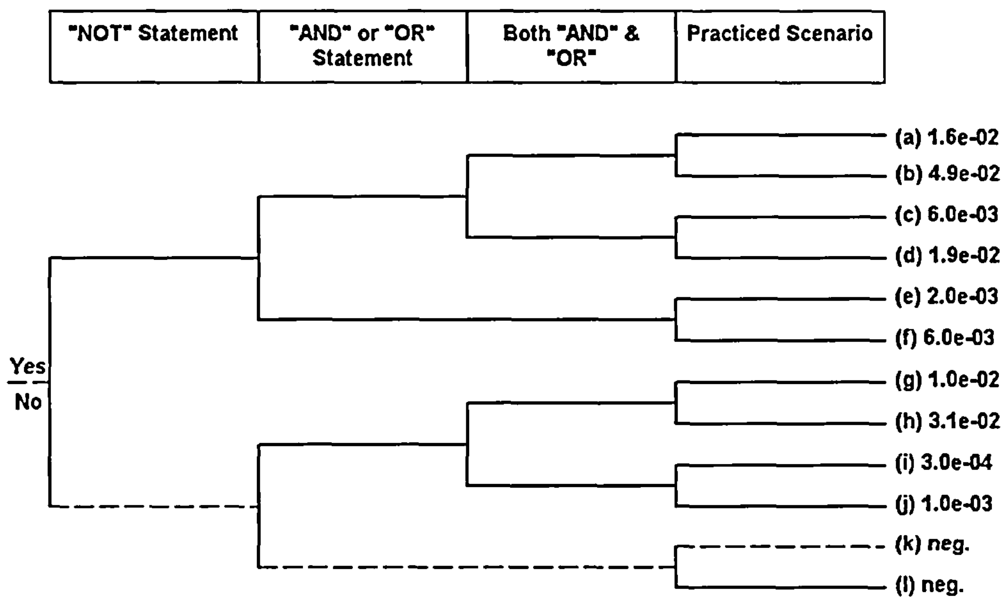
pce: Skip a step in procedure



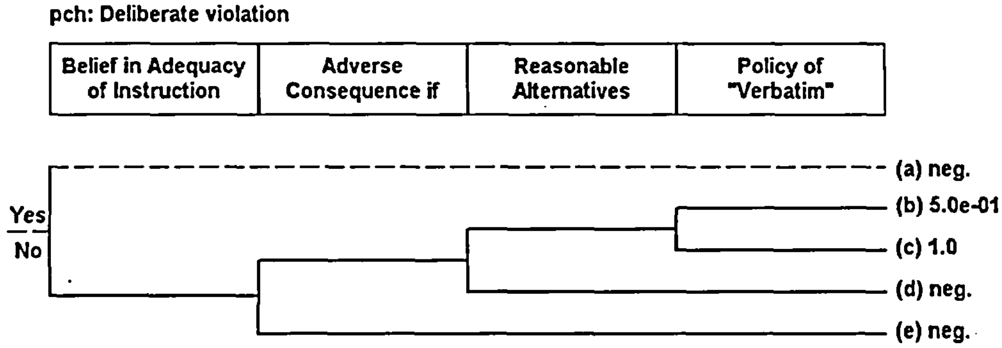
pcf: Misinterpret instruction



pcg: Misinterpret decision logic



pch: Deliberate violation



Cognitive Recovery

06--OC6----F-HE

Table 149: 06--OC6----F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.5e-03

Recovery Factors Identified:
Step 19 starts procedural loop.

Execution Unrecovered

06--OC6----F-HE

Table 150: 06--OC6----F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
E-1, step 18	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: Check if RCS cooldown and Depressurization is required.						Comments:						
E-1, step 19 RNO	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: Go to step 17						Comments:						
ES-1.2												0.0e+00
Actions:						Comments:						
2.a RNO a.2	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	4	M	2		3.5e-03
Actions: Start Charging Pumps as necessary.						Comments:						
Step 2.b	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	4	M	2		3.5e-03
Actions: Align Charging Pump Suction to RWST						Comments:						
Step 2.c	1.3E-3	20-7b	2	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Start a second Charging Pump and establish maximum Charging Flow						Comments:						
Step 5.a	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Dump Stm from Intact S/G(s) using the Stm Dump System in STM PRESS mode						Comments:						
Step 8	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Place all PRZR HTR switches to off position						Comments:						
Step 9.a	1.3E-3	20-7b	2	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Depress. RCS to refill PRZR - use normal spray						Comments:						
Step 9.b	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: PRZR Level > 19%						Comments:						
Step 9.c	1.3E-3	20-7b	2	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Stop RCS Depressurization						Comments:						
Step 11.a	1.3E-3	20-7b	2	M	2	neg.	20-11	8	M	2		2.6e-03
Actions: Any SI Pump Running						Comments:						
Step 11.b & c	1.3E-3	20-7b	2	M	2	3.8E-3	20-10	1	M	2		1.0e-02
Actions: Determine required RCS Subcooling - RCS subcooling > than required						Comments:						
Step 11.d	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: PRZR level >19%						Comments:						
Step 11.d-r	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: PRZR level > 19%						Comments:						
Step 11.e	4.3E-4	20-7b	1	M	2	1.3E-3	20-12	3	M	2		3.5e-03
Actions: Stop one SI Pump						Comments:						
Step 11.c RNO.c	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: RCS hot leg temperature >330 deg. F						Comments:						
Step 16.a	1.3E-3	20-7b	2	M	2	1.3E-3	20-11	1	M	2		5.2e-03

Actions: RCS Subcooling based on Core Exit TCs >30 deg. F						Comments:						
Step 16.b	1.3E-3	20-7b	2	M	2	3.8E-3	20-11	4	M	2		1.0e-02
Actions: PRZR Level >5%						Comments:						

Execution Recovery

06--OC6----F-HE

Table 151: 06--OC6----F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
E-1, step 18		Check if RCS cooldown and Depressurization is required.	1.0e-02				5.0e-03
	E-1, step 19 RNO	Go to step 17		1.0e-02	HD	5.0e-01	
Step 9.b		PRZR Level > 19%	1.0e-02				5.0e-03
	Step 11.d-r	PRZR level > 19%		1.0e-02	HD	5.0e-01	
ES-1.2			0.0e+00				0.0e+00
2.a RNO a.2		Start Charging Pumps as necessary.	3.5e-03				3.5e-03
Step 2.b		Align Charging Pump Suction to RWST	3.5e-03				3.5e-03
Step 2.c		Start a second Charging Pump and establish maximum Charging Flow	5.2e-03				5.2e-03
Step 5.a		Dump Stm from Intact S/G(s) using the Stm Dump System in STM PRESS mode	3.5e-03				3.5e-03
Step 8		Place all PRZR HTR switches to off position	3.5e-03				3.5e-03
Step 9.a		Depress. RCS to refill PRZR - use normal spray	5.2e-03				5.2e-03
Step 9.c		Stop RCS Depressurization	5.2e-03				5.2e-03
Step 11.a		Any SI Pump Running	2.6e-03				2.6e-03
Step 11.b & c		Determine required RCS Subcooling - RCS subcooling > than required	1.0e-02				1.0e-02
Step 11.d		PRZR level >19%	1.0e-02				1.0e-02
Step 11.e		Stop one SI Pump	3.5e-03				3.5e-03
Step 11.c RNO.c		RCS hot leg temperature >330 deg. F	1.0e-02				1.0e-02
Step 16.a		RCS Subcooling based on Core Exit TCs >30 deg. F	5.2e-03				5.2e-03
Step 16.b		PRZR Level >5%	1.0e-02				1.0e-02
		Total Unrecovered:	1.0e-01			Total Recovered:	9.1e-02

HEP	06--OC2----F-HE	HEP Description	Cooldown and Depressurize the RCS in Nat. Circ - flood
Revision Date	10/27/2005	Evaluator	GE Baldwin
Operations Reviewer	J. Stafford	Review	E. Coen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April, 2005 and simulator observation 9/29/05.	
Scenario	During a flooding event, the operators decide a natural circulation cooldown is required. The operators enter ES-0.2 from ES-0.1 at step 28. A natural circulation cooldown is performed via ES-0.2.		
Event Description	During a flooding event, the operators decide a natural circulation cooldown is required. The operators enter ES-0.2 from ES-0.1 at step 28. A natural circulation cooldown is performed via ES-0.2.		
Assumptions for the Event	The following assumptions are made: • Charging is established and aligned to RWST		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Approximately 1 hour in the event, the decision to cooldown via ES-0.2, "Natural Circulation Cooldown", is made at step 28 of ES-0.1, "Reactor Trip Response". The operators borate the RCS and perform 1 hour soak for mixing. The operators start the RCS cooldown and depressurization approximately 3 hours after the start of the event. The operators need to start the cooldown in 6 hours.		
Success Criteria	RCS is cooling down at approximately 25 deg/hr and depressurizing with in the guideline of ES-0.2		
References Used	ES-0.1, ES-0.2, N-CVC-35A		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

06--OC2----F-HE, Cooldown and Depressurize the RCS in Nat. Circ - flood

Basic Event Summary

Analyst:	GEB
Rev. Date:	10/27/05
Cognitive Method:	CDBTM/THERP

Table 152: 06--OC2----F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	4.4e-02	4.3e-02
P_{exe}	3.1e-02	3.1e-02
Total HEP		7.4e-02
Error Factor		5

HFE Scenario Description:
During a flooding event, the operators decide a natural circulation cooldown is required. The operators enter ES-0.2 from ES-0.1 at step 28. A natural circulation cooldown is performed via ES-0.2.

Related Human Interactions:
NONE

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ES-0.1, step 28, ES-0.2, steps 1-8

Training:

	-	None	
X	-	Classroom	Frequency:
X	-	Simulator	Frequency:

Degree of Clarity of Cues & Indications:

X - **Very Good**
- **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- X - **Rule**
- **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- **Auxiliary Building**	
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

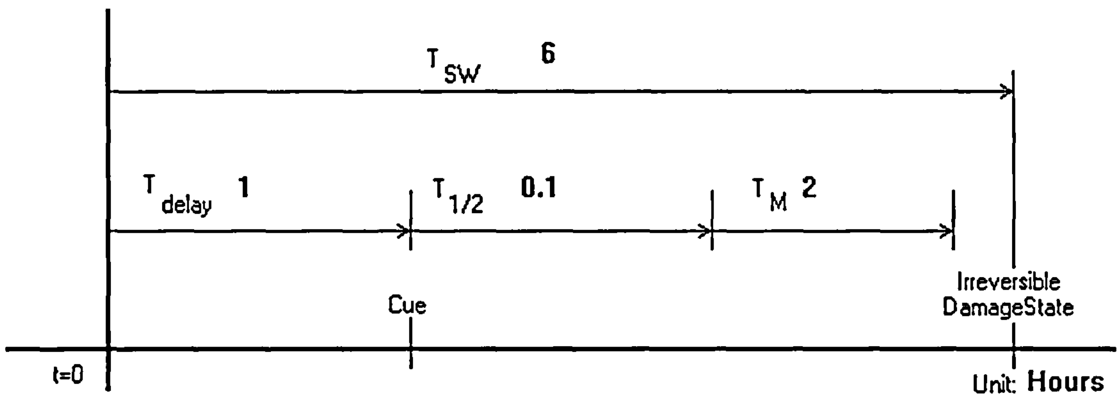
Stress:

- **Optimum (Low)**
- X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

06--OC2----F-HE

Cue:
Completion of ES-0.1, step 28



Reference for System Time: Maracor Data 10/26/05

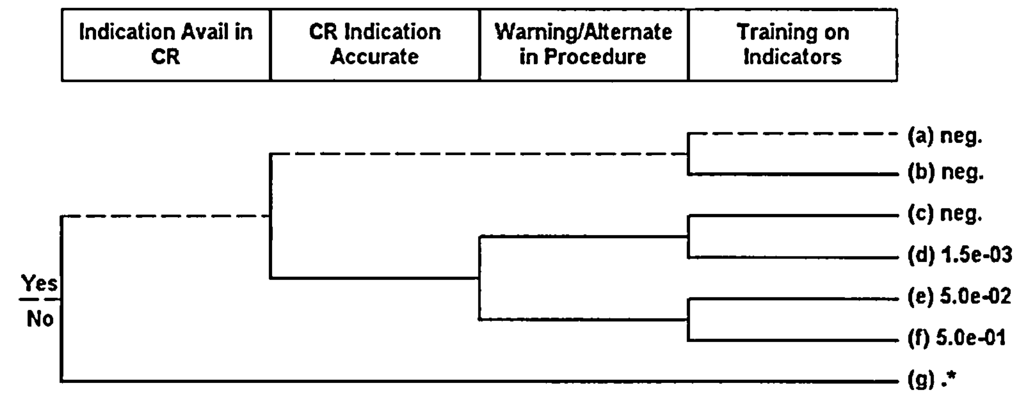
Reference for Manipulation Time: Simulator Observation and Operator interviews

Duration of time window available for action (TW): 1.90 Hours

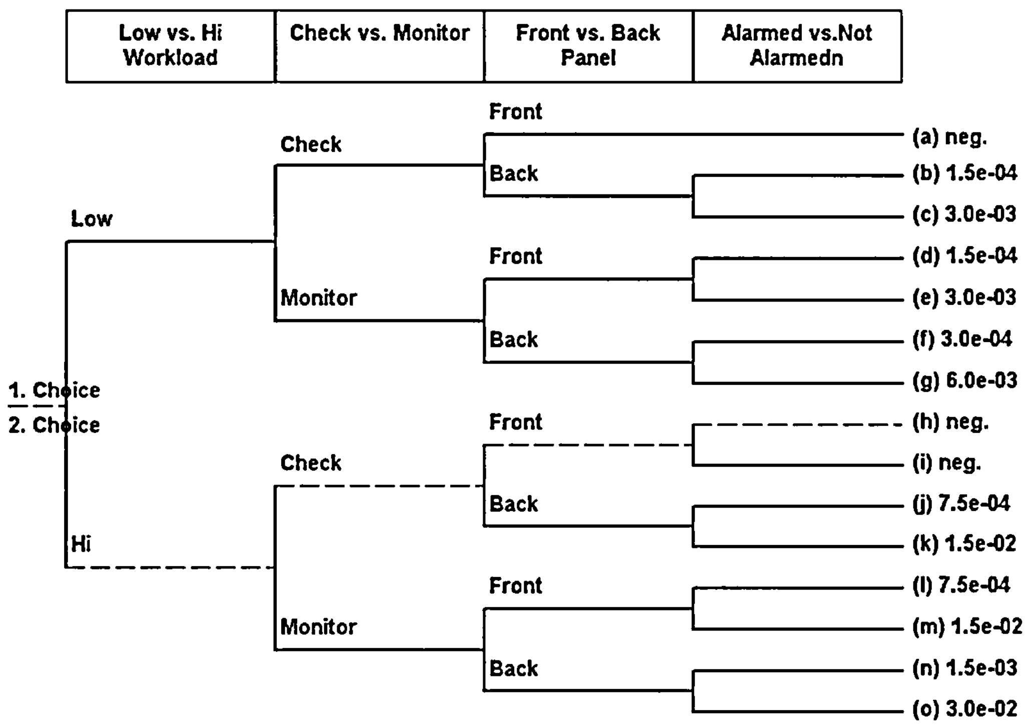
Table 153: 06--OC2----F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	c	1.0e-03
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	c	3.0e-02
Pc_g: Misinterpret decision logic	k	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		4.4e-02

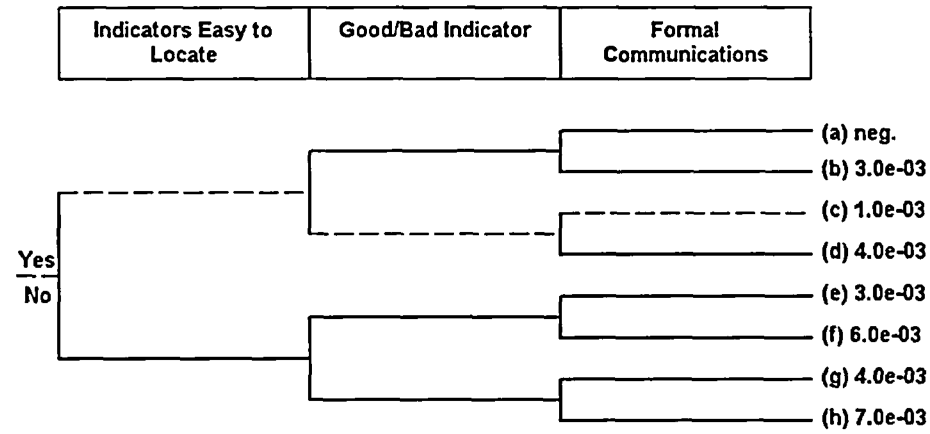
pca: Availability of information



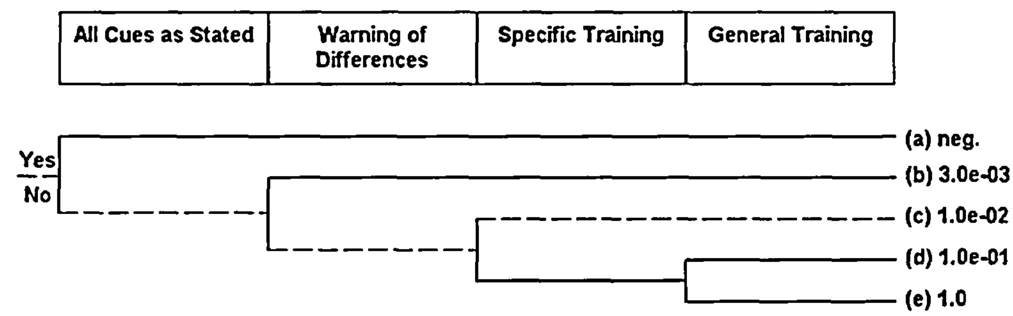
pcb: Failure of attention



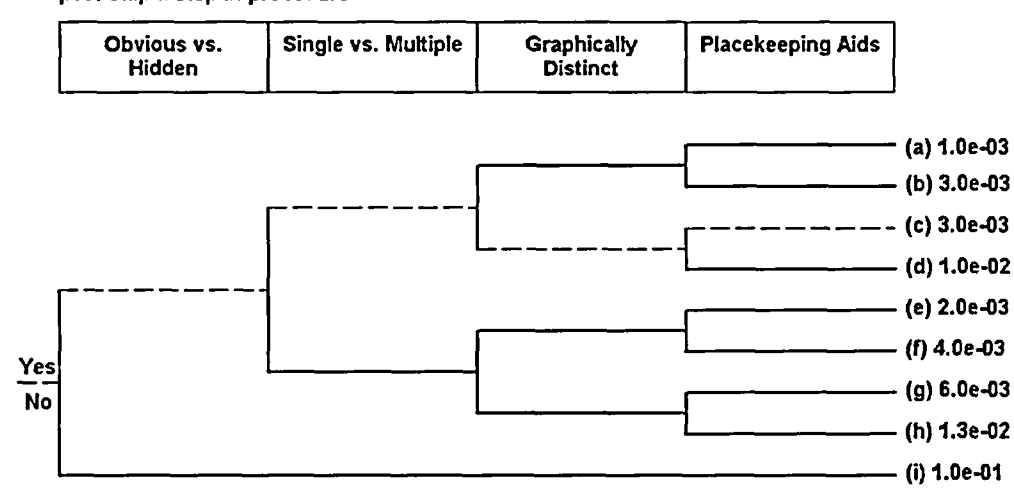
pcc: Misread/miscommunicate data



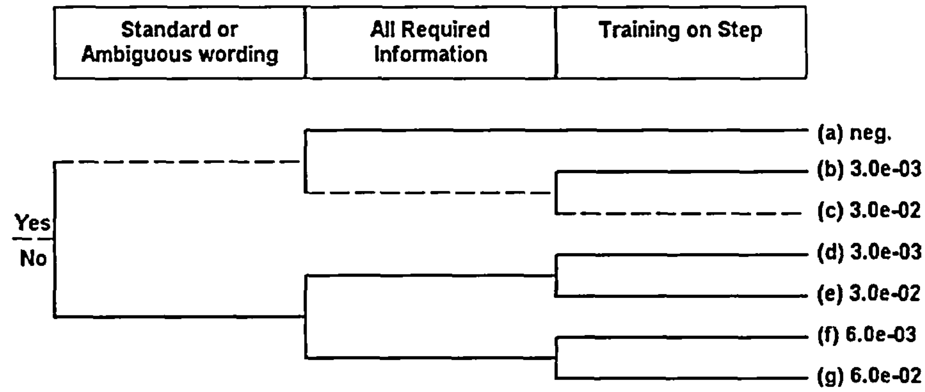
pcd: Information misleading



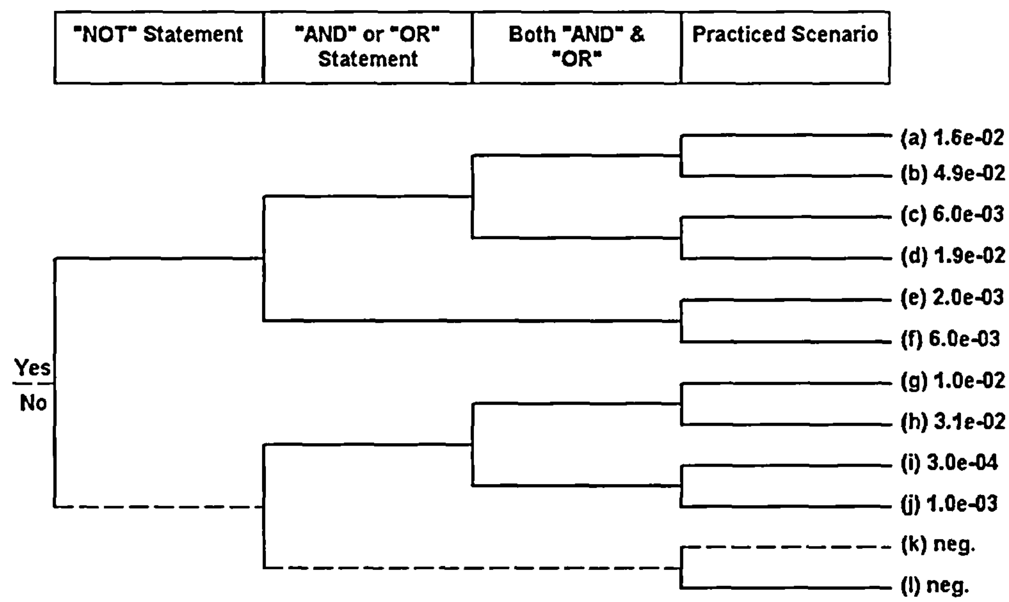
pce: Skip a step in procedure



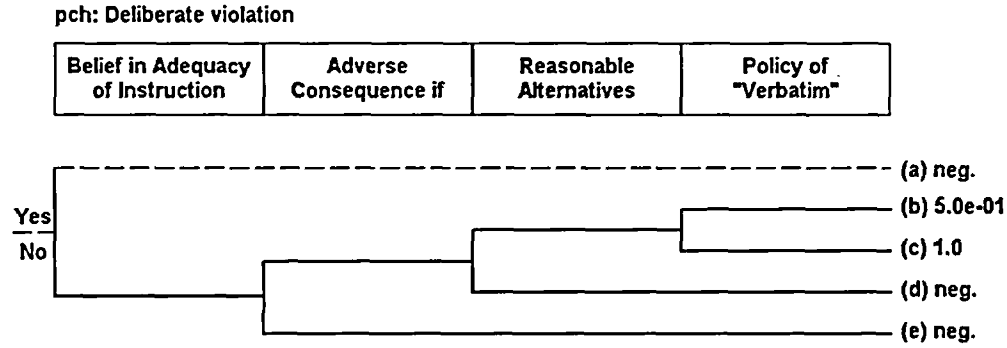
pcf: Misinterpret instruction



pcg: Misinterpret decision logic



pch: Deliberate violation



Cognitive Recovery

06--OC2----F-HE

Table 154: 06--OC2----F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-02	-	-	-	-	-	NC	-	1.0		3.0e-02
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											4.3e-02

Recovery Factors Identified:
Step 19 starts procedural loop.

Execution Unrecovered

06--OC2----F-HE

Table 155: 06--OC2----F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 3												0.0e+00
Actions: Establish CSD Boron Concentration						Comments:						
Step 3.a-1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Open CVC-440						Comments:						
Step 3.a-2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Start Boric Acid Pump						Comments:						
Step 3.a-3	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: When Addition complete, Stop Boric Acid Pump						Comments:						
Step 3.a-4	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Close CVC-440						Comments:						
Step 6.b RNO.b	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Dump Stm with Atm Stm Dump or S/G PORV for 25 deg/hr cooldown						Comments:						
Step 8.a RNO.a	1.3E-3	20-7	1	M	2	1.3E-3	20-12	4	M	2		5.2e-03
Actions: Depressurize using PRZR PORV						Comments:						

Execution Recovery

06--OC2----F-HE

Table 156: 06--OC2----F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 3		Establish CSD Boron Concentration	0.0e+00				
Step 3.a-1		Open CVC-440	5.2e-03				
Step 3.a-2		Start Boric Acid Pump	5.2e-03				
Step 3.a-3		When Addition complete, Stop Boric Acid Pump	5.2e-03				
Step 3.a-4		Close CVC-440	5.2e-03				
Step 6.b RNO.b		Dump Stm with Atm Stm Dump or S/G PORV for 25 deg/hr cooldown	5.2e-03				
Step 8.a RNO.a		Depressurize using PRZR PORV	5.2e-03				
		Total Unrecovered:	3.1e-02			Total Recovered:	3.1e-02

HEP	86-INSTRRCRF-HE	HEP Description	Recover AFW Control
Revision Date	10/27/2005	Evaluator	GE Baldwin
Operations Reviewer	J. Stafford	Reviewer	E. Coen
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05. Additional plant walk downs conducted in April, 2005 and simulator observation 9/29/05.	
Scenario	After a reactor trip, the TD AFW pump is the only operating AFW pump and S/G level is in the required level band. The DC power is lost to AFW-10 A and AFW-10B.		
Event Description	After a reactor trip, the TD AFW pump is the only operating AFW pump and S/G level is in the required level band. The DC power is lost the AFW-10 A and AFW-10B.		
Assumptions for the Event	The following assumptions are made: • TSC is activated.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. The operator will discover the loss of control from use approximately 8 hours into the event. The operators would pass the failure to the TSC with 5 minutes of discovery. The TSC would investigate and come up with a plan to manually operate the valves and recover S/G level control in approximately 1 hour. The TSC would execute the plan in 0.5 hours. There is approximately 3 hours to recover AFW flow control.		
Success Criteria	AFW Flow is restored before S/G level is less than 4%.		
References Used	ES-0.1, EPIPs		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	None		

86-INSTRRCRF-HE, Recover AFW Control

Basic Event Summary

Analyst:	
Rev. Date:	10/26/05
Cognitive Method:	CDBTM/THERP

Table 157: 86-INSTRRCRF-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.3e-01	1.3e-02
P_{exe}	5.2e-03	5.2e-03
Total HEP		1.8e-02
Error Factor		5

HFE Scenario Description:
After a reactor trip, the TD AFW pump is the only operating AFW pump and S/G level is in the required level band. The DC power is lost the AFW-10 A and AFW-10B.

Related Human Interactions:
none

Performance Shaping Factors:
Moderate due the limited method of feed to S/G

Procedure and step governing HI:
ES-0.1, step 6

Training:

- None

X - Classroom Frequency: 1

- Simulator

Degree of Clarity of Cues & Indications:

X - Very Good

- Average
- Poor

Human-Machine Interface:

- Control Room Panels
- Local Control Panels

X - Local Equipment

Special Requirements:

Tools	Parts	Clothing

Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**
- **Rule**
- X - **Knowledge**

Complexity of Response

Cognitive		Execution	
X	Complex		Complex
	Simple	X	Simple

Environment:

Lighting		Heat/Humidity	
X	Normal	X	Normal
	Emergency		Hot / Humid
	Portable		Cold

Radiation		Atmosphere	
X	Background	X	Normal
	Green		Steam
	Yellow		Smoke
	Red		Respirator required

Equipment Accessibility:

	Location	Accessibility
	Control Room Front Panels	
	Control Room Back Panels	
	Hot Shutdown Panels	
	Auxiliary Building	
	Electrical Building	
	Containment	
X	**Pump house**	With Difficulty
	Switchyard	

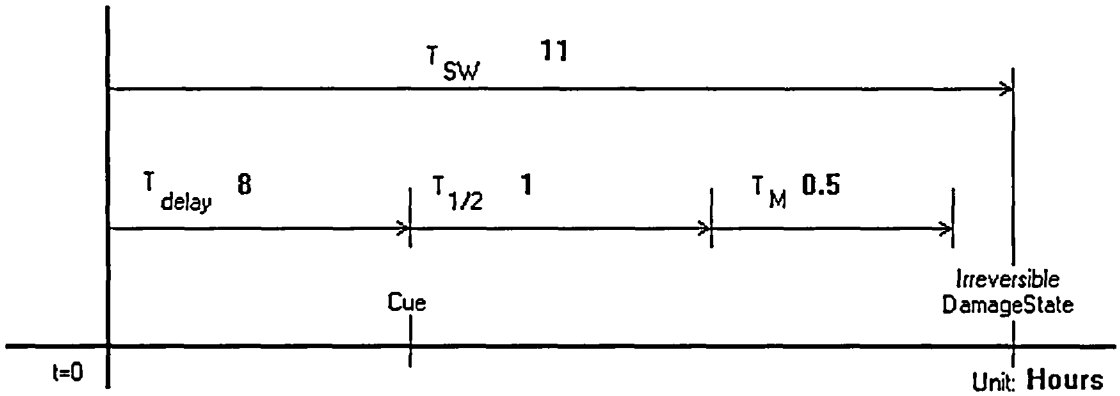
Stress:

- **Optimum (Low)**
- X - **Moderate**
- **Extreme (High)**

Cognitive Unrecovered

86-INSTRRCRF-HE

Cue:
TD AFW Pump is in operation and S/G level is being maintained between 4-50%



Reference for System Time: Maracor Data 10/26/05

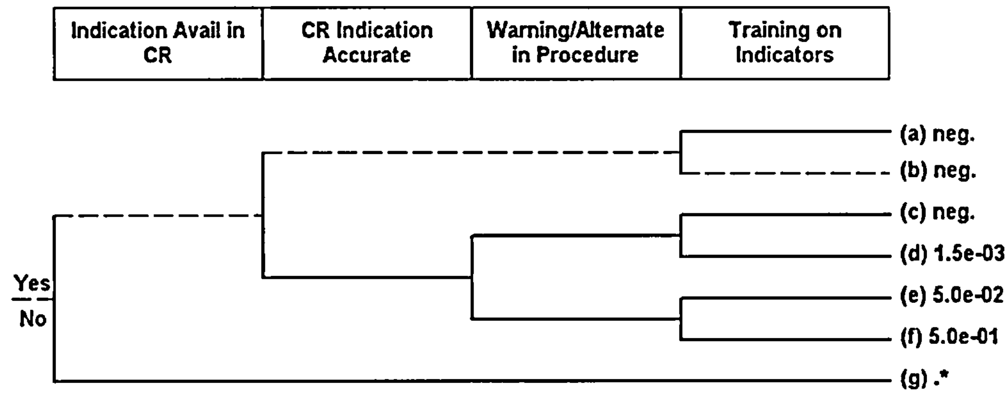
Reference for Manipulation Time: Operator interviews

Duration of time window available for action (TW): 1.50 Hours

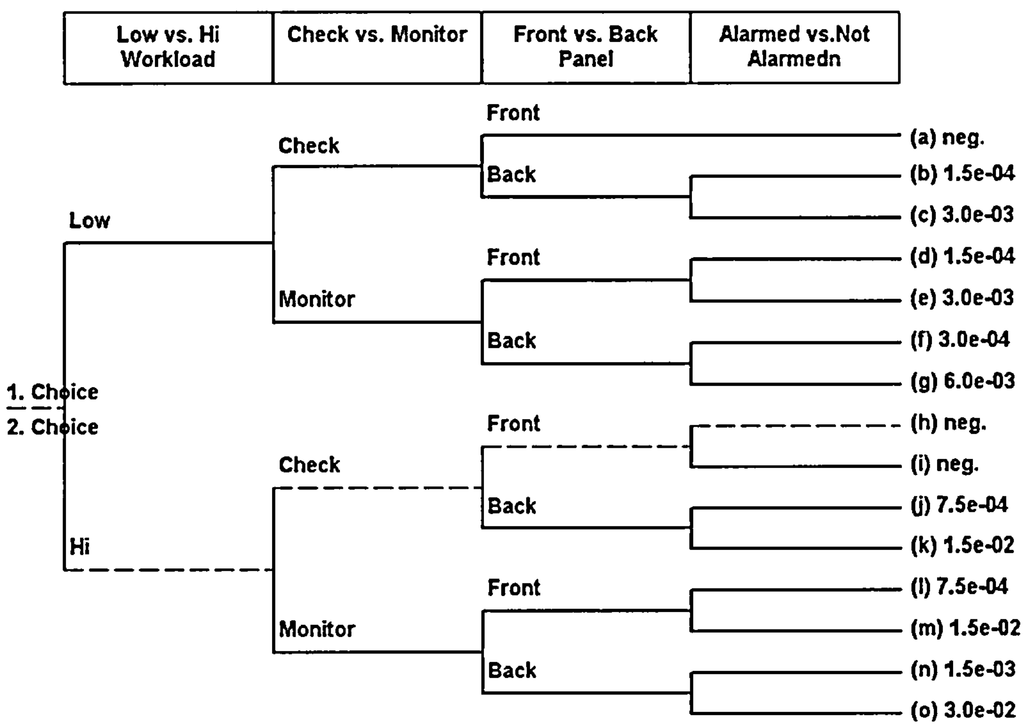
Table 158: 86-INSTRRCRF-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	d	1.0e-01
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	c	3.0e-02
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.3e-01

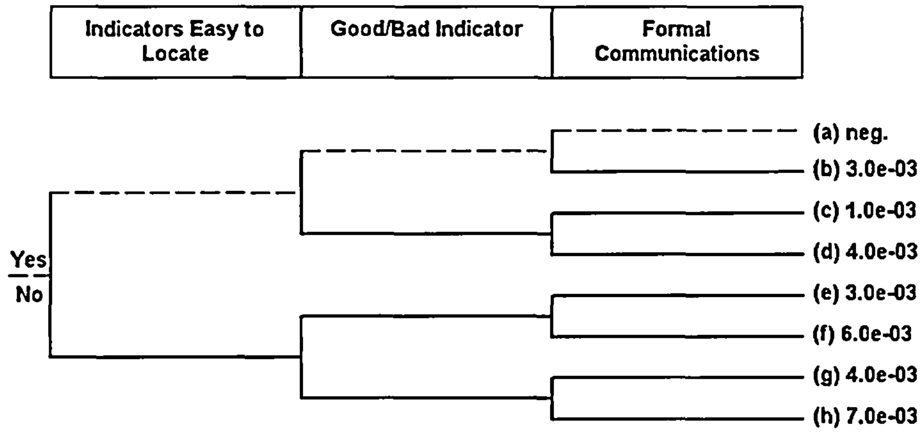
pca: Availability of information



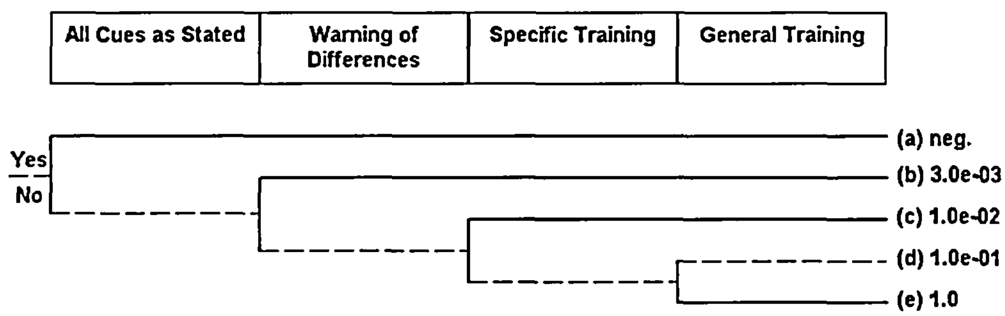
pcb: Failure of attention



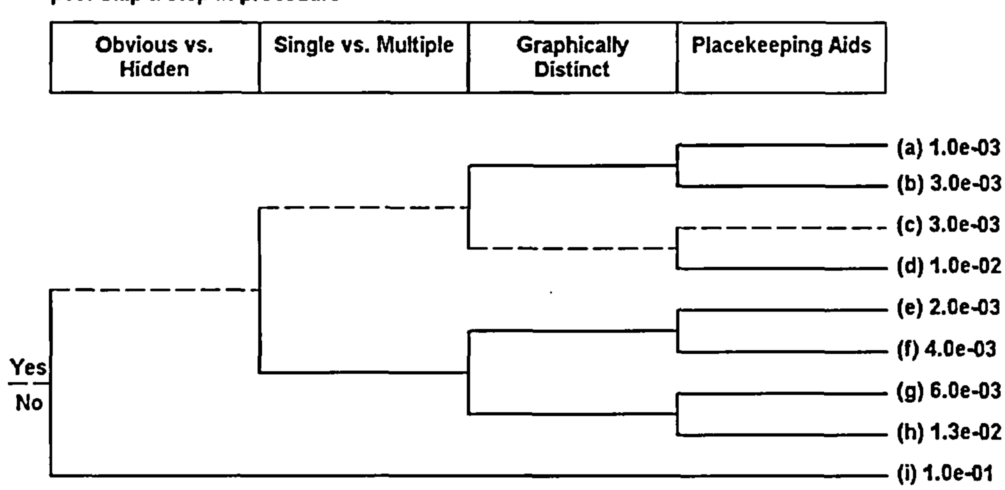
pcc: Misread/miscommunicate data



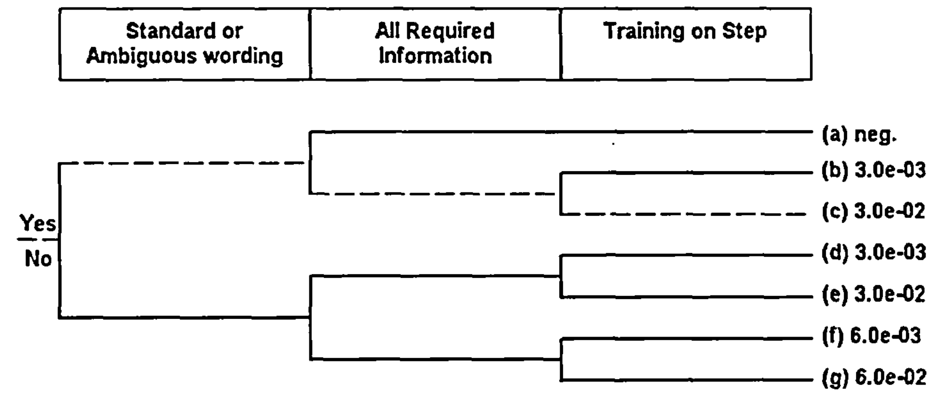
pcd: Information misleading



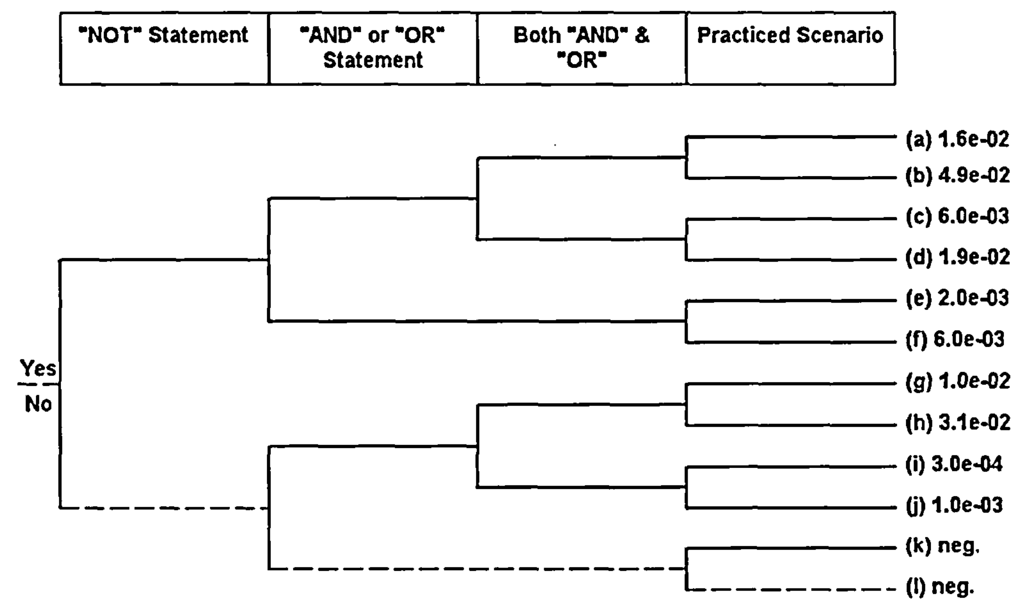
pce: Skip a step in procedure



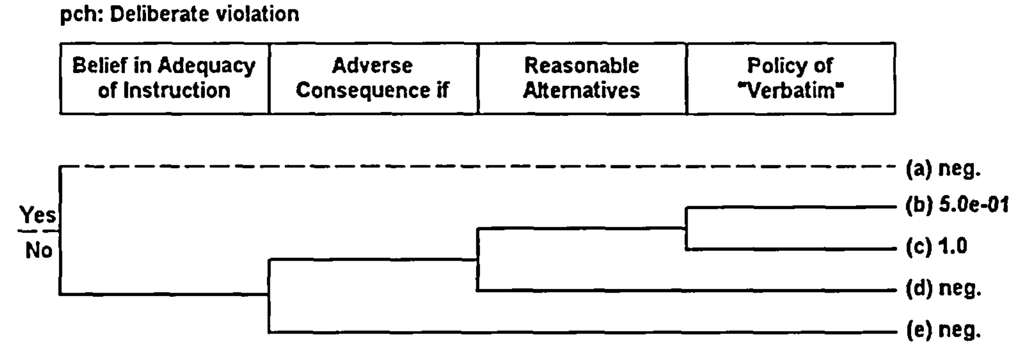
pcf: Misinterpret instruction



pcg: Misinterpret decision logic



pch: Deliberate violation



Cognitive Recovery

86-INSTRRCRF-HE

Table 159: 86-INSTRRCRF-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-01	-	-	-	-	X	1.0e-01	-	1.0e-01		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	X	1.0e-01	LD	5.3e-02		1.6e-04
Pc_f:	3.0e-02	-	-	-	-	X	1.0e-01	LD	7.9e-02		2.4e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.3e-02

Recovery Factors identified:

Execution Unrecovered

86-INSTRRCRF-HE

Table 160: 86-INSTRRCRF-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-13	1	M	2		5.2e-03
Actions: Throttle feedwater to S/G						Comments:						

Execution Recovery

86-INSTRRCRF-HE

Table 161: 86-INSTRRCRF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Throttle feedwater to S/G	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

Execution Recovery

05B-MDPTD2HF-HE

Table 162: 05B-MDPTD2HF-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Start TD AFW Pump	5.2e-03				
		Total Unrecovered:	5.2e-03			Total Recovered:	5.2e-03

HEP	04-CW-TRIP-F-HE	HEP Description	Trip CW Pump during Flood Event - 6 min.
Revision Date	10/27/2005	Evaluator	GE Baldwin
Operations Reviewer	J. Stafford	Reviewer	E. Coen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 9/30/05	
Scenario	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.		
Event Description	Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly. The NAO then reports water and rapidly increasing water level in Turbine Building Basement. The CRS directs the tripping of the reactor and then both CW Pumps.		
Assumptions for the Event	The following assumptions are made: • The operators will determine a waterbox boot failure due to the volume and level increase of the water • Operator will trip the CW pumps to put the plant in a safe condition without procedural directive.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At the waterbox boot failure, water enters the Turbine building Sump causing 47033-P, Miscellaneous Sump Level High, to actuate. Approximately 1 minute later the NAO is sent to investigate upon arrival discovers the water with a rapidly increasing level. The NAO then informs the Control room of the situation approximately 5.4 minutes after the alarm. Within 2.4 minute of receiving this information the Control Room personnel decide to trip the CW pumps. The total elapsed time from the waterbox boot failure is approximately 9 minutes. The allowed time is 6 minutes. This action is unsuccessful.		
Success Criteria	Both CW pump are stopped.		
References Used	FP-OP-COO-01, A-MDS-30, ARP 47033-P		
Cognitive Assumption	None		
Cognitive Recovery Assumptions	None.		

Execution Assumptions	None
Execution Recovery Assumptions	None

04-CW-TRIP-F-HE, Trip CW Pump during Flood Event - 6 min.

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/27/05
Cognitive Method:	HCR/ORE/THERP

Table 163: 04-CW-TRIP-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	1.0e+00
P_{exe}	1.0e-02	1.0e-02
Total HEP		1.0e+00
Error Factor		1

HFE Scenario Description:
Circ. Water Boot to a single Condenser Waterbox ruptures flooding the Turbine Building Basement causing 47033-P, Miscellaneous Sump Level High, to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing rapidly.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate stress due to magnitude of event. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
A-MDS-30 directs the investigation of the level and source.
FP-OP-COO-01 is a fleet procedure for the conduct of operations, which directs the operator to take action to maintain the plant in a safe condition.

Training:

X - **None**
- **Classroom**
- **Simulator**

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**
- **Poor**

Human-Machine Interface:

X - **Control Room Panels**
- **Local Control Panels**
- **Local Equipment**

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- - **Skills**
- - **Rule**
- X - **Knowledge**

Complexity of Response

Cognitive	Execution
- Complex	- Complex
X - Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

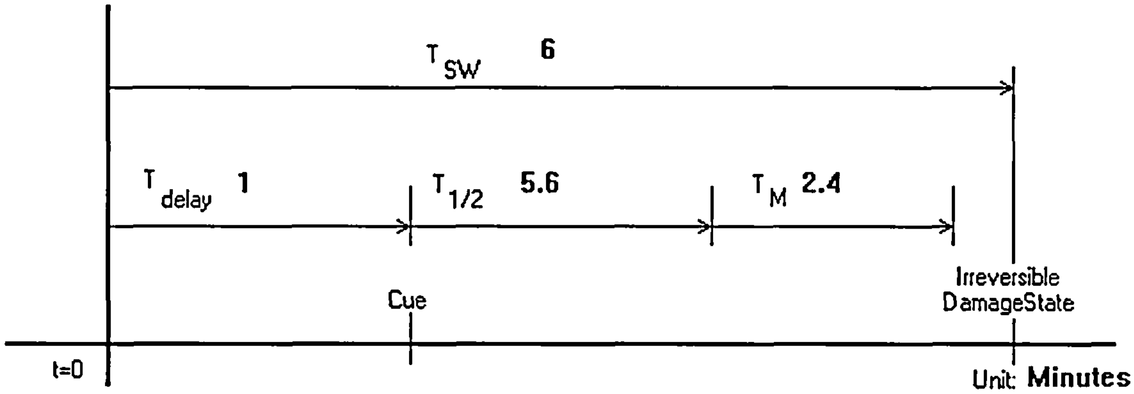
Stress:

- - **Optimum (Low)**
- X - **Moderate**
- - **Extreme (High)**

Cognitive

04-CW-TRIP-F-HE

Cue:
47033-P, Miscellaneous Sump Level High actuates. Various equipment alarms on equipment in Turbine Building Basement and Potato Bin area.



Reference for System Time: MARACOR MEMO 10/12/05

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): -3.00 Minutes

Sigma User Defined

Sigma: 1.0e-02

HEP: 1.0e+00

Execution Unrecovered

04-CW-TRIP-F-HE

Table 164: 04-CW-TRIP-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump A						Comments: No Applicable procedure						
2	1.3E-3	20-7	1	M	2	1.3E-3	20-12	3	M	2		5.2e-03
Actions: Trip CW Pump B						Comments: No Applicable procedure						

Execution Recovery

04-CW-TRIP-F-HE

Table 165: 04-CW-TRIP-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Trip CW Pump A	5.2e-03				
2		Trip CW Pump B	5.2e-03				
		Total Unrecovered:	1.0e-02			Total Recovered:	1.0e-02

U. S. Nuclear Regulatory Commission
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11555 Rockville Pike
Rockville, MD 20852

Dominion Energy Kewaunee, Inc.
N490 Highway 42
Kewaunee, WI 54216-9511

Volume 2 of 2

Flooding Significance Determination Process - Risk Assessment Report
10/31/05

Appendix C

Fault Tree Analysis

Attachment 2 – Operator Cues for Analyzed Events

Operator Cues for Analyzed Events

Prepared by: [signature] JEFFREY T. STAFFORD

Signature Print Name

10-20-05

Date

Reviewed by: [signature] Paul T. Rappel

Signature Print Name

10/20/05

Date

PURPOSE

The purpose of this document is to catalog the cues, such as alarms, available to the operating crews in response to seven postulated internal flooding scenarios. This document will also catalog the relevant training that has occurred in either initial license training courses, licensed operator requalification training courses, non-licensed operator qualification courses, or non-licensed operator continuing training courses.

DISCUSSION

The seven initiating events examined are:

1. Circulating Water (CW) Condenser Inlet Break
2. Circulating Water (CW) Condenser Outlet Break
3. Random Fire Protection (FP) or Service Water (SW) Break (6000 gpm)
4. Large Feedwater Break
5. Moderate Feedwater Break
6. Large Main Steam Break
7. Moderate Main Steam Break

The report format lists the initiating event, cues available to the operator in the form of Annunciators, SER points, Plant Process Computer System (PPCS) points, and referenced procedures from the associated Alarm Response Procedures (ARP's), comments relative to expected actions and training conducted on the initiating event, associated systems, or procedures.

Section I - CW Inlet Break

<u>CONTROL ROOM INDICATIONS</u>
Circulating Water Pump A amps (44553)
Circulating Water Pump B amps (44556)

<u>CONTROL ROOM ALARMS</u>
Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47033-P MISCELLANEOUS SUMP LEVEL HIGH
SER Point: 1594 – TURBINE BUILDING SUMP LEVEL HIGH
Setpoint: 34.5 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Near Immediate
Procedure to Enter: A-MDS-30

Annunciator: 47051-W CONDENSER VACUUM LOW
SER Point: 359 – CONDENSER VACUUM LOW
Setpoint: 5" Hg absolute
Computer Point: P0300A
Setpoint: : 5" Hg absolute
Time until alarm actuation following event: Unknown – likely computer alarm only.
Procedure to Enter: E-AR-09

Annunciator: 47063-V EMERG TURB OIL SUMP LEVEL HIGH
SER Point: 1573 – EMERGENCY TURBINE OIL SUMP LEVEL HIGH
Setpoint: 24 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-TOP-20

<u>Operator Response</u>:
No direct procedure guidance existed in the relevant time frame. However, the crew would respond to Miscellaneous Sump Level Hi alarms for the Turbine Building Sump. The Emergency Turbine Oil Sump Level High also alarms due to water leakage around the cover, as well as the berm surrounding the Turbine Oil Reservoir overflowing.

Some loss of condenser vacuum would occur from the decreased cooling flow. This would alert the Operators from a computer alarm at 2.5" Hg absolute pressure.

The Reactor initially stays at power. The NAO would be dispatched to the Turbine Building basement and report the leak rather quickly. The CW pumps would be ordered to be stopped, which terminates the flooding.

The C/R Crew then initiates a manual Reactor Trip/Turbine Trip and enters E-0. Transition would be to ES-0.1 Reactor Trip Response.

If a loss of offsite power occurs coincident with the initiating event, such as during a seismic event, then the flood is stopped by loss of power to the CW Pumps.

Training:
While no direct training of the initiating event was conducted, operators are thoroughly trained on the construction and operation of the affected systems. Examples include:

Circulating Water System (RO2-02-LP004/AOI-41-LP004)
Synopsis: Covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

Circulating Water System Review (LRC-04-LP202)
Synopsis: Covers several subsystems, as well as loss of condenser vacuum due to CW malfunction. Note this results in reactor trip condition.

Circulating Water Study Guide (NAO-SG 2.1.4)
Synopsis: Initial NAO training on CW system, including function/purpose, principles of operation, major components, system arrangement, flow paths, controls and indications.

CW/SW Malfunctions and LOCA (LRC-02-SE201)
Synopsis: Licensed Operator Requalification Training scenario. Involves influx of fish that causes breach in traveling water screens that results in a reactor trip.

Section II - CW Outlet Break

CONTROL ROOM INDICATIONS
Circulating Water Pump A amps (44553)
Circulating Water Pump B amps (44556)

CONTROL ROOM ALARMS
Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47033-P MISCELLANEOUS SUMP LEVEL HIGH
SER Point: 1594 – TURBINE BUILDING SUMP LEVEL HIGH
Setpoint: 34.5 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Near Immediate
Procedure to Enter: A-MDS-30

Operator Response:
No direct procedure guidance existed in the relevant time frame. However, the crew would respond to Miscellaneous Sump Level Hi alarms for the Turbine Building Sump. The Emergency Turbine Oil Sump Level High also alarms due to water leakage around the cover, as well as the berm surrounding the Turbine Oil Reservoir overflowing.

The Reactor initially stays at power. The NAO would be dispatched to the Turbine Building basement and report the leak rather quickly. The CW pumps would be ordered to be stopped, which terminates the flooding.

The C/R Crew then initiates a manual Reactor Trip/Turbine Trip and enters E-0. Transition would be to ES-0.1 Reactor Trip Response.

If a loss of offsite power occurs coincident with the initiating event, such as during a seismic event, then the flood is stopped by loss of power to the CW Pumps.

Training:
While no direct training of the initiating event was conducted, operators are thoroughly trained on the construction and operation of the affected systems. Examples include:

Circulating Water System (RO2-02-LP004/AOI-41-LP004)

Synopsis: Covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

Circulating Water System Review (LRC-04-LP202)
Synopsis: Covers several subsystems, as well as loss of condenser vacuum due to CW malfunction. Note this results in reactor trip condition.

Circulating Water Study Guide (NAO-SG 2.1.4)
Synopsis: Initial NAO training on CW system, including function/purpose, principles of operation, major components, system arrangement, flow paths, controls and indications.

CW/SW Malfunctions and LOCA (LRC-02-SE201)
Synopsis: Licensed Operator Requalification Training scenario. Involves influx of fish that causes breach in traveling water screens that results in a reactor trip.

Section III – Random Service Water or Fire Protection Header Break

CONTROL ROOM INDICATIONS
SW Header A Pressure Meter 41503
SW Header B Pressure Meter 41506
Fire Header Pressure Meter 41502

CONTROL ROOM ALARMS
Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47033-P MISCELLANEOUS SUMP LEVEL HIGH
SER Point: 1594 – TURBINE BUILDING SUMP LEVEL HIGH
Setpoint: 34.5 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: A-MDS-30

Annunciator: 47051-P SW HEADER PRESSURE LOW
SER Point: 93 – SW HEADER A LESS THAN 82 PSIG
SER Point: 122– SW HEADER B LESS THAN 78 PSIG
SER Point: 124 – SW HEADER A LESS THAN 72 PSIG
SER Point: 125 – SW HEADER B LESS THAN 22 PSIG
Setpoint: If Header A selected: 82 psig starts B1 Service Water Pump, 78 psig Starts B2 Service Water Pump, 72 psig Starts A1 and A2 Service Water Pumps and closes SW-3A and SW-3B
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-SW-02

Annunciator: 47052-P TURBINE BLDG SW HEADER ABNORMAL
SER Point: 123 – TURBINE BUILDING SW HEADER LESS THAN 60 PSIG
Setpoint: Less than 60 psig on turbine building Service Water header
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-SW-02

Annunciator: 47052-Q TURBINE BLDG SW ISOLATION ALERT
SER Point: 841 – SERVICE WATER HEADER A PRESSURE LOW
SER Point: 842 – SERVICE WATER HEADER B PRESSURE LOW
Setpoint: Less than 82.5 psig on Service Water header

Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-SW-02

Annunciator: 47052-L FIRE PROTECTION HDR PRESSURE LOW
SER Point: 1541 FIRE PROTECTION HDR PRESSURE LOW
Setpoint: < 60 psig
Computer Point: P2903A
Setpoints: (Low) 115 psig, 105 psig, 95 psig, 85 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47054-L FIRE PUMPS ABNORMAL
SER Point: 1538 – FIRE PUMP A RUNNING
SER Point: 1540 – FIRE PUMP B RUNNING
Setpoint: A Fire Pump Auto starts on 110 psig Fire Protection header pressure and any deluge valve opening; B Fire Pump Auto starts on 102 psig Fire Protection header pressure.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: E-FP-08

Operator Response:

In the case of a Service Water (SW) leak, A-SW-02, "Abnormal Service Water System Operation" is entered. The diagnosis of a leak condition ensues. If a leak exists in the Turbine Building header, the leak will be isolated from the Control Room by positioning the Turbine Building Service Water Isolation control switch to isolate. The crew trips the Reactor and Turbine immediately prior to isolation.

In the case of a Fire Protection (FP) header leak, direct procedure guidance does not exist. However, the jockey pump will not maintain FP system pressure. The drop in pressure results in the Fire Pumps starting and Annunciator 54L Fire Pumps Abnormal alarms. E-FP-08, "Emergency Operating Procedure – Fire", is entered and early dispatch of the NAO to investigate identifies the leak and no fire present. An NAO will be instructed to isolate the header or go to the screenhouse to stop the Fire Pumps, likely through door 4. Though lacking direct procedure guidance for a fire header rupture, NAO's routinely locate and operate FP system components through use of the following procedures:

- N-FP-08-CLA, Fire Protection System Seal Checklist (performed every 4 weeks)
  - All major fire protection system isolation verified in required position and sealed. Includes yard piping isolations, pump discharge valve isolations, sprinkler system isolations, and ventilation filter housing isolations.
- SP 08-081, Fire Pump Test (performed monthly)
  - Synopsis: Both fire pumps auto start tested sequentially. Requires local operation of pump breakers, and local operation of pump discharge isolation valves.

- SP 08-183, Fire System Valve Cycling (performed annually)
    - All major system isolation valves cycled.

Training

Service Water

Service Water System (RO2-02-LP002/AOI-41-LP002)
Synopsis: Covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

Service Water System Review (AOC-02-LP401)
Synopsis: Identifies and explains purpose of major system components, system arrangements and flowpaths, local component operation, and power supplies

Procedure Review: A-SW-02 (AOC-02-403)
Reviews actions in Abnormal Operating Procedure A-SW-02 pertaining to NAO's. Includes leaks in both 'A' and 'B' and Turbine Building headers.

Abnormal Service Water System / Procedure Review (LRC-04-LP401)
Synopsis: Covers abnormal conditions including Service Water leaks in A, B, and Turbine Building Headers.

CW/SW Malfunctions and LOCA (LRC-02-SE201)
Synopsis: Licensed Operator Requalification Training scenario. Involves influx of fish that causes breach in traveling water screens that results in a reactor trip.

Fire Protection

NAO Study Guide (NAO-SG 2.2.8)
Synopsis: This study guide requires initial NAO candidates to describe system function/purpose, principles of operation, system arrangements and flowpaths, locate local controls and indications and list power supplies.

Fire Protection System (RO2-02-LP008/AOI-44-LP008)
Synopsis: This initial training lesson plan covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

E-FP-08/Fire Strategies (LRC-01-LP603)
Synopsis: This continuing training lesson plan for licensed operators covers operator response to a fire per E-FP-08 and, given a system actuation, to operate the system per N-FP-08. This procedure contains the direction to isolate actuated fire systems when they

are no longer required to suppress a fire. This session also includes a discussion of fire area strategy maps.

E-FP-08/Emergency Operating Procedure – Fire (LRC-04-LP402)
Synopsis: This continuing training lesson plan for licensed operators covers operator response to a fire per E-FP-08. Primary focus is on procedure revisions and updates.

Reactor Operator Task: Respond to a Fire (Task # 0080010501)
This initial qualification task focuses on licensed operator response to a fire per E-FP-08, N-FP-08, NAD-02.10, and Fire Area Strategies Book.

Quarterly Fire Brigade Drills and Training (various lesson plans/fire drill scenarios)
All Fire Brigade members, including operators, participate in quarterly fire drills. These are staged in various plant locations, both inside and outside the power block. These exercises test members' knowledge of key equipment locations as well as exercise use of Fire Area Strategy maps. In addition, quarterly classroom sessions are held as well. Relevant topics include:

- Fire Area Strategies (T-FBT-LP 08-7)
    - Synopsis: Reviews fire area strategy maps. The maps include key isolation valves for sprinkler and deluge systems.

Section IV - Large Feedwater Break (Actuates all Fire Sprinklers)

CONTROL ROOM INDICATIONS
For a large break there would likely be an audible indication of feedwater break.

Basis: On 5/14/1999 Point Beach Unit 1 experienced a feedwater heater rupture. Control room staff could hear the rupture (INPO OE9914).

CONTROL ROOM ALARMS
Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47031-E S/G A LOW LOW LEVEL REACTOR TRIP
SER Point: 319 - S/G A LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47031-F S/G B LOW LOW LEVEL REACTOR TRIP
SER Point: 323 - S/G B LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47031-G S/G A LOW FEEDWATER FLOW REACTOR TRIP
SER Point: 309 - S/G A SF>FF AND LOW WATER LEVEL REACTOR TRIP
Setpoint: 1/2 Channels of Steam flow 0.87E6 lbs/hr > Feed flow AND 1/2 channels/G < 25.5%
Computer Point: None
Time until alarm actuation following event: Unknown.

Procedure to Enter: E-0

Annunciator: 47031-H S/G B LOW FEEDWATER FLOW REACTOR TRIP
SER Point: 314 - S/G B SF>FF AND LOW WATER LEVEL REACTOR TRIP
Setpoint: 1/2 Channels of Steam flow 0.87E6 lbs/hr > Feed flow AND 1/2 channels/G < 25.5%
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47033-P MISCELLANEOUS SUMP LEVEL HIGH
SER Point: 1594 – TURBINE BUILDING SUMP LEVEL HIGH
Setpoint: 34.5 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: A-MDS-30

Annunciator: 47051-L FIRE DETECTION SYSTEM ACTIVATED
SER Point: 55 – TURBINE OIL RESERVOIR FIRE
SER Point: 62 –TURBINE BUILDING OPERATING FLOOR FIRE
SER Point: 63 – TURBINE BUILDING MEZZANINE FLOOR FIRE
SER Point: 64 – TURBINE BUILDING BASEMENT FLOOR FIRE
SER Point: 800 – HYDROGEN SEAL OIL PUMP AREA FIRE
Setpoint:
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-FP-08

Annunciator: 47052-L FIRE PROTECTION HDR PRESSURE LOW
SER Point: 1541 FIRE PROTECTION HDR PRESSURE LOW
Setpoint: < 60 psig
Computer Point: P2903A
Setpoints: (Low) 115 psig, 105 psig, 95 psig, 85 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47053-L FIRE DETECTION SYSTEM TROUBLE
SER Point:
Setpoint: Alarm condition in any one of the fire protection zones that has not reset.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47054-L FIRE PUMPS ABNORMAL
SER Point: 1538 – FIRE PUMP A RUNNING
SER Point: 1540 – FIRE PUMP B RUNNING
Setpoint: A Fire Pump Auto starts on 110 psig Fire Protection header pressure and any deluge valve opening; B Fire Pump Auto starts on 102 psig Fire Protection header pressure.
Computer Point: None
Time until alarm actuation following event: Unknown

Procedure to Enter: E-FP-08

Annunciator: 47061-A FEEDWATER PUMP A TRIP
SER Point: 1591 – FEEDWATER PUMP A TRIP
Setpoint: alarm activated by Feedwater Pump A breaker closed AND any of the following: less than 180 psig suction pressure for greater than 2 minutes; more Feedwater Pumps running than Condensate Pumps; Condensate Pumps A & B off.
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: A-FW-05A

Annunciator: 47061-B S/G A SF>FF
SER Point: 1578 – STEAM GEN A STM FLOW > FEED FLOW
Setpoint: S/G A STM Flow FI-464 0.87E6 lbs/hr > S/G A FW Flow FI-466, or S/G A STM Flow FI-465 0.87E6 lbs/hr > S/G A FW Flow FI-467
Computer Point: None
Time until alarm actuation following event:
Procedure to Enter: None

Annunciator: 47061-C S/G A FEED FLOW EXCESSIVE
SER Point: 900 – STEAM GENERATOR A FEED FLOW EXCESSIVE
Setpoint: S/G A FW Flow FI-466 0.71E6 lbs/hr > S/G A STM Flow FI-464, or S/G A FW Flow FI-467 0.71E6 lbs/hr > S/G A STM Flow FI-465
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47061-D FEEDWATER PUMP B TRIP
SER Point: 1592 – FEEDWATER PUMP B TRIP
Setpoint: alarm activated by Feedwater Pump B breaker closed AND any of the following: less than 180 psig suction pressure for greater than 2 minutes; Condensate Pumps A & B off.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47061-E S/G B SF>FF
SER Point: 1581 – STEAM GEN B STM FLOW > FEED FLOW
Setpoint: S/G B STM Flow FI-474 0.87E6 lbs/hr > S/G B FW Flow FI-476, or S/G B STM Flow FI-475 0.87E6 lbs/hr > S/G B FW Flow FI-477
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47061-F S/G B FEEDFLOW EXCESSIVE
SER Point: 901 – STEAM GENERATOR B FEED FLOW EXCESSIVE
Setpoint: S/G B FW Flow FI-476 0.71E6 lbs/hr > S/G B STM Flow FI-474, or S/G B FW Flow FI-477 0.71E6 lbs/hr > S/G B STM Flow FI-475
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47061-G FWP A/B SUCTION PRESS LOW
SER Point: 165 – FEEDWATER PUMP A SUCTION PRESSURE LOW
SER Point: 166 – FEEDWATER PUMP B SUCTION PRESSURE LOW
Setpoint: < 180 psig
Computer Point: P2800A
Setpoints: (Low) 250 psig, 240 psig, 230 psig, 220 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-A S/G A PROGRAM LEVEL DEVIATION
SER Point: 148 – STEAM GENERATOR A PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-B S/G A BYPASS CV LEVEL DEVIATION
SER Point: 150 – S/G A BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G A Level LI-461 is +/- 5% from setpoint on FW-10A/CV-31157 controller
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-C S/G A LEVEL LOW
SER Point: 1577 – STEAM GENERATOR A LEVEL LOW
Setpoint: 1/2 Channels < 25.5%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-D S/G B PROGRAM LEVEL DEVIATION
SER Point: 162 – STEAM GENERATOR B PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-E S/G B BYPASS CV LEVEL DEVIATION
SER Point: 164 - S/G B BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G B Level LI-471 is +/- 5% from setpoint on FW-10B/CV-31158 hand controller
Computer Point: L0471A

Time until alarm actuation following event: Unknown
Setpoints: (Low) 30%, 25%, 20%, 15%
Procedure to Enter: A-FW-05A

Annunciator: 47062-F S/G B LEVEL LOW
SER Point: 1580 - STEAM GENERATOR B LEVEL LOW
Setpoint: 1/2 Channels < 25.5%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-S HTR DRAIN TANK LEVEL HIGH/LOW
SER Point: 2 – HEATER DRAIN TANK LEVEL LOW
Setpoint: < 13.88%
Computer Point: L2301A
Setpoint: (Low) 25%
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47063-O COND PUMP A HOTWELL LEVEL TRIP
SER Point: 140 – CONDENSATE PUMP A LOW HOTWELL LEVEL
Setpoint: < 5%
SER Point: 1566 – CONDENSATE PUMP A LOW HOTWELL LEVEL TRIP
Setpoint: < 5% AND Condensate Pump A breaker closed.
Computer Point: L2400A
Setpoint: (Low) 60%
Computer Point: L2401A
Setpoint: (Low) 60%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-CD-03

Annunciator: 47063-P FEEDWATER HTR BYPASS ALERT
SER Point: 104 – FEEDWATER HEATER BYPASS ALERT
Setpoint: < 240 psig
Computer Point: P2800A
Setpoints: (Low) 250 psig, 240 psig, 230 psig, 220 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: A-CD-03

Annunciator: 47064-A S/G A LEVEL LOW LOW
SER Point: 1576 – STEAM GENERATOR A LEVEL LOW LOW
Setpoint: 1/3 channels < 17%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A

Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-C FEEDWATER PUMP A VIBRATION
SER Point: 328 – FEEDWATER PUMP A OUTER BRG VIBRATION ALERT
Setpoint: horizontal 5 mils to peak, vertical 5 mils to peak
SER Point: 329 – FEEDWATER PUMP A INNER BRG VIBRATION ALERT
Setpoint: horizontal 3 mils to peak, vertical 3 mils to peak
SER Point: 340 – FEEDWATER PUMP A GEAR BOX ACCELERATION ALERT
Setpoint: input end 1.0 inches/second, output end 1.0 inches/second
SER Point: 341 – FEEDWATER PUMP A MOTOR BRGS VELOCITY ALERT
Setpoint: inboard end 0.35 inches/second, outboard end 0.35 inches/second
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-D S/G B LEVEL LOW LOW
SER Point: 1579 – STEAM GENERATOR B LEVEL LOW LOW
Setpoint: 1/3 channels < 17%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-F FEEDWATER PUMP B VIBRATION
SER Point: 506 – FEEDWATER PUMP B OUTER BRG VIBRATION ALERT
Setpoint: horizontal 5 mils to peak, vertical 5 mils to peak
SER Point: 507 – FEEDWATER PUMP B INNER BRG VIBRATION ALERT
Setpoint: horizontal 3 mils to peak, vertical 3 mils to peak
SER Point: 508 – FEEDWATER PUMP B GEAR BOX ACCELERATION ALERT
Setpoint: input end 1.0 inches/second, output end 1.0 inches/second
SER Point: 509 – FEEDWATER PUMP B MOTOR BRGS VELOCITY ALERT
Setpoint: inboard end 0.425 inches/second, outboard end 0.35 inches/second
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-O COND PUMP B HOTWELL LEVEL TRIP
SER Point: 141 – CONDENSATE PUMP B LOW HOTWELL LEVEL
Setpoint: 2/2 channels of condenser hotwell level less than 14%
SER Point: 1567 – CONDENSATE PUMP B LOW HOTWELL LEVEL TRIP
Setpoint: 2/2 channels of condenser hotwell level less than 14% AND Condensate Pump B breaker closed
Computer Point: L2400A
Setpoint: (Low) 60%

Computer Point: L2401A
Setpoint: (Low) 60%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-CD-03

Annunciator: 47065-O CONDENSER HOTWELL LEVEL HIGH/LOW
SER Point: 106 – CONDENSER HOTWELL LEVEL LOW
Setpoint: < 43% AND MU-3B/CV-31305 NOT in FLUSH position
SER Point: 1700 – CONDENSER HOTWELL LEVEL HIGH/LOW
Setpoint: Condenser Hotwell Level < 43% AND MU-3B/CV-31305 NOT in FLUSH
Computer Point: L2400A
Setpoint: (Low) 60%
Computer Point: L2401A
Setpoint: (Low) 60%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-CD-03

Annunciator: 47033-45 TLA-20 4160V STATOR TEMPERATURE HOT
SER Point: None
Computer Point: Cond Pmp A Stator – T2474A
Setpoint: 110 degrees Celsius
Computer Point: Cond Pmp B Stator – T2484A
Setpoint: 110 degrees Celsius
Computer Point: FW Pump A Stator – T2809A
Setpoint: 125 degrees Celsius
Computer Point: FW Pump B Stator – T2829A
Setpoint: 125 degrees Celsius
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A, A-CD-03

Operator Response

Due to the large feedwater break being the bounding case in terms of operator response, a simulator scenario was conducted on September 29, 2005. See details in report titled "Crew Exercise - Large Feedwater Break". (Appendix C, Attachment 6) This report also contains the relevant operator training references that shaped key decisions made in the course of the scenario.

Training

The report titled "Crew Exercise - Large Feedwater Break" contains the relevant operator training references that shaped key decisions made in the course of the scenario.

Section V- Moderate Feedwater Break (Actuates 100 Fire Sprinklers)

CONTROL ROOM INDICATIONS
For a moderate break there may or may not be an audible indication in the Control Room.

Basis: On 5/14/1999 Point Beach Unit 1 experienced a feedwater heater rupture. Control room staff could hear the rupture (INPO OE9914).

Control Room meters and recorders would provide indication of steam generator level and feedwater flow changes.

S/G A NR Level Indication Meters - 4104801, 4104802, 4104803
S/G B NR Level Indication Meters - 4105201, 4105202, 4105203
S/G A and B WR Level Recorder - 43014
S/G A and B WR (Cold Cal) Level Recorder - 42563
S/G A and B NR Level Recorder – 42560

S/G A Steam Flow Meters 4105001, 4105002
S/G A Feed Flow Meters 4104601, 4104602
S/G B Steam Flow Meters 4105101, 4105102
S/G B Feed Flow Meters 4104101, 4104102
S/G A SF and FF Recorder – 42506
S/G B SF and FF Recorder - 42562

CONTROL ROOM ALARMS
Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47033-P MISCELLANEOUS SUMP LEVEL HIGH
SER Point: 1594 – TURBINE BUILDING SUMP LEVEL HIGH
Setpoint: 34.5 inches from sump bottom
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: A-MDS-30

Annunciator: 47051-L FIRE DETECTION SYSTEM ACTIVATED
SER Point: 55 – TURBINE OIL RESERVOIR FIRE
SER Point: 62 –TURBINE BUILDING OPERATING FLOOR FIRE
SER Point: 63 – TURBINE BUILDING MEZZANINE FLOOR FIRE
SER Point: 64 – TURBINE BUILDING BASEMENT FLOOR FIRE

SER Point: 800 – HYDROGEN SEAL OIL PUMP AREA FIRE
Setpoint:
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-FP-08

Annunciator: 47052-L FIRE PROTECTION HDR PRESSURE LOW
SER Point: 1541 FIRE PROTECTION HDR PRESSURE LOW
Setpoint: < 60 psig
Computer Point: P2903A
Setpoints: (Low) 115 psig, 105 psig, 95 psig, 85 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47053-L FIRE DETECTION SYSTEM TROUBLE
SER Point:
Setpoint: Alarm condition in any one of the fire protection zones that has not reset.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47054-L FIRE PUMPS ABNORMAL
SER Point: 1538 – FIRE PUMP A RUNNING
SER Point: 1540 – FIRE PUMP B RUNNING
Setpoint: A Fire Pump Auto starts on 110 psig Fire Protection header pressure and any deluge valve opening; B Fire Pump Auto starts on 102 psig Fire Protection header pressure.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: E-FP-08

Annunciator: 47062-A S/G A PROGRAM LEVEL DEVIATION
SER Point: 148 – STEAM GENERATOR A PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-B S/G A BYPASS CV LEVEL DEVIATION
SER Point: 150 – S/G A BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G A Level LI-461 is +/- 5% from setpoint on FW-10A/CV-31157 controller
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-D S/G B PROGRAM LEVEL DEVIATION
SER Point: 162 – STEAM GENERATOR B PROGRAM LEVEL DEVIATION LOW

Setpoint: > +/- 5%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-E S/G B BYPASS CV LEVEL DEVIATION
SER Point: 164 - S/G B BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G B Level LI-471 is +/- 5% from setpoint on FW-10B/CV-31158 hand controller
Computer Point: L0471A
Time until alarm actuation following event: Unknown
Setpoints: (Low) 30%, 25%, 20%, 15%
Procedure to Enter: A-FW-05A

Annunciator: 47033-45 TLA-20 4160V STATOR TEMPERATURE HOT
SER Point: None
Computer Point: Cond Pmp A Stator – T2474A
Setpoint: 110 degrees Celsius
Computer Point: Cond Pmp B Stator – T2484A
Setpoint: 110 degrees Celsius
Computer Point: FW Pump A Stator – T2809A
Setpoint: 125 degrees Celsius
Computer Point: FW Pump B Stator – T2829A
Setpoint: 125 degrees Celsius
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A, A-CD-03

Operator Response

This event is similar to the large feedwater line break, the difference being less water flooding into the Turbine building from the break and from fewer sprinklers. The Control Room will have similar indications to the large feedwater line break scenario and the NAO would encounter similar conditions locally. The overall procedure path is likewise similar. The operators will enter E-0, transition to ES-0.1. In parallel, the control room crew will address the fire alarms received by use of E-FP-08. At step 3.2.1.a the NAO will be dispatched to assess conditions in the Turbine Building. When the Turbine Building is accessible, the NAO will investigate for a fire. Once conditions are verified, he'll report there is no fire. The crew exits E-FP-08 to N-FP-08, Step 4.3 to isolate the sprinklers.

Training

The relevant training topics for a moderate feedwater break are identical to those for a large feedwater break. **Refer to the report** "Crew Exercise - Large Feedwater Break" for a discussion of training conducted.

Section VI: Large Main Steam Break (Actuates all Fire Sprinklers)

CONTROL ROOM INDICATIONS
For a large break there would be an audible indication.

Basis: On 5/14/1999 Point Beach Unit 1 experienced a feedwater heater rupture. Control room staff could hear the rupture (INPO OE9914).

CONTROL ROOM ALARMS
Annunciator: 47021-A SI TRAIN A ACTUATED
SER Point: 1296 - SI TRAIN A ACTUATED
Setpoint: 2/3 Loop A Steam Pressure < 514 psig OR 2/3 Loop B Steam Pressure < 514 psig
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-0

Annunciator: 47021-B SI TRAIN B ACTUATED
SER Point: 1441 - SI TRAIN B ACTUATED
Setpoint: 2/3 Loop A Steam Pressure < 514 psig OR 2/3 Loop B Steam Pressure < 514 psig
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-0

Annunciator: 47022-B MAIN STEAM HEADER A LOW PRESSURE SI
SER Point: 310 - MAIN STEAM HEADER A LOW PRESSURE SI
Setpoint: 2/3 Loop A Steam Pressure < 514 psig
Computer Point: P0468A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0469A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0482A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0480D
Setpoints: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-0

Annunciator: 47022-C MAIN STEAM HEADER B LOW PRESSURE SI
SER Point: 315 - MAIN STEAM HEADER B LOW PRESSURE SI
Setpoint: 2/3 Loop B Steam Pressure < 514 psig
Computer Point: P0478A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0479A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0483A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0423D
Setpoints: None
Time until alarm actuation following event: Immediately

Procedure to Enter: E-0

Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47031-E S/G A LOW LOW LEVEL REACTOR TRIP
SER Point: 319 - S/G A LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47031-F S/G B LOW LOW LEVEL REACTOR TRIP
SER Point: 323 - S/G B LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47031-K POWER RANGE RATE REACTOR TRIP
SER Point: 302 – POWER RANGE HIGH FLUX RATE REACTOR TRIP
Setpoint: 2/4 Channels Change >5% IN 2 SECONDS
Computer Point: N1041A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1042A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1043A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1044A
Setpoints: Calculated based on RTO Operating limit

Time until alarm actuation following event: Immediately

Procedure to Enter: E-0

Annunciator: 47031-L POWER RANGE OVERPOWER ROD STOP
SER Point: 1671 – POWER RANGE OVERPOWER ROD STOP
Setpoint: 1/4 Channels >103%
Computer Point: N1041A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1042A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1043A
Setpoints: Calculated based on RTO Operating limit
Computer Point: N1044A
Setpoints: Calculated based on RTO Operating limit
Time until alarm actuation following event: Immediately
Procedure to Enter: None

Annunciator: 47051-L FIRE DETECTION SYSTEM ACTIVATED
SER Point: 55 – TURBINE OIL RESERVOIR FIRE
SER Point: 62 –TURBINE BUILDING OPERATING FLOOR FIRE
SER Point: 63 – TURBINE BUILDING MEZZANINE FLOOR FIRE
SER Point: 64 – TURBINE BUILDING BASEMENT FLOOR FIRE
SER Point: 800 – HYDROGEN SEAL OIL PUMP AREA FIRE
Setpoint:
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-FP-08

Annunciator: 47052-L FIRE PROTECTION HDR PRESSURE LOW
SER Point: 1541 FIRE PROTECTION HDR PRESSURE LOW
Setpoint: < 60 psig
Computer Point: P2903A
Setpoints: (Low) 115 psig, 105 psig, 95 psig, 85 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47053-L FIRE DETECTION SYSTEM TROUBLE
SER Point:
Setpoint: Alarm condition in any one of the fire protection zones that has not reset.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47054-L FIRE PUMPS ABNORMAL
SER Point: 1538 – FIRE PUMP A RUNNING
SER Point: 1540 – FIRE PUMP B RUNNING
Setpoint: A Fire Pump Auto starts on 110 psig Fire Protection header pressure and any deluge valve opening; B Fire Pump Auto starts on 102 psig Fire Protection header pressure.
Computer Point: None

Time until alarm actuation following event: Unknown/SI inhibits Fire Pump Operation Pumps may not start.
Procedure to Enter: E-FP-08

Annunciator: 47061-B S/G A SF>FF
SER Point: 1578 – STEAM GEN A STM FLOW > FEED FLOW
Setpoint: S/G A STM Flow FI-464 0.87E6 lbs/hr > S/G A FW Flow FI-466, or S/G A STM Flow FI-465 0.87E6 lbs/hr > S/G A FW Flow FI-467
Computer Point: None
Time until alarm actuation following event:
Procedure to Enter: None

Annunciator: 47061-E S/G B SF>FF
SER Point: 1581 – STEAM GEN B STM FLOW > FEED FLOW
Setpoint: S/G B STM Flow FI-474 0.87E6 lbs/hr > S/G B FW Flow FI-476, or S/G B STM Flow FI-475 0.87E6 lbs/hr > S/G B FW Flow FI-477
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47061-G FWP A/B SUCTION PRESS LOW
SER Point: 165 – FEEDWATER PUMP A SUCTION PRESSURE LOW
SER Point: 166 – FEEDWATER PUMP B SUCTION PRESSURE LOW
Setpoint: < 180 psig
Computer Point: P2800A
Setpoints: (Low) 250 psig, 240 psig, 230 psig, 220 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-A S/G A PROGRAM LEVEL DEVIATION
SER Point: 148 – STEAM GENERATOR A PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47061-I STEA M GENERATOR A LO-LO PRESS SI CHANNEL ALERT
SER Point: 1174 - STEA M GENERATOR A LO-LO PRESS SI CHANNEL ALERT
Setpoint: 1/3 CHANELS <500 PSIG
Computer Point: P0468A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0469A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0482A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Time until alarm actuation following event: IMMEDIATE
Procedure to Enter: E-0

Annunciator: 47061-J STEA M GENERATOR B LO-LO PRESS SI CHANNEL ALERT

SER Point: 1172 - STEA M GENERATOR B LO-LO PRESS SI CHANNEL ALERT
Setpoint: 1/3 CHANELS <500 PSIG
Computer Point: P0478A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0479A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Computer Point: P0483A
Setpoints: (High) 1110, 1090, 1070, 1050 (Low) 600, 580, 560, 540
Time until alarm actuation following event: IMMEDIATE
Procedure to Enter: E-0

Annunciator: 47061-K MAIN STEAM ISOLATION VLV CLOSED
SER Point: 136 S/G A Main Steam Isolation Valve Closed
SER Point: 137 S/G B Main Steam Isolation Valve Closed
Setpoint: S/G A OR S/G B Main Steam Isolation Valve
Computer Point: None
Time until alarm actuation following event: Immediate
Procedure to Enter: E-0

Annunciator: 47062-B S/G A BYPASS CV LEVEL DEVIATION
SER Point: 150 – S/G A BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G A Level LI-461 is +/- 5% from setpoint on FW-10A/CV-31157 controller
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-C S/G A LEVEL LOW
SER Point: 1577 – STEAM GENERATOR A LEVEL LOW
Setpoint: 1/2 Channels < 25.5%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-D S/G B PROGRAM LEVEL DEVIATION
SER Point: 162 – STEAM GENERATOR B PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-E S/G B BYPASS CV LEVEL DEVIATION
SER Point: 164 - S/G B BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G B Level LI-471 is +/- 5% from setpoint on FW-10B/CV-31158 hand controller

Computer Point: L0471A
Time until alarm actuation following event: Unknown
Setpoints: (Low) 30%, 25%, 20%, 15%
Procedure to Enter: A-FW-05A

Annunciator: 47062-F S/G B LEVEL LOW
SER Point: 1580 - STEAM GENERATOR B LEVEL LOW
Setpoint: 1/2 Channels < 25.5%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-A S/G A LEVEL LOW LOW
SER Point: 1576 – STEAM GENERATOR A LEVEL LOW LOW
Setpoint: 1/3 channels < 17%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47064-D S/G B LEVEL LOW LOW
SER Point: 1579 – STEAM GENERATOR B LEVEL LOW LOW
Setpoint: 1/3 channels < 17%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A
Time until alarm actuation following event: Unknown
Procedure to Enter: A-CD-03

Annunciator: 47033-45 TLA-20 4160V STATOR TEMPERATURE HOT
SER Point: None
Computer Point: Cond Pmp A Stator – T2474A
Setpoint: 110 degrees Celsius
Computer Point: Cond Pmp B Stator – T2484A
Setpoint: 110 degrees Celsius
Computer Point: FW Pump A Stator – T2809A
Setpoint: 125 degrees Celsius
Computer Point: FW Pump B Stator – T2829A

Setpoint: 125 degrees Celsius
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A, A-CD-03

Operator Response
The operator responds using E-0. Safety Injection has actuated, thus inhibiting automatic fire pump operation. At E-0 step 17, a decision will be made on whether to reset and start the fire pumps. If dispatched, the NAO discovers there is no fire and consequently the Control Room will not reset the Fire Pumps. The MSIV's have closed automatically due to the steam line break (HI-HI Steam Flow coincident with SI or HI Steam Flow coincident with LO-LO Tave and SI) or were manually closed by the operating crew for personnel safety. This sequence terminates the flooding to the Turbine Building.

Training
Main Steam and Steam Dump (RO2-02-LP06A/AOI-42-LP06A)
Synopsis: This initial training lesson plan covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

System Review: Main Steam and Steam Dump System (LRC-04-LP201)
Synopsis: This licensed operator requalification lesson focuses on operation, automatic actions, interlocks, instrumentation, control and alarms associated with Main Steam Isolation Valves and Steam Dumps.

Faulted S/G (LRC-04-SE501)
Synopsis: This licensed operator requalification scenario addresses a stuck open S/G PORV requiring a reactor trip and execution of E-2, Faulted S/G Isolation.

EDG Malfunction/Restore Power/S/G Fault (LRC-02-SE402)
Synopsis: This simulator scenario, designed for either initial or continuing training, involves a stuck open steam dump valve coincident with a stuck open MSIV. Execution of E-2 required to mitigate the event.

Abnormal/Emergency Operations Day 13 (RO4-06-SED13)
Synopsis: This initial license-training scenario involves a S/G tube rupture coincident with a S/G Safety valve stuck open on the same S/G.

Increased Secondary Heat Removal Events (RO4-05-LP002)
Synopsis: This initial license-training lesson plan reviews initiating events, parameter trends, impact on critical safety functions, applicable reactor trip settings, and engineered safety features that mitigate consequences of increase heat removal events.

Section VII: Moderate Main Steam Break (Actuates 100 Fire Sprinklers)

CONTROL ROOM INDICATIONS

For a moderate break there may or may not be an audible indication of steam line break.

Basis: On 5/14/1999 Point Beach Unit 1 experienced a feedwater heater rupture. Control room staff could hear the rupture (INPO OE9914).

Control Room meters and recorders would provide indication of steam generator level and steam and feed flow changes.

S/G A NR Level Indication Meters - 4104801, 4104802, 4104803
S/G B NR Level Indication Meters - 4105201, 4105202, 4105203
S/G A and B WR Level Recorder - 43014
S/G A and B WR (Cold Cal) Level Recorder - 42563
S/G A and B NR Level Recorder – 42560

S/G A Steam Flow Meters 4105001, 4105002
S/G A Feed Flow Meters 4104601, 4104602
S/G B Steam Flow Meters 4105101, 4105102
S/G B Feed Flow Meters 4104101, 4104102
S/G A SF and FF Recorder – 42506
S/G B SF and FF Recorder - 42562

CONTROL ROOM ALARMS

Annunciator: 47023-K SEISMIC TROUBLE
SER Point: 330 – SEISMIC MONITOR EVENT
Setpoint: 0.03g Horiz/Vert Ground Acceleration
SER Point: 331 – SEISMIC MONITOR OPERATIONAL BASIS EARTHQUAKE
Setpoint: 0.06g Horiz, 0.04g Vert Ground Acceleration
SER Point: 332 – SEISMIC MONITOR DESIGN BASIS EARTHQUAKE
Setpoint: 0.12g Horiz, 0.08g Vert Ground Acceleration
Computer Point: None
Time until alarm actuation following event: Immediately
Procedure to Enter: E-O-05

Annunciator: 47031-E S/G A LOW LOW LEVEL REACTOR TRIP
SER Point: 319 - S/G A LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0462A
Setpoints: (Low) 30%, 25%, 20%, 15%

Computer Point: L0463A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47031-F S/G B LOW LOW LEVEL REACTOR TRIP
SER Point: 323 - S/G B LOW LOW LEVEL REACTOR TRIP
Setpoint: 2/3 Channels < 17%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0472A
Setpoints: (Low) 30%, 25%, 20%, 15%
Computer Point: L0473A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-0

Annunciator: 47051-L FIRE DETECTION SYSTEM ACTIVATED
SER Point: 55 – TURBINE OIL RESERVOIR FIRE
SER Point: 62 –TURBINE BUILDING OPERATING FLOOR FIRE
SER Point: 63 – TURBINE BUILDING MEZZANINE FLOOR FIRE
SER Point: 64 – TURBINE BUILDING BASEMENT FLOOR FIRE
SER Point: 800 – HYDROGEN SEAL OIL PUMP AREA FIRE
Setpoint:
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-FP-08
Annunciator: 47052-L FIRE PROTECTION HDR PRESSURE LOW
SER Point: 1541 FIRE PROTECTION HDR PRESSURE LOW
Setpoint: < 60 psig
Computer Point: P2903A
Setpoints: (Low) 115 psig, 105 psig, 95 psig, 85 psig
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47053-L FIRE DETECTION SYSTEM TROUBLE
SER Point:
Setpoint: Alarm condition in any one of the fire protection zones that has not reset.
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47054-L FIRE PUMPS ABNORMAL
SER Point: 1538 – FIRE PUMP A RUNNING
SER Point: 1540 – FIRE PUMP B RUNNING
Setpoint: A Fire Pump Auto starts on 110 psig Fire Protection header pressure and any deluge valve opening; B Fire Pump Auto starts on 102 psig Fire Protection header pressure.
Computer Point: None
Time until alarm actuation following event: Unknown.
Procedure to Enter: E-FP-08

Annunciator: 47061-B S/G A SF>FF
SER Point: 1578 – STEAM GEN A STM FLOW > FEED FLOW
Setpoint: S/G A STM Flow FI-464 0.87E6 lbs/hr > S/G A FW Flow FI-466, or S/G A STM Flow FI-465 0.87E6 lbs/hr > S/G A FW Flow FI-467
Computer Point: None
Time until alarm actuation following event:
Procedure to Enter: None

Annunciator: 47061-E S/G B SF>FF
SER Point: 1581 – STEAM GEN B STM FLOW > FEED FLOW
Setpoint: S/G B STM Flow FI-474 0.87E6 lbs/hr > S/G B FW Flow FI-476, or S/G B STM Flow FI-475 0.87E6 lbs/hr > S/G B FW Flow FI-477
Computer Point: None
Time until alarm actuation following event: Unknown
Procedure to Enter: None

Annunciator: 47062-A S/G A PROGRAM LEVEL DEVIATION
SER Point: 148 – STEAM GENERATOR A PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-B S/G A BYPASS CV LEVEL DEVIATION
SER Point: 150 – S/G A BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G A Level LI-461 is +/- 5% from setpoint on FW-10A/CV-31157 controller
Computer Point: L0461A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-D S/G B PROGRAM LEVEL DEVIATION
SER Point: 162 – STEAM GENERATOR B PROGRAM LEVEL DEVIATION LOW
Setpoint: > +/- 5%
Computer Point: L0471A
Setpoints: (Low) 30%, 25%, 20%, 15%
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A

Annunciator: 47062-E S/G B BYPASS CV LEVEL DEVIATION
SER Point: 164 - S/G B BYPASS CONTROL VALVE LEVEL DEVIATION LOW
Setpoint: alarm actuated when S/G B Level LI-471 is +/- 5% from setpoint on FW-10B/CV-31158 hand controller
Computer Point: L0471A
Time until alarm actuation following event: Unknown
Setpoints: (Low) 30%, 25%, 20%, 15%
Procedure to Enter: A-FW-05A

Annunciator: 47033-45 TLA-11 Reactor Thermal Power High
SER Point: None
Computer Point: R5300G RTO Operating Limit
Computer Point: R5103G RTO Operating Limit minus 0.3 MWth
Computer Point: R5110G Reactor Thermal 1 minute Avg.
Computer Point: R5114G Reactor Thermal 15 Minute Avg.
Computer Point: R5113G Reactor Thermal 8 Hr Avg.
Setpoint: R5110G ≥ 1777MWth
Setpoint: R5113G ≥ R5301G
Setpoint: R5114G ≥ R5300G
Time until alarm actuation following event: Near immediate if at 100% power.
Procedure to Enter: A-CP-46A

Annunciator: 47033-45 TLA-20 4160V STATOR TEMPERATURE HOT
SER Point: None
Computer Point: Cond Pmp A Stator – T2474A
Setpoint: 110 degrees Celsius
Computer Point: Cond Pmp B Stator – T2484A
Setpoint: 110 degrees Celsius
Computer Point: FW Pump A Stator – T2809A
Setpoint: 125 degrees Celsius
Computer Point: FW Pump B Stator – T2829A
Setpoint: 125 degrees Celsius
Time until alarm actuation following event: Unknown
Procedure to Enter: A-FW-05A, A-CD-03

Operator Response
Either a manual Rx Trip is directed or the Plant trips on S/G Lo Level w/SF>FF, or on S/G Lo Lo level. No SI occurs, so MSIV's stay open and continue to feed the break in the Turbine Building. Misc Sump Level high alarms for the Turbine Building sump.

E-0 is entered and then exited after step 4 to ES-0.1, step 1.

NAO would be dispatched to Turbine Building and promptly report a steam line break and location. C/R would perform MS Isolation by this report or in ES-0.1, step 1 contingency.

E-FP-08 is in effect, but there is no fire. Sprinklers will be isolated by the NAO per N-FP-08. This terminates the flooding into the Turbine Building.

Training
Main Steam and Steam Dump (RO2-02-LP06A/AOI-42-LP06A)
Synopsis: This initial training lesson plan covers system flow path, function/purpose, operating characteristics of major components, interfaces with other plant systems, power

supplies to major components, automatic actions, interlocks, instrumentation, controls and alarms associated with the system.

System Review: Main Steam and Steam Dump System (LRC-04-LP201)
This licensed operator requalification lesson focuses on operation, automatic actions, interlocks, instrumentation, control and alarms associated with Main Steam Isolation Valves and Steam Dumps.

Faulted S/G (LRC-04-SE501)
This licensed operator requalification scenario addresses a stuck open S/G PORV requiring a reactor trip and execution of E-2, Faulted S/G Isolation.

EDG Malfunction/Restore Power/S/G Fault (LRC-02-SE402)
This simulator scenario, designed for either initial or continuing training, involves a stuck open steam dump valve coincident with a stuck open MSIV. Execution of E-2 required to mitigate the event.

Abnormal/Emergency Operations Day 13 (RO4-06-SED13)
This initial license-training scenario involves a S/G tube rupture coincident with a S/G Safety valve stuck open on the same S/G.

Increased Secondary Heat Removal Events (RO4-05-LP002)
This initial license-training lesson plan reviews initiating events, parameter trends, impact on critical safety functions, applicable reactor trip settings, and engineered safety features that mitigate consequences of increase heat removal events.

CONCLUSIONS
There are appropriate indications and/or annunciators available to alert the operating crew that any of the seven initiating events is in progress. Operators are trained to respond to the symptoms provided. Procedure guidance is provided for a portion of the events identified. In those instances where direct procedure guidance does not exist, operators are trained on system construction, principles of operation, as well as component controls, indications, interlocks, and alarms. In addition, operators have routine contact with the system components to maintain familiarity with location and operation.

REFERENCES

A-CD-03	Condensate System Abnormal Operation
A-CP-46A	UFMD/UTM Abnormal Operation
A-FW-05A	Abnormal Feedwater System Operation
A-MDS-30	Miscellaneous Drains and Sumps (MDS) Abnormal Operation
A-SW-02	Abnormal Service Water System Operation
A-TOP-20	Abnormal Turbine Oil Purification System Operation
E-0	Reactor Trip or Safety Injection
E-AR-09	Loss of Condenser Vacuum
E-FP-08	Emergency Operating Procedure – Fire

Appendix C

Fault Tree Analysis

Attachment 3 – Crew Exercise – Large Feedwater Break

Crew Exercise – Large Feedwater Break

Prepared by: ______________________ Jeffrey T. Stafford
Signature Print Name

10-21-05
Date

Reviewed by: ______________________ Paul T. Rappel
Signature Print Name

10/21/05
Date

1.0 PURPOSE

This document discusses the simulator scenario that was conducted to support the Significance Determination Process for Turbine Building flooding resulting from a large feedwater break. The break was assumed to result in actuation of all fire protection sprinkler systems in the affected areas.

2.0 DISCUSSION

The scenario was run on September 29, 2005. One control room operating crew was assigned to participate. The crew's Nuclear Auxiliary Operators (NAO's) did not participate as the scenario team leader assumed their role. The crew was unaware of the scenario being run and did not receive training prior to the scenario. In order to be conservative, the scenario was run with the minimum shift complement available. The modifications installed during the 2005 Forced Outage were not available and/or assumed to not be installed. The procedure set was extensively "retro-fitted" to support a June 30, 2004 time frame. This date was chosen to remove procedure enhancements made as a result of learning acquired during the plant shutdown to address design issues, including internal flooding. The crew was briefed on the procedure set available for them to use, however, several procedures that would not be expected to be used during the scenario were also retro-fitted so as not to direct crew actions or strategies. The crew was given a review period to discuss the procedure set and ask questions. The crew was also given an opportunity to walk down the control boards and ask questions. One question asked was the status of the berm in the Diesel Generator B room. The scenario team responded the crew could assume the berm was in place. The crew made two requests relative to configuration of equipment in the simulator. They requested that Circulating Water Pump B and Service Water Pump B2 be started. The scenario team performed the requested actions prior to turning the simulator over to the crew. The scenario team consisted of the Supervisor – Nuclear Shift Operations, a Senior Operations Instructor, an Operations Instructor, one Probabilistic Risk Assessment (PRA) analyst, one PRA engineer (contractor), and one Engineering Supervisor. The scenario guide is included in this report as Attachment A.

Note: The detailed time line associated with this exercise is included in this report as Attachment D.

The scenario was initiated from 100% power with no major equipment OOS. The break was simulated to be upstream of the high-pressure feedwater heaters. The simulated break size was 100%. The reactor tripped on Low-Low S/G water level of 17% in approximately 16 seconds. The crew entered E-0, Reactor Trip or Safety Injection. The Nuclear Control Operators (NCO) performed their immediate operator actions and reported completion to the Unit Supervisor (US). The immediate actions were completed and reported in approximately 30 seconds. The US then began reading E-0. As the immediate actions were being read by the US, the Shift Manager (SM) directed the NAO's to investigate the fire alarms that occurred coincident with the initiating event. The SM then directed the

Feedwater and Condensate Pumps tripped. Immediately following this direction, the NAO's reported it was unsafe to enter the Turbine Building due to the presence of steam. The Shift Manager directed the Auxiliary Operator to access the Auxiliary Building via Door 143, located upstairs from the Control Room, and then proceed to Door 8, Auxiliary Building to Safeguards Alley door. After accessing Safeguards Alley, the AO was to open the breakers for the Fire Pumps located on Bus 52 (Fire Pump A) and Bus 61 (Fire Pump B). The scenario team stated (as the NAO) after an appropriate delay this was not possible due to steam and hot water issuing from the safeguards alley trench. The NAO was then simulated to return to the Control Room via the route taken into the Auxiliary Building. As recourse, the EO was instructed to contact Security to gain access to the Screenhouse from the ground level outside of the Administration Building via Door 166. The scenario team responded this was not possible due to the door being locked from inside the Screenhouse. Further efforts then continued to enter the Turbine Building to determine the extent of damage. Fire protection equipment, such as bunker gear, helmets and self-contained breathing apparatus (SCBA) are available immediately outside of the Control Room in an area protected by Door 118. The use of these items was simulated to occur. The overall context of the drill was to allow entry onto the Turbine Building operating floor 5 minutes after the break was terminated and entry to the mezzanine level was possible 10 minutes after the break. This is consistent with engineering analysis that determined the temperature on the mezzanine level to be 133°F ten minutes following the initiating event. This is important due to the location of the sprinkler isolation valves on both the north and south ends of the mezzanine.

The crew completed the immediate actions of E-0 and determined Safety Injection (SI) was not required and transitioned to ES-0.1, Reactor Trip Response approximately 5 minutes into the scenario. The Turbine Driven Auxiliary Feedwater (TDAFW) Pump was placed in Pullout at approximately 10 minutes. Bus 1 and Bus 2 locked out at a time of 12 minutes. This placed the reactor coolant system into a natural circulation condition. At 15 minutes, the lowest row of breakers on Bus 61 and Bus 62 were assumed to become wet, causing the breakers to trip. This resulted in Battery Charger and Safeguards Inverter alarms. The crew continued the performance of ES-0.1 in parallel with addressing the alarming conditions.

At scenario time of 23 minutes, the NAO's were dispatched to the Turbine Building Mezzanine to close the sprinkler isolations. After a delay of 4 minutes, the north isolation valves were reported closed. After another 4-minute delay, the south isolation valves were reported closed. This was reported 31 minutes into the scenario. Following the scenario, an NAO was timed to validate the assumptions made during the development of the simulator exercise. The results were consistent and the total time of 8 minutes was determined to be an accurate value. The detailed timing of these actions is included in this report as Attachment C. Isolation of the sprinkler system significantly reduced flow into the turbine-building basement. Nonetheless, the SM directed the isolation of the

Turbine Oil Reservoir Deluge system and the Hydrogen Seal Oil Unit sprinklers. Both of these actions were completed at 43 minutes.

At a problem time of 33 minutes, Bus 61 and Bus 62 locked out. This was communicated to the control room team by the balance of plant operator. This in particular drew the attention of the Shift Technical Advisor (STA). Based on the continuing proliferation of annunciators associated with safeguards electrical distribution as well as a desire to maximize S/G inventory, the STA concluded that the TDAFW Pump should be restarted. The STA discussed the situation with the SM, who relayed the direction to the operating crew. The TDAFW Pump was restarted at 38 minutes. In addition, due to concerns over the imminent submersion of the MDAFW Pumps, the SM directed they be secured. This was accomplished immediately following the restart of the TDAFW Pump. This action is significant due to the loss of the ability to start any non-running AFW pumps at a time of 48 minutes. The 48-minute limit is based on the time to reach the 9" level in safeguards alley, which will result in the auxiliary lube oil pumps becoming submerged and unavailable. The auxiliary lube oil pumps are necessary to make up the lube oil pressure interlock that in turn initiates the start sequence of the associated AFW pump.

With the loss of Bus 61 and Bus 62, the crew became more concerned over the continued availability of Busses 51 and 52. A plan was devised to drain water from the Bus 51/52 area to the Screenhouse via the Cardox tank room and Diesel Generator B room. Prior to using the plan, which was developed at the 56-minute point, Bus 51 and Bus 52 locked out. When asked following the scenario if they would have continued with the strategy, the SM said "No".

The simulator was frozen at 63 minutes. The crew convened with members of the scenario team in a classroom to answer follow-up questions. The follow-up questions and responses are included in this report as Attachment C.

3.0 CONCLUSIONS

The actions taken during the scenario were successful in maintaining core cooling. Follow-up questions allowed the scenario team to determine the crew's priorities were to initiate a plant cooldown and depressurization. Plant Cooldown per ES-0.2 will be blocked due to the loss of equipment necessary to perform boration of the RCS to cold shutdown boron concentration per N-CVC-35-A, Boron Concentration Control.

4.0 Crew performance deficiencies were relatively minor. The crew initially over-emphasized the need to stop the fire protection pumps rather than focus on isolation of the affected fire sprinkler headers. This was corrected and appropriate direction given.

5.0 REFERENCES

The following Lesson Plans document previous training received by Operations that contributed to the mitigation of a Turbine Building Flooding event initiated by a Feedwater line break.

Condensate System

1. Condensate and Air Removal	RO0-02-LP003 AO1-42-LP003
2. Condensate System Review	LRC-04-LP102

Description: Prior training on the Condensate system as described in these lesson plans provided knowledge of the 2200gpm Condensate recirculation requirements for the Air Ejector and Gland Steam Exhaust Condenser that is provided by C-701 with a flow of 2500gpm. BOP observed Condensate flow of 5600gpm with C-701 closed after Feedwater Pumps A and B were stopped due to the Feedwater Line Break. These indications prompted the BOP to recommend stopping Condensate Pumps A and B due to continued leakage from system piping.

Feedwater System

1. Main Feedwater	RO2-02-LP05A AO1-42-LP05A

Description: Lesson plan learning objectives have students describe Main Feedwater system flowpath, operating characteristics and system interfaces of Feedwater System and components as listed. The lesson plan describes system flow path and normal indications observed at the control boards. This prior training provides operator knowledge to detect abnormal system response which prompted operators to stop Feedwater Pumps A and B when indications of pump run out and a system leak were observed.

Fire Protection System

1. Fire Protection	NAO-SG 2.2.8 RO2-02-LP008 AO1-44-LP008
2. E-FP-08/Fire Strategies	LRC-01-LP603 LRC-04-LP402
3. Respond to a Fire	RO1-03-OJ008

Description: Fire System training from EO/AO through RO/SRO discusses knowing locations of components, power supplies and system response. NAO-SG 2.2.8 required performance of N-FP-08CL, the checklist identifies location and isolation of Turbine Building Basement and Mezzanine sprinklers. This prior training provided knowledge required to identify and isolate the fire system actuation caused by the high temperatures during steam release of the Feedwater line break.

Decision to Manually Start Turbine-Driven Auxiliary Feedwater Pump

1.	Auxiliary Feedwater System	LRC-04-LP305 RO2-02-LP05B LRC-02-LP204
2.	DC & Emerg. AC Supply & Distr.	LRC-02-LP304 RO2-03-LP38/AOI-46-LP038
3.	Decreased Sec. Heat Removal	RO4-05-LP003
4.	Core Damage from Loss of Heat Sink	RO4-05-LP015 LRC-04-SE 204
5.	FW Malfunction	LRC-02-SE203
6.	Loss of All AC Without SI	LRC-04-SE201
7.	Loss of All AC with SI Required	LRC-04-SE202
8.	ECA-0.0/Emergency DG OPS	LRC-02-SE103
9.	IPEOP Introduction and Usage	RO4-04-LP001
10.	Response to Loss of Secondary Heat Sink	RO4-04-LP035

As the deleterious effects from feed line break and fire suppression water progressed to Safeguards Alley, the Shift Technical Advisor assumed that the two running Motor-Driven Auxiliary Feedwater Pumps would eventually fail (i.e., short out) due to water intrusion into their area.

All of the Auxiliary Feedwater Pumps require lube oil pressure be established before starting. The Shift Technical Advisor (STA) recognized that if there was no DC power available for starting the Turbine-Driven Auxiliary Lube Oil Pump and the two Motor-Driven Auxiliary Feedwater Pumps failed, then the Heat Sink critical safety function would be challenged.

With the Heat Sink critical safety function degraded, Core Cooling critical safety function would become challenged, which would likely direct the operators to bleed and feed using Safety Injection Pumps and Pressurizer PORVs. But with the imminent loss (i.e., assumed) of 4160V buses, the Safety Injection Pumps would soon be unavailable.

Earlier in the event, the Turbine-Driven Auxiliary Feedwater Pump was manually stopped by procedure. DC power is necessary to start the pump's auxiliary lube oil pump, which would pressurize the lube oil and allow starting of the Turbine-Driven Auxiliary

Feedwater Pump. Once the Turbine-Driven Auxiliary Feedwater Pump was running, the threat of failure due to shorting out did not exist.

Additionally, Auxiliary Feedwater Pump lube oil cooler water drains to the trench during pump operation. This quantity of water could be reduced by stopping the Motor-Driven Auxiliary Feedwater Pumps and run only the Turbine-Driven Auxiliary Feedwater Pump. The quantity of water from the lube oil coolers may have been insignificant compared to the water backfilling from the Turbine Building, but this action would have reduced the rate at which level was rising in Safeguards Alley, thereby prolonging the availability of electrical components in the area.

Therefore the STA recommended to the Shift Manager that the Turbine-Driven Auxiliary Feedwater Pump be started in order to sustain/replenish inventory in the Steam Generators and to stop both Motor-Driven Auxiliary Feedwater Pumps to slow the water level rise in Safe Guards Alley.

Additional Training References

Emergency CRAC/ES-0.2 (LRC-03-SE103)
Synopsis: This licensed operator requalification scenario includes a natural circulation cooldown in accordance with ES-0.2.

Abnormal Operating Procedures (AOP's) associated with: DC Supply and Distribution, Loss of A Safeguards Power, 4160V Supply and Distribution, and 480V Supply and Distribution (RO4-03-SED14)
Synopsis: This initial license-training scenario covers battery charger malfunctions, bus lockouts, and loss of DC distribution.

Reactor Trip Response (RO4-04-LPD004)
Synopsis: This initial license-training lesson plan involves a reactor trip response in accordance with ES-0.1.

Reactor Trip or Safety Injection (RO4-04-LPD002)
Synopsis: This initial license-training lesson plan covers operator response to a reactor trip or safety injection in accordance with E-0.

Natural Circulation Cooldown (RO4-04-LPD006)
Synopsis: This initial license-training lesson plan covers operator actions required to perform a natural circulation cooldown in accordance with ES-0.2.

Natural Circulation Cooldown with Steam Void in Vessel (RO4-04-LPD007)
Synopsis: This initial license-training lesson plan covers operator actions required to perform a natural circulation cooldown with a steam void in the reactor vessel in accordance with ES-0.3.

IPEOP's Associated with E-0, ES-0.1, and ES-1.1 (RO4-04-SED02)
Synopsis: This initial license-training simulator scenario covers operator response to a reactor trip in accordance with E-0 and stabilizing the plant in Hot Shutdown per ES-0.1.

IPEOP's – Equipment Operator (AOI-47-LPEOP)
Synopsis: Identifies the in-plant operator actions that need to be performed while the IPEOP's are being implemented per plant procedures.

IPEOP's – Auxiliary Operator (AOI-85-LPEOP)
Synopsis: Identifies the in-plant operator actions that need to be performed while the IPEOP's are being implemented per plant procedures.

IPEOP's Associated with E-0, ES-0.1, and ES-0.2 and ES-0.3 (RO4-04-SED03)
Synopsis: This initial license-training simulator scenario covers operator response to a reactor trip in accordance with E-0 and stabilizing the plant in Hot Shutdown per ES-0.1, then conducting a natural circulation cooldown in accordance with ES-0.2 and ES-0.3.

PROCEDURE REFERENCES

A full procedure set was provided to the Operating Crew for use during the scenario. However, many procedures were replaced with the revision in effect as of June 30, 2004. The crew did not actively use all of the previous revisions provided. Additional procedures beyond those expected to be used were provided in order to not compromise the contents of the scenario.

Normal/Abnormal/Emergency Procedures

E-AS-01	Loss of Instrument Air
A-CD-03	Condensate System Abnormal Operation
A-CW-04	Abnormal Circulating Water System Operation
E-CW-04	Loss of Circulating Water
A-FW-05A	Abnormal Feedwater System Operation
A-FW-05B	Abnormal Auxiliary Feedwater System Operation
A-MS-06	Abnormal Main Steam and Steam Dump System Operation
N-FP-08	Fire Protection System
E-FP-08	Emergency Operating Procedure – Fire
A-HD-11	Abnormal Heater and Moisture Separator Drain System and Bleed Steam System
A-MDS-30	Miscellaneous Drains and Sumps (MDS) Abnormal Operation
A-CC-31	Abnormal Component Cooling Water System Operations
A-CC-31	Abnormal RXCP Operation
A-EDC-38	Abnormal DC Supply and Distribution System
A-EHV-39	Abnormal 4160V AC Supply and Distribution System
A-ELV-40	480V AC Supply Distribution System Abnormal

Integrated Plant Emergency Operating Procedures (IPEOP's)

E-0	Reactor Trip or Safety Injection
ES-0.1	Reactor Trip Response
ES-0.2	Natural Circulation Cooldown
ES-0.3	Natural Circulation Cooldown with Steam Void in Vessel
ES-1.1	SI Termination
ES-1.3	Transfer to Containment Sump Recirculation
ECA-1.1	Loss of Emergency Coolant Recirculation
FR-H.1	Response to Loss of Secondary Heat Sink

Alarm Response Procedures (ARP's)

47051-L	FIRE DETECTION SYSTEM ACTIVATED
47061-C	S/G A FEED FLOW EXCESSIVE
47061-F	S/G B FEED FLOW EXCESSIVE

Start scenario with Clean SER printout
Use of two-way radios
Distribution of procedures
Cues from the field
Roles and responsibilities of the scenario team

Time complete	Expected Actions and Responses E-0 and ES-0.1

	• Large Feedwater Break occurs
	• Feedwater Pumps trip
	• Receive S/G A(B) Program Level Deviation alarm and Misc Sump Level High alarm.
	• NCO's notice S/G levels decreasing.
	• NAO may be dispatched to Turbine Building if time permits.
	• One minute after Feedwater Break, FP system actuates with the following zones affected:
	  ○ 0503
	  ○ 0703
	  ○ 0704
	  ○ 1001
	  ○ 1004
	  ○ 1104

	• Plant trips on S/G Lo Level w/SF>FF, or on S/G Lo Lo level. OR • Rx Trip manually initiated prior to reaching trip setpoint
	• E-0 Steps 1-4 (no SI occurs).
	• Exit to ES-0.1 Step 1
	• Steam Dump transferred to steam pressure mode*
	• TDAFW PUMP Placed in Pullout*
	• Check RCS Temp <554
	• Verify FW-7A/B closed
	• Verify AFW flow >205 gpm
	• Main FW Pumps in Pullout
	• Verify all control rods fully inserted
	• Check PZR Level Control
	• Check PZR Pressure Control
	• Check Steam Generator Levels
	• Verify All AC Buses energized by off-site power

At time=12
BUS 1&2
lockout

At time=12
BUS 1&2
lockout

		• Steam Dump to Steam Pressure Mode
		• Verify Natural Circulation in RCS
		• Check SR Indications
At time=15 Open Pzr Htr Grp B brkrs;		• Shut Down unnecessary Plant Equipment; HDP's and CDP's
		• Maintain Stable Plant Conditions
		• Set S/G PORV's at 1005 psig
		• Shut down the Turbine
		• Shift CI from CD to AFW
		• Align Traps and Drains per N-TD-13* *If E-FP-08 has not been completed by this time, it is expected for the NAO to respond that they cannot access the required areas due to the steam leak and water present in the TB Basement
		• Align Secondary Plant Pumps for Shutdown
		• Shift S/G Blowdown to Mode I
		• Establish Secondary Plant Shutdown Conditions
		• Verify MS-312A-1 and B-1 OPEN
At time=45 Open Pzr Htr Grp A brkrs;		• Place all MAT supply breakers to PULLOUT
		• Investigate Cause of Trip
		• Take Aux MWH readings in RR
		• Complete System Disturbance Report
		• Place heating boiler in operation
		• Initiate CAP
		• Notify NRC
		• Determine transition to ES-0.2 is required

Time Start/Stop	Expected Actions and Responses E-FP-08 and N-FP-08
	• **Dispatch NAO to investigate**
	• NAO reports Turbine Building is full of steam, but there is no fire. Fire suppression is actuated on the Turbine Building Mezzanine and Basement.
	• Rest of E-FP-08 is not applicable, crew transitions to N-FP-08.
	• Step 4.3, NAO is dispatched to isolate actuated sprinkler systems* • **At this point ensure that a minimum of 10 minutes has passed from feedwater line break initiation. If <10 minutes, inform crew that TB mezzanine is not accessible** o Should isolate the following: ▪ **FP-346** ▪ **FP-348** ▪ **FP-276** ▪ **FP-278** o **NOTE: THESE ARE LISTED ON THE FIRE STRATEGIES FOR THE AFFECTED AREA**
	• NAO isolates affected sprinklers 10 minutes after being dispatched or at t=20 whichever is greater

At the specified time intervals enter the following malfunctions

IF THE FP SPRINKLERS ARE ISOLATED AT LESS THAN OR EQUAL TO 30 MINUTES

12 MINUTES BUS 1&2 LOCKOUT

33 MINUTES BUS 61&62 LOCKOUT

80 MINUTES BUS 51&52 LOCKOUT

100 MINUTES BUS 5 LOCKOUT

IF THE FP SPRINKLERS ARE ISOLATED AT GREATER THAN 30 MINUTES

12 MINUTES BUS 1&2 LOCKOUT

33 MINUTES BUS 61&62 LOCKOUT

48 MINUTES NON-RUNNING AFW PUMPS CANNOT BE STARTED (Auxiliary Lube Oil Pumps OOS)

60 MINUTES BUS 51&52 LOCKOUT AND ALL RUNNING MDAFWP's are tripped

100 MINUTES BUS 5 LOCKOUT

Simulated Reports from the field

If dispatched to the turbine building <5 minutes:

"There is a large amount of steam in the turbine building. I can't see well enough to enter safely"

At 5 minutes:

"I can get out to the operating floor. There is a large amount of steam. Some panels on the turbine building are blown out. Can hear large of amounts of water entering the building."

At 10 minutes:

"I can get to the mezzanine. All sprinklers are going off. There does not appear to be a fire. The Turbine building basement cannot be entered due to steam, hot water and poor visibility due to the sprinklers."

If dispatched to Bus 1 and 2 after lockout:

"There is large amounts of hot water when I open Door 9. It is not safe to enter."

If dispatched to safeguards alley via Door 8:

"The trench is overflowing with very hot water. There is some steam coming off the water. It is not safe to enter."

The following are abort criteria:

Entrance into FR-H.1 and AFW is not restored at prior to entering procedure loop waiting for feed and bleed

The crew elects to go to N-O-04 to stabilize the plant at HSD rather than initiate a cooldown.

ATTACHMENT B FOLLOW-UP QUESTIONS

Follow-up Questions

1. Is this how you envisioned a flooding scenario?

   Yes, but crew stated they were not certain the scenario would be flooding. They were also prepared for AFW pressure switch/runout issues.

2. Why was the TDAFW Pump restarted?

   The TDAFW Pump was restarted at the suggestion of the STA. He was concerned about makeup capabilities to the steam generators. Basis for restarting the TDAFW Pump was as follows:
   a. No electrical requirements for running the pump.
   b. No concerns with shorting out a component
   c. Maximize inventory in the steam generators
   d. Developing scenario where electrical equipment was being lost. Concerned over future possibility of not being able to get pump restarted.

3. Why were the MDAFW Pumps stopped?

   The MDAFW Pumps were stopped because they could not handle the flooding. The Shift Manager stated in order to speed recovery efforts, he would prefer the motors become wet when de-energized rather than energized.

4. Were there any conflicting indications?

   Yes. Signficant items were as follows:
   a. Hotwell level continued to lower after feedwater and condensate pumps were tripped. NOTE: This was due to an override placed on the hotwell level indicator. The action to stop the condensate pumps was not anticipated when developing the scenario.
   b. Waste Area Sump alarm, Waste Holdup Tank Hi-Hi level alarms, North Penetration Room High Temperature SER, and RHR Pump Pit FCU's started automatically. NOTE: These items were missed during scenario development. The FCU's would not start due to a HELB in the Turbine Building. The feedwater break used to initiate the event is actually downstream of FW-12A and FW-12B and through the use of overrides was simulated to occur in the Turbine Building. A limited amount of overrides available on the KPS simulator forced the scenario developer to choose which overrides directly affected the outcome of the scenario.
   c. Some Bus 61/62 equipment stayed lit following the loss of power. NOTE: Individual MCC's are not modeled on the KPS simulator. As such, the scenario developer on a priority basis selected individual components. A

limited amount of overrides available on the KPS simulator forced the scenario developer to choose which overrides directly affected the outcome of the scenario.

d. Upon loss of MCC's, some inverter and battery charger alarms were staggered rather than simultaneous. NOTE: This item noted by scenario development team. This item was overlooked during scenario development.

5. Based on feedback that the level in the CARDOX room was equal to the level in the Turbine Building Basement, would you continue to open doors to route water through the Diesel Generator Room B?

No. This would jeopardize Bus 6. NOTE: At this point of the scenario, the focus was maintaining Bus 51/52 energized. Between the time the direction was given to open doors and drain water from Bus 51/52 area, Busses 51/52 locked out. The Shift Manager stated this strategy would be abandoned at this point.

6. If one 4160v Bus remained energized, describe the procedure flowpath to continue to mitigate the event in progress.

Complete ES-0.1 and go to ES-0.2 then ES-0.3. Cooldown and depressurization is a priority due to the loss of RXCP seal cooling.

7. Describe what would happen if all Bus 5 and Bus 6 were de-energized?

A transition to ECA-0.0 would occur. This would also lead to a cooldown and depressurization when it was determined a charging pump could not be restarted.

ATTACHMENT C NAO TASKS

NAO Tasks

1. You are dispatched to isolate sprinkler and deluge valves actuating on the Turbine Building Mezzanine beginning with the North isolation valves.

Time to don turnout gear: 3:22

Time to travel to North isolation valves: 0:37

Time to close North isolation valves: 1min. for each valve*

Time to travel to South isolation valves: 1:25

Time to close South isolation valves: 1 min. for each valve*

2. You are dispatched to isolate the Turbine Oil Reservoir Deluge System and Hydrogen Seal system sprinklers

Time to travel to Turbine Oil Reservoir Deluge isolation valve: 0:53

Time to close Turbine Oil Reservoir Deluge isolation valve: 0:30*

Time to travel to Hydrogen Seal system sprinklers isolation valve: 1:30**

Time to close Hydrogen Seal system sprinklers isolation valves: 0:30*

You are dispatched to route water through Door 3 to the Screenhouse tunnel. Given there is approximately 18" of water on the floor, describe the report you would make to the control room prior to taking this action.

"I'm standing in 18" of water and opening Door 3 to D/G B Room would jeopardize Bus 6. Are you sure you want me to do this?"

*Times are estimated based on valve construction. Valves are cycled as part of surveillance procedure.

**Operator initially went to Turbine Oil Storage Room Deluge valve. When given cue that water was still spraying at the H2 seal oil unit, he then proceeded to the correct isolation valve. Time recorded reflects total travel time, first to incorrect isolation, then to the correct isolation valve.

NOTES:
Operator stated he could recall from memory all pertinent valve locations due to performing N-FP-08CLA on a routine basis.

Equipment taken was a lantern and flashlight to aid in visibility.

Transit was not done in turnout gear for safety reasons.

Operator stated communications would have been PCS phones. Two-way radios were also available.

Operator also stated one of his priorities would be to access the Screenhouse and attempt to isolate Fire Protection.

Operator was successful in the use of the Fire Area Strategies Book to locate sprinkler isolation valves.

ATTACHMENT D – TIME LINE OF SIGNIFICANT ACTIONS

Simulator Run for Past Flooding conducted 9/29/05

Time	Elapsed Time (Min.)	Action
1854	-1	Initial plant conditions: Plant at 100% power with no equipment OOS
1855	0	Feedwater Break occurs
1855:23		• Reactor trip occurs • Operator start performing immediate action of E-0, "Reactor Trip or Safety Injection"
1855:49		Operator immediate actions complete
1856:09	1	Control Room Supervisor (CRS) request the Shift Manager (SM) to review Emergency Plan Implementing Procedures (EPIP) for emergency classification
1856:35		Using Emergency Procedures (IPEOP), Operators complete step 1 of E-0
1856:55		• Operators complete Step 2 of E-0 • Equipment Operator (EO) and Auxiliary Operator (AO) requested to investigate fire alarms
1857	2	SM directs the stopping of Feedwater and Condensate Pumps NAO's report steam in Turbine Building; not safe to enter
1858	3	• Feedwater and Condensate Pumps stopped with 26% level in Hotwell • SM held crew brief
1859	4	• SM states with the steam and humidity reported that a fire is not present and directs EO to trip fire pumps • Operators start Step 4 of E-0
1900:38	5	Step 4 of E-0 complete without Safety Injection (SI) required. Red Paths checked – No Red Path Operators transition to ES-0.1, "Reactor Trip Response"
1901:45	6	Plant Announcement made for the Reactor Trip
1901:47		AO provides report and SM assumes a large Feedwater break
1902:25	7	Stopped Heater Drain Pumps
1902:51		Operators entered ES-0.1
1903	8	Operators complete step 2.a of ES-0.1
1904	9	SM directs the splitting of the crew. Reactor Operator (RO) and CRS directed to deal with the reactor trip/plant. SM and Balance of Plant (BOP) would deal with the fire problems
1906	11	Contacted Security to try to gain access to Screenhouse via surface entry
1907	12	Bus 1 and 2 lockout.
1908	13	Operators complete step 4 of ES-0.1
1910	15	Battery alarms activate for Battery B
1913	18	Operators complete Step 7 of ES-0.1

1914	19	Operator identify battery charger problem
1915	20	SM has made the decision to declare an Unusual Event and requested Notifier
1918	23	AO and EO dispatched to close fire sprinkler isolations beginning with North Isolation valves
1921	26	Operators are in step 12 of ES-0.1 and are checking for stable plant conditions
1922	27	First sprinkler isolation valve reported closed
1923	28	Operators take actions to stabilize plant conditions per ES-0.1, step 12
1926	31	All sprinkler isolations on Turbine Building Mezzanine are closed.
1928	33	Bus 61/62 are lost. Reactor Operator suggests initiating SI to stop Fire Pumps. Shift Manager states isolation in progress and SI is not required.
1929	34	Operator enter A-ELV-40, " 480V AC Supply Distribution System Abnormal"
1933	38	Turbine-driven AFW pump restarted and Motor-driven AFW Pumps stopped
1936	41	Started action to place Main Turbine in normal shutdown condition
1937	42	Shift Manager directed EO NOT to enter Bus 51/52 room due to possible flood propagation into room
1938	43	EO/AO report Turbine Oil Deluge valve and H2 Seal Oil Unit sprinklers isolated.
1939	44	SM held a crew brief
1940	45	BOP requested to have EO investigate Battery problems
1941	46	Operators enter A-EDC-38, "Abnormal DC Supply and Distribution System"
1942	47	EO directed to investigate the battery problems and status of inverters
1943	48	BOP reports lowering battery voltage
1944	49	EO reports all inverters aligned to "Alternate Source" and Battery Chargers do not have AC voltage
1945	50	CRS request SM to ask the electricians to investigate the battery problems.
1947	52	Operators start walking down all annunciators for missed annunciators. NAO reports water is getting past Door 163 and entering Bus 51/52 area.
1949	54	Crew is led by the shift manager in a discussion of what they can do

		for the conditions and recovery actions.
1951	56	Crew decides to attempt to drain water away from Bus 51/52 via Diesel Generator B (using 6 inch curb to channel water) to Screenhouse. The EO was directed to enter via South Cardox Room door then into DG B Room. The EO was to prop open the Door to Screenhouse then open the door to Cardox Room and finally the door to Bus 51/52.
1956	61	Bus 51/52 Lockout
1958	63	Freeze Simulator; Key parameters: RCS Press. = 2241, S/G Press = 849, Pzr Level = 21%, Th = 551, Tc=529

Appendix D

Accident Sequence Analysis

Accident Sequence Analysis

Owner's Acceptance: THOMAS G HOOK (Signature) THOMAS G HOOK (Print Name)

10-30-05 (Date)

Kewaunee Power Station

Accident Sequence Analysis for Turbine Building Floods

Effective Date: October 2005

Prepared By: Russell Sharpe — Date 10/28/05

Reviewed By: D. Jones — Date 10/29/05

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INTERNAL FLOODING – Accident Sequence Analysis for Turbine Building Floods

1.0 PURPOSE

The purpose of the internal flooding accident sequence analysis is to define, analyze, and document the potential flooding scenario results at Kewaunee Power Station (KPS) for initiating events caused by breaks of non-safety-related piping in the Turbine Building before February 2005. That is, the analysis considers the plant prior to installation of the flood mitigation modifications installed in and around safeguards alley. Flooding events caused by earthquakes are considered separately.

The following information is identified, correlated, and developed as part of this analysis:

- Initiating events for breaks caused by failures of non-safety-related piping in the Turbine Building
- Equipment susceptible to flood damage for each initiating event
- Propagation pathways for each initiating event
- Accident progression and sequence timing

2.0 MODEL DEVELOPMENT

Internal flooding analysis encompasses the effects from the accumulation of fluids arising from the rupture, cracking or incorrect operation of components within the station. In practice, major internal floods have occurred in nuclear power plants, for example, from the rupture of pipes, valves and expansion joints as well as from operator errors during plant maintenance activities. Potential internal flood sources from non-safety-related piping located in the Turbine Building are considered in this analysis. Flooding events caused by safety-related piping or piping located outside of the Turbine Building are outside the scope of this analysis.

The steps for conducting the internal flooding accident sequence analysis are described in the following section.

2.1 Steps for Turbine Building Internal Flooding Accident Sequence Analysis

The analysis of the Turbine Building internal flooding accident sequences consists of the following steps:

1. Review information collected from the internal flooding walkdown, including flood areas, possible flood sources, critical flood heights for equipment modeled in the PRA, drainage capacities and paths, flood detection instrumentation, interconnecting areas, and potential barriers (curbs, dikes, doors, etc.)

2. Collect other necessary information, including the floor area of the flood areas, and identification of which system trains have piping in each flood area.

3. Determine the potential damage scenarios presented in each flood area (e.g., submergence, humidity or temperature, flood egress or ingress, etc.).

4. Identify any areas that may be easily screened from further analysis.

5. Determine the potential flood scenarios for each flood area, including damage within the area, flood egress from the area, damage to connecting areas and associated flood heights, detection of the flood, potential means of isolation, and potential for unisolated floods to fill multiple flood areas.

6. Identify the initiating event that could occur due to the flood (e.g., manual trip, loss of a service water train, loss of main feedwater, etc.) and associated equipment damage, and the corresponding accident sequence progression.

7. Calculate the timing associated with flood detection and isolation, based on break flow rate, location of detection instrumentation and PRA equipment, floor area of the associated areas, flood level alarm depths, and equipment critical flood heights.

The results from each of these steps are presented in Section 5.0 of this appendix.

Following development of the flood scenarios and corresponding accident progression, the event trees and system fault trees are then developed and quantified in order to evaluate the effects of Turbine Building flooding events in each flood area in terms of the resulting accident sequence frequencies. The new models and resultant quantification are documented in a separate report.

2.2 Turbine Building Internal Flooding Major Assumptions

The key assumptions that were made during the internal flooding accident sequence analysis are discussed in Section 5 for each of the specific flooding scenarios. In addition, the following general assumptions apply:

1. Analysis of equipment in the Auxiliary Building, with the exception of Bus 1 and Bus 2, was not performed as part of this study.

2. While some of the supporting documentation for this flooding analysis states that no safety related equipment is damaged by flooding events, this flooding analysis makes no such assumption. Much of the equipment analyzed in this flooding study is safety related and is modeled as failed due to a flooding event.

3. Analyses [CALC03] show that the bottom row of circuit breakers on buses 51, 52, 61, and 62 will fail open when level on them reaches 2.75 inches. For all accident scenarios, it is assumed that these loads will be lost. The most important PRA equipment that is powered by these breakers includes Fire Pump A (Breaker 15106), both Motor Driven AFW Pump auxiliary lube oil pumps (Breakers 15206 and 16206), both Safety Related Battery Chargers (Breakers 15206 and 16206), Battery Room Exhaust Fan A (Breaker 15206), and Battery Room Exhaust Fan B (16206). These analyses also show that other loads on the buses are not impacted until level reaches a much higher flood level.

4. With the exception of the circuit breakers on the bottom row of buses 51, 52, 61, and 62, flood-induced failure of a bus or MCC is assumed to fail all associated circuit breakers at the same time. No distinction is made between the failure of a circuit breaker within a bus and failure of the bus itself. Therefore, explicit consideration of circuit breakers, other than the bottom row on buses 51, 52, 61, and 62, is not needed.

5. The critical flood heights (CFH) for the PRA equipment were obtained from outside analysis [CALC03]. The CFH is the water depth at which a piece of equipment will become disabled due to submergence. The following flood heights were obtained from outside analysis:

Component	Critical Flood Height (inches)
4 kVAC Bus 5	4
4 kVAC Bus 6	4
480 VAC Bus 51	11
480 VAC Bus 52	11
480 VAC Bus 61	11
480 VAC Bus 62	11
Turbine Driven AFW Pump (Fail to Start)	9
Turbine Driven AFW Pump (Fail to Run)	18
Motor Driven AFW Pump A	9

Component	Critical Flood Height (inches)
(Fail to Start)	
Motor Driven AFW Pump A (Fail to Run)	13
Motor Driven AFW Pump B (Fail to Start)	9
Motor Driven AFW Pump B (Fail to Start)	13

6. No credit is taken for the 6-inch curb that used to protect DG 1B and 4 kVAC Bus 6. This is a conservatism in the analysis since the curb would afford the operator more time to isolate the break before enough water is deposited in the Turbine Building to make the failure of the 4 kVAC Bus 6 inevitable. A longer isolation time would in turn result in a lower human error probability (HEP) for that isolation event. A lower HEP could then result in a lower core damage frequency.

7. It is assumed that the flood-induced loss of Reserve Auxiliary Transformer (RAT) Auxiliaries powered from 480 VAC MCC-42A will not cause a failure of the RAT during the postulated flooding events. The RAT Auxiliaries provide oil circulation and fans for transformer cooling. These auxiliaries are powered from MCC-42A, which is located in the southeast corner area of the Turbine Building Basement. MCC-42A and MCC-42G share a common breaker on 480V Bus 42. MCC-42G is located on the west side of Turbine Mezzanine between the Feedwater heaters.

   The loss of the RAT auxiliaries reduces the RAT capacity from 40 MVA to 24 MVA. The stopping of the Main Feedwater (5000 hp) or Reactor Coolant (6000 hp) Pumps would reduce the load with in this limit. The flooding event will cause a loss of Main Feedwater Pumps early in the event thus reducing load on the RAT to less than 24 MVA. In general, as the flood causes breakers to trip the load on the RAT is reduced. See Attachment 4 for a detailed explanation.

8. It is assumed that the postulated flooding events will not cause a lockout of the RAT. In the event that power was lost to MCC 42A as a result of a Turbine Building flooding event, the only impact on the Reserve Auxiliary Transformer would be the loss of its associated cooling fans. This is shown on drawing XK-108-8 [DWG01]. The loss of the supplemental cooling fans does not cause a transformer lockout. A loss of the fans only reduces the rated output of the transformer.

There is a contact off of a lockout auxiliary relay that is used in the fan control circuit. However, this only results in the tripping of the fans in the event of a transformer lockout. It will not cause a transformer lockout

9. It is assumed that sufficient fuel oil is normally present in the fuel oil storage tanks to support 24 hours of operation of the Technical Support Center (TSC) diesel generator. See Attachment 6 for a detailed explanation.

10. It is assumed that the pressurizer heaters are not required during accident mitigation. During a natural circulation cooldown, two procedures can be used. The first procedure, ES-0.2 - Natural Circulation Cooldown [PROC01], is used assuming pressure control is available. Pressure control would be available via the Pressurizer Heaters since Pressurizer Spray requires forced circulation (Reactor Coolant Pumps) to work. The second procedure, ES-0.3 - Natural Circulation Cooldown with Steam Void in Vessel [PROC02], is used if pressure control has been lost. Steam voids in the Reactor Vessel head form when Pressurizer pressure control is lost, which would include the loss of Pressurizer Heaters. Both of these procedures are in accordance with the WOG emergency operating procedure guidelines.

11. It is assumed that it is possible to manually operate the steam generator PORV without electric power or compressed air. See Attachment 5 for a detailed explanation.

12. No fire protection water, service water, circulating water, condensate, or feedwater piping is located in the vicinity of Buses 3 and 4. Therefore, failure of the buses from these sources is not credible, except in that case of a high-energy line break (HELB) as discussed in the following assumption.

13. For feedwater and steam line breaks, Buses 3 and 4 are assumed to be unavailable to supply loads credited in accident mitigation. Following a steam line or feedwater line break, the steam atmosphere expected in the Turbine Building in conjunction with the spray flow from the actuated fire protection system is expected to render these buses unreliable. See Attachment 3 for a detailed explanation.

14. Loss of offsite power from the RAT is considered to have a negligible contribution to overall risk and is not considered in the accident sequence analysis.

15. If flow from a break is not stopped before water level in the Turbine Building reaches 18-inches, then core damage is assumed. At a level of 18-inches in the Turbine Building, water level in the safeguards alley will eventually fail all equipment located there along with both electrical safety trains.

16. The use of AFW crossover valves to control S/G level and the potential of grounds would have little impact on battery availability. See Attachment 1 for a detailed explanation.

3.0 UNIT DIFFERENCES

Kewaunee Power Station is a single unit site so there are no unit differences.

4.0 RISK MONITOR CONSIDERATIONS

The risk monitor used at KPS is the Safety Monitor. Changes to the Safety Monitor model are outside the scope of this analysis.

5.0 ACCIDENT SEQUENCE ANALYSIS

The first step in the internal flooding PRA accident sequence analysis is to correlate and summarize pertinent information from other documents. Accident-specific progression is then developed.

5.1 Analysis of KPS Internal Flood Areas

Figure 5-1 presents the layout of the Turbine Building basement and Safeguards Alley including flood area designations. Table 5-1 consolidates and summarizes the pertinent information from the Flood Area Definitions (Appendix B), and other sources, in order to determine the possible internal flooding scenarios at KPS. Table 5-1 presents the following information:

- The Flood Area identifier for each area.
- The possible sources of flooding present in the flood area (obtained from KPS Internal Flooding Screening Assessment [NB01]), and the type of hazard each source presents. Hazards include submergence (su), temperature (temp), and humidity (hu). In addition, the table also indicates whether the source contains only a limited volume of fluid.
- The equipment contained in the flood area that is modeled in the internal events PRA.
- The potential damage scenario(s) for the flood area. Potential scenarios include whether the equipment contained in the area may be damaged due to submergence or spray.
- The flood detection method that exists for the flood scenario. Most flood areas do not contain detection instrumentation within the area; instead flood detection instrumentation is typically contained within the lower areas in a building to which the other areas are designed to drain.

- The propagation paths for fluid egress from the flood area. Egress paths may include propagation due to open communication via unsealed penetrations (pen), open stairwells, open doorways, open access ways (i.e., no wall separating flood areas), drains, gaps under closed doors, etc. or via hazard barriers that fail due to sufficient accumulation of water.

- The connecting flood area, building, or plant area to which a flood may propagate.

- Whether equipment may be damaged in the connecting area due to flood ingress. If the connecting area does not contain PRA equipment, or the drainage capacity exceeds the flood ingress rate, no damage will occur. Similarly, if the flood source is of limited volume (i.e., all sources except Circulating Water (CW), Service Water (SW) and Fire Protection Water (Fire) are finite sources, although some are of sufficient volume to propagate, such as lines connecting to the CST and RWST, or may cause damage due to splashing) limited damage is expected due to propagation. For connecting areas where PRA equipment damage may occur due to flood ingress, the user is directed to the table entry for that area to determine the equipment that may be damaged.

Table 5-1
Summary of KPS Flood Areas

Area	Sources	PRA Equipment	Damage Scenario	Drainage Paths	Drainage Capacity (gpm)	Flood Detection	Propagation Paths	Connecting Area	Equipment Damage
TU-22-1	Fire SW CW FW Main Stm (su)	Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pmp 1A Plt Equip Wtr Pmp 1B MCC-32D MCC-42B MCC-42D AOV PW-52	Submergence Spray	Drains to Turb Bldg sump	200	Sump High-High-High Level Alarm	Door 4 Door 6 Door 401 Drains Drains	TU-95B-1 TU-95B-1 TU-94 TU-95B-1 TU-94	Yes Yes Yes Yes Yes
TU-90	SW Fire (su)	4 kVAC Bus 5 MCC 52A EDG 1A MOV SW-10A	Submergence	Drains to Turb Bldg sump	150	None present.	Door 136 Door 2	TU-95A SC-70A	Yes N/A
TU-92	SW Fire (su)	4 kVAC Bus 6 MCC 62A EDG 1B MOV SW-4B	Submergence	Drains to Turb Bldg Sump	150	None present.	Door 3 Door 1	TU-94 SC-70A	Yes N/A

Table 5-1
Summary of KPS Flood Areas

Area	Sources	PRA Equipment	Damage Scenario	Drainage Paths	Drainage Capacity (gpm)	Flood Detection	Propagation Paths	Connecting Area	Equipment Damage
TU-94	SW Fire (su)	Air Compressor 1A AOV SW-4A	Submergence	Drain to Turb Bldg sump	150	None present.	Door 401 Door 5 Door 3 Drains	TU-22-1 TU-95A TU-92 TU-22-1	Yes Yes Yes Yes
TU-95A	SW Fire (su)	480 VAC Swgr Bus 51 480 VAC Swgr Bus 52 AOV SA-200 Air Compressor 1C	Submergence	Drain to Turb Bldg sump	150	None present.	Door 263 Door 5 Door 136 Door 268	TU-95B-1 TU-94 TU-90 TU-95B-1	Yes Yes Yes Yes
TU-95B-1	SW Fire CST (limited) Steam (limited) (su, hu)	480 VAC Swgr Bus 61 480 VAC Swgr Bus 62 AOV SA-400 Air Compressor 1B AOV SA-60 AOV SA-121 MDAFP 1B (run) MDAFP 1B (start) MOV AFW-10B TB Bsmt Fan Coil 1B	Submergence	Drain to Turb Bldg sump	150	None present.	Door 4 Door 6 Door 8 Door 263 Door 243 Door 244 Door 261 Door 262 Door 268 Drains	TU-22-1 TU-22-1 Aux Bldg TU-95A TU-95B-2 TU-95B-2 TU-95C TU-95C TU-95A TU-22-1	Yes Yes N/A Yes Yes Yes Yes Yes Yes Yes
TU-95B-2	SW CST (limited) Steam (limited) (su, hu)	TDAFP (run) TDAFP (start) MCC 5262	Submergence	Drain to Turb Bldg sump	150	None present.	Door 243 Door 244	TU-95B-1 TU-95B-1	Yes Yes

Table 5-1
Summary of KPS Flood Areas

Area	Sources	PRA Equipment	Damage Scenario	Drainage Paths	Drainage Capacity (gpm)	Flood Detection	Propagation Paths	Connecting Area	Equipment Damage
TU-95C	SW CST (limited) (su)	MDAFP 1A (run) MDAFP 1A (start) MOV AFW-10A TB Bsmt Fan Coil 1A	Submergence	Drain to Turb Bldg sump	150	None present.	Door 261 Door 262	TU-95B-1	Yes

5.2 Description of KPS Turbine Building Internal Flooding Scenarios

Based on the information in Table 5-1, the following internal flooding scenarios have been identified for pipe breaks in the Turbine Building (TU-22-1Table 5-2 lists all these scenarios as well as the equipment (and associated basic event identifier) in the Turbine Building that is immediately disabled by the pipe break (and/or sprinkler discharge), the flood areas to which the spilled water will first propagate, and any means of detection and isolation of the break.

A pipe break inside the Turbine Building is expected to cause failure of the condensate pumps and feedwater pumps, resulting in a Loss of Main Feedwater event as analyzed in the Internal Events PRA [NB02]. The accident response for such a flooding event is identical to that of a Loss of Main Feedwater given that the flood-induced failures are primarily limited to the area of the Turbine Building containing the feedwater and condensate equipment. The event trees developed for this internal flooding analysis include only those sequences that involve flood-induced failures in Safeguards Alley. The logic associated with a Loss of Feedwater without flood-induced failure of equipment in Safeguards Alley is not repeated in the event trees developed here.

Buses 1 and 2 power only the reactor coolant pumps and the main feedwater pumps. All flooding events in the Turbine Building are assumed to cause a non-recoverable loss of main feedwater. While forced circulation with the reactor coolant pumps is desired, use of the pumps is not required and is not credited in the PRA models. Therefore, loss of power from Buses 1 and 2 has no impact on the Turbine Building flooding PRA results and is not considered further in this analysis since the reactor coolant pumps and main feedwater pumps are never credited.

Pipe breaks in the Turbine Building are of concern because of the threat of propagation of water into Safeguards Alley where the Safeguards AC Power buses and the Auxiliary Feedwater System equipment is housed. Flood area TU-95A houses 480 VAC Buses 51/52 that provide power to the Chemical and Volume Control System (Normal Charging) and the Component Cooling Water System as well as one Fire Pump. Flood area TU-95B-1 houses Motor Driven AFW Pump B and 480 VAC Buses 61/62. Buses 61/62 also provide power to the Chemical and Volume Control System (Normal Charging) and the Component Cooling Water System as well as one Fire Pump. Flood area TU-95B-2 houses the Turbine Driven AFW Pump. Flood area TU-95C houses Motor Driven AFW Pump A. Flood area TU-90 houses Emergency Diesel Generator A and 4 kVAC Bus 5 which provides power to 480 VAC Buses 51/52, Motor Driven AFW Pump A, and Safety Injection Pump A. Flood area TU-92 houses Emergency Diesel Generator B and 4 kVAC Bus 6 which provides power to 480 VAC Buses 61/62, Motor Driven AFW Pump B, and Safety Injection Pump B.

This analysis includes discussion of the time to isolate breaks to prevent eventual failure of components and discussion of time to actually fail components. Because of the dynamic nature of the flow of water from the Turbine Building to Safeguards Alley, these two times can differ significantly. A pipe break might deposit several inches of water into the Turbine Building before

the break is isolated, however that same water level might never be realized in one of the other flood areas due to the flow of water out of that area via a door gap. At the instant in time that the break is isolated, there might be several inches of water in the Turbine Building and no water in the flood area of interest. However, due to the flow of water from the Turbine Building to that flood area, the water level might eventually reach a critical flood height in that area. Thus, timely isolation can prevent eventual failure of equipment.

Additionally, this analysis investigates the amount of time between the pipe break and the actual (not the eventual) failure of a component. This failure time typically is independent of the isolation of the pipe break.

5.2.1 Circulating Water Pipe Break (Condenser Inlet Expansion Joint Rupture – 58,000 gpm)

5.2.1.1 Introduction

The event tree for a Large Circulating Water Break (Figure 5-2) models the behavior of Kewaunee Power Station following a postulated 58,000-gpm condenser inlet expansion joint rupture. Normal mitigation of this event requires isolation of the break by tripping both Circulating Water pumps followed by auxiliary feedwater to remove core decay heat. However, the flow rate of this postulated break is so great that the operator is not expected to be able to isolate the rupture to avoid eventual failure of the auxiliary feedwater system. Therefore, this initiator is expected to result in core damage.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

CI06B - Large Circulating Water Pipe Break

I5 - Isolation of Break in Time to Prevent Failure of Mitigating Equipment

5.2.1.2 Accident Progression

After a successful reactor trip, decay heat must be removed. For decay heat removal to be successful, flow from the circulating water system to the Turbine Building must be terminated before flood-induced failure of required equipment occurs.

GOTHIC analysis indicates that the operator would have approximately 3 minutes to isolate such a rupture (by tripping the Circulating Water pumps) to prevent eventual damage to 4 kVAC Bus 5 and 4 kVAC Bus 6 and approximately 5 minutes to isolate the rupture to prevent eventual

damage to the 480 VAC buses in Safeguards Alley [CALC01]. Since it is expected that the operators will require more than 3 minutes to diagnose the flooding event and trip the Circulating Water pumps, the human error probability will be nearly 1.0. Further, the time available to isolate the rupture before eventual failure of the Turbine Driven AFW pump is not sufficient to support successful operator actions. Therefore, a rupture of a condenser inlet expansion joint is assumed to result in core damage.

The initiating event due to a large break in the Circulating Water System is named IE-CI06B.

5.2.2 Circulating Water Pipe Break (Condenser Outlet Expansion Joint Rupture – 14,000 gpm)

5.2.2.1 Introduction

The event tree for a Moderate Circulating Water Break (Figure 5-3) models the behavior of Kewaunee Power Station following a postulated 14,000-gpm condenser outlet expansion joint rupture. Normal mitigation of this event requires isolation of the break by tripping both Circulating Water pumps. After termination of break flow, decay heat removal and maintenance of reactor coolant pump (RXCP) seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

CX06B - Moderate Circulating Water Pipe Break

I5 - Isolation of Break in Time to Prevent Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61/62 Due to Excessive Water Level in Safeguards Alley

I18 - Isolation of Break in Time to Prevent 18 Inches of Water in the Turbine Building

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RXCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.2.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

The Circulating Water system is designed to move over 400,000 gpm of water to the condenser water boxes and has the capability of placing extremely large amounts of water into the Turbine Building in a short amount of time. The probability of a random break in the circulating water piping is very small when compared to the probability of an expansion joint rupture. Therefore, a 14,000-gpm break is analyzed due to its higher likelihood. This flow rate represents a complete rupture of a condenser outlet expansion joint.

GOTHIC analysis indicates that the operator would have approximately 13 minutes to isolate such a rupture (by tripping the Circulating Water pumps) to prevent eventual damage to 4 kVAC Bus 5 in Safeguards Alley which provides power to 480 VAC Bus 51/52. Further, the operator would have approximately 19 minutes to isolate the rupture to prevent eventual failure of the Turbine Driven AFW pump's ability to start due to submergence of the associated auxiliary lube oil pump (at 9 inches). Also, the operator would have approximately 22 minutes to isolate the rupture to prevent eventual failure of 4 kVAC Bus 6 and failure of 480 VAC Bus 61/62 (this isolation will also prevent submergence failure of the MDAFPs at 13 inches). The operator would have approximately 25 minutes to prevent the water level in the Turbine building from reaching 18 inches. [CALC01]

A Circulating Water pipe break would first be indicated by a Turbine Building sump high-high-high level alarm in the control room from level switch LA-16666 [REPORT02]. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. Another indication would be low condenser vacuum, which likely would result in a reactor trip.

In this scenario, the expansion joint rupture will be isolated by the manually tripping the Circulating Water pumps. If this trip fails, water will continue to flow into Safeguards Alley via leakage under the doors and flow through the drain lines, causing failure of the electrical equipment housed there.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will

flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around 4 kVAC Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90 [CALC04].
Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

The initiating event due to a moderate break in the Circulating Water System is named IE-CX06B.

5.2.2.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

<u>Moderate Circulating Water Pipe Break (CX06B)</u>

This top event represents the initiator, a rupture of the condenser outlet expansion joint resulting in lake water being spilled into the Turbine Building Basement at a rate of 14,000 gpm.

<u>Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)</u>

The operator must isolate the expansion joint rupture by tripping both Circulating Water pumps from the control room within approximately 13 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While

the water level near the bus might be negligible 13 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will eventually result in a peak water level (several minutes later) that is sufficiently high to cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump and Prevent Failure of 480 VAC Bus 61/62 (ITD)

The operator must isolate the expansion joint rupture by tripping both Circulating Water pumps from the control room within approximately 19 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 19 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the expansion joint rupture by tripping both Circulating Water pumps from the control room within approximately 22 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 22 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that tripping the Circulating Water pumps within approximately 22 minutes also will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Isolation of Break in Time to Prevent 18 Inches of Water in the Turbine Building (I18)

The operator must isolate the expansion joint rupture by tripping both Circulating Water pumps from the control room within approximately 25 minutes of the rupture to prevent the water level in the Turbine Building from reaching 18 inches. If water level reaches this height, core damage is assumed since the electrical connections of the reserve auxiliary transformer (RAT) to Buses 1 and 2 will be submerged leading to a loss of offsite power and the eventual failure of all safety-related buses. Additionally, this water level in the Turbine Building will result in the failure of the diesel generators since the supply fans are powered from 480 VAC Buses 51/52 and 61/62.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 36 minutes of the initial break [CALC01]. Finally, if the turbine-driven pump is not restarted before 36 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition for the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal

LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal

LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least one half hour before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 6 hours [CALC01. The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.3 Service Water Pipe Break

5.2.3.1 Introduction

The event tree for a Service Water Break (Figure 5-4) models the behavior of Kewaunee Power Station following a postulated 6000-gpm break in the Service Water Turbine Building header. (A 6000-gpm break was deemed to be most representative of a Service Water pipe break because a 12,800-gpm break (a guillotine pipe break) is considered too improbable and a 1000-gpm break is considered too inconsequential.) Normal mitigation of this event requires isolation of both SW-4A and -4B. After termination of break flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the

event tree structure as top events:

SI06B - Service Water Pipe Break

I5 - Isolation of Break in Time to Prevent Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61/62 Due to Excessive Water Level in Safeguards Alley

I18 - Isolation of Break in Time to Prevent 18 Inches of Water in the Turbine Building

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.3.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is

preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

The Service Water system is designed to supply approximately 12,800 gpm of water to the various plant loads. Piping associated with the Service Water Turbine Building header constitutes the vast majority of Service Water piping that resides in the Turbine Building, therefore the piping associated with the Turbine Building header is the only Service Water piping considered. (Service Water piping not associated with the Turbine Building header is either very small or normally isolated.)

GOTHIC analysis indicates that the operator would have approximately 29 minutes to isolate a 6000-gpm Service Water pipe break (by isolating the Turbine Building header) to prevent eventual damage to 4 kVAC Bus 5. [CALC01]. Isolating the break within approximately 45 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room. Also, isolating the break within approximately 51 minutes will prevent the water from ultimately reaching the 4-inch level in the vicinity of 4 kVAC Bus 6 (this isolation will also prevent submergence failure of the MDAFPs at 13 inches). The operator would have

approximately 66 minutes to prevent the water level in the Turbine Building from reaching 18 inches. [CALC01]

A Service Water pipe break would first be indicated by a Turbine Building sump high-high-high level alarm in the control room from level switch LA-16666 [REPORT02]. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. Another indication would be Service Water low discharge pressure (if the pipe break is sufficiently large). The Abnormal Service Water System Operation procedure (A-SW-02) instructs the operator to isolate the Turbine Building header by closing both SW-4A and -4B. If this isolation fails, water will flow into Safeguards Alley via leakage under the doors and flow through the drain lines, causing failure of the electrical equipment housed there.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 4 kVAC 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90 [CALC04].
Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

For small SW pipe breaks (<2 inches), the operator would have approximately 2 hours to isolate the break before failure of the 4 kVAC buses in Safeguards Alley occurs. Since it is unreasonable to expect the operators to fail to isolate such a break in a two-hour period, small Service Water breaks are not analyzed any further.

The initiating event due to a large break in the Service Water System is named IE-SI06B.

5.2.3.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

Service Water Pipe Break (SI06B)

This top event represents the initiator, a break in the Service Water Turbine Building header resulting in lake water being spilled into the Turbine Building Basement at a rate of 6000 gpm.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the Service Water pipe break by closing valves SW-4A and SW-4B from the control room within approximately 29 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 29 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump and Prevent Failure of 480 VAC Bus 61/62 (ITD)

The operator must isolate the Service Water pipe break by closing valves SW-4A and SW-4B from the control room within approximately 45 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 45 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the Service Water pipe break by closing valves SW-4A and SW-4B from the control room within approximately 51 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 51 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that closing SW-4A and -4B within approximately 52 minutes also will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Isolation of Break in Time to Prevent 18 Inches of Water in the Turbine Building (I18)

The operator must isolate the Service Water pipe break by closing valves SW-4A and SW-4B from the control room within approximately 66 minutes of the rupture to prevent the water level in the Turbine Building from reaching 18 inches. If water level reaches this height, core damage is assumed since the electrical connections of the reserve auxiliary transformer (RAT) to Buses 1 and 2 will be submerged leading to a loss of offsite power and the eventual failure of all safety-related buses. Additionally, this water level in the Turbine Building will result in the failure of the diesel generators since the supply fans are powered from 480 VAC Buses 51/52 and 61/62.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 61 minutes of the initial break [CALC01]. Finally, if the turbine-driven pump is not restarted before 61 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the

ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW 2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCAs based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least one hour [CALC01] before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, bus 6 would be available to support safety injection pump operation for approximately 7 hours [CALC01]. The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.4 Fire Protection Water Pipe Break

5.2.4.1 Introduction

The event tree for a Fire Protection Water Break (Figure 5-5) models the behavior of Kewaunee Power Station following a postulated 6000-gpm break in the Fire Protection Water header. Normal mitigation of this event requires isolation of flow from both fire pumps. After termination of break flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

FI06B - Fire Protection Water Pipe Break

I5 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61 Due to Excessive Water Level in Safeguards Alley

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.4.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

The Fire Protection system is designed to supply approximately 4000 gpm of water to the various sprinklers and deluge systems throughout the plant. However, since the maximum system flow at pump runout is 6000 gpm, a 6000-gpm pipe break is analyzed. A break in the piping would cause a decrease in system pressure and automatically initiate one or both of the fire pumps. A Fire Protection pipe break would first be indicated by a FIRE PUMP RUNNING activation in the control room. Such a large pipe break will also result in a FIRE PROTECTION HDR PRESSURE LOW annunciator in the control room. If the pipe break is greater than 200 gpm (the capacity of the Turbine Building sump pumps), then a Turbine Building sump high-level alarm in the control room from level switch LA-16666 will sound in the control room. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room.

GOTHIC analysis shows this event to be self-limiting due to the isolation of the fire pumps when water level reaches the failure height(s) of the associated 480 VAC buses. Fire Pump A is fed from breaker 15106 on 480 VAC Bus 51. The static trip unit associated with this breaker is 2.75 inches above the ground [CALC03]. Since the feed breaker for Fire Pump B is on the top row of 480 Bus 62, Fire Pump B will fail when Bus 62 fails at the 11-inch level [CALC03].

GOTHIC analysis [CALC01] indicates that the operator would have approximately 29 minutes to isolate a 6000-gpm Fire Protection pipe break (by isolating flow from the Fire Protection pumps) to prevent eventual failure of 4 kVAC Bus 5. Isolating the break within approximately 45 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room. Also, isolating the break within approximately 62 minutes will prevent the water from ultimately reaching the 4-inch level in the vicinity of 4 kVAC Bus 6 and the 11-inch level near 480 VAC Bus 61/62. The self-limiting nature of the event prevents the water level from exceeding 18 inches in the TDAFP area; therefore the TDAFP is not subject to submergence failure. The water level will reach 4 inches in the vicinity of the 4 kVAC Bus 6 in approximately 8.5 hours after the initial pipe break [CALC01]

Upon discovery of the pipe break location, the operator would attempt to isolate the break by closing a valve. However, most of the valves in the Fire Protection System simply isolate a branch off the main header (such as a deluge valve or a hose station) and do not isolate the header itself. Therefore the operator must trip the fire pumps or close the manual pump discharge valves (located in the Screenhouse) to stop flow. The fire pumps, however, will continue to initiate automatically on low header pressure regardless of how many times the pumps are stopped. The only way to definitively stop the pump discharge coincident with a fire protection pipe break is to isolate the power supplies to the pumps by tripping the appropriate breakers on bus 51 and 62 located in the Safeguards Alley or close the manual discharge isolation valves.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed

water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around 4 kVAC Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90 [CALC04].

Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

For small Fire Protection pipe breaks (<2 inches), the operator would have approximately 2 hours to isolate the break before failure of the 4 kVAC buses in Safeguards Alley occurs. Since it is unreasonable to expect the operators to fail to isolate such a break in a two-hour period, small Fire Protection breaks are not analyzed any further.

The initiating event due to a large break in the Fire Protection Water System is named IE-FI06B. The timeline for operator actions associated with this event is provided in Attachment 2. This timeline is supported by Attachments 2 and 3 of the Fault Tree Analysis (Appendix C).

5.2.4.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

<u>Fire Protection Water Pipe Break (FI06B)</u>

INTERNAL FLOODING – **Accident Sequence Analysis for Turbine Building Floods**

This top event represents the initiator, a break in the Fire Protection Water header resulting in lake water being spilled into the Turbine Building Basement at a rate of 6000 gpm.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the Fire Protection Water pipe break by stopping flow from both Fire Pumps by either tripping the 480 VAC breaker associated with each pump or locally closing each Fire Pump's manual discharge valve within approximately 29 minutes of the pipe break to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 29 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump (ITD)

The operator must isolate the Fire Protection Water pipe break by stopping flow from both Fire Pumps by either tripping the 480 VAC breaker associated with each pump or locally closing each Fire Pump's manual discharge valve within approximately 45 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 45 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and 480 VAC Bus 61/62 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the Fire Protection Water pipe break by stopping flow from both Fire Pumps by either tripping the 480 VAC breaker associated with each pump or locally closing each Fire Pump's manual discharge valve within approximately 62 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 62 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that stopping flow from the Fire Pumps within approximately 56 minutes will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 61 minutes of the initial break [CALC01]. Finally, if the turbine-driven pump is not restarted before 61 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed

cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition for the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the

thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD)

then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least one hour [CALC01] before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 7 hours [CALC01]. The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.5 Feedwater Pipe Break (Large Fire Sprinkler Response)

5.2.5.1 Introduction

The event tree for a Feedwater Pipe Break resulting in a Large Fire Sprinkler Response (Figure 5-6) models the behavior of Kewaunee Power Station following a Feedwater pipe break that results in a fire sprinkler discharge of 6000 gpm. Normal mitigation of this event requires isolation of sprinkler flow. After termination of sprinkler flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the

event tree structure as top events:

WI06B - Feedwater Pipe Break (Large Fire Sprinkler Response)

I5 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61 Due to Excessive Water Level in Safeguards Alley

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.5.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

A pipe break in the Feedwater System will deposit approximately 80,000 gallons of water onto the Turbine Building floor and result in the room temperature increasing to the point that the fire protection sprinklers will discharge. This event will result in a rapid reactor trip due to steam generator low level.

Fire sprinkler actuation would cause a decrease in Fire Protection system pressure and automatically initiate one or both of the fire pumps. This would result in a FIRE PUMP RUNNING alarm in the control room. If the pipe break is of sufficient size and a large number of sprinklers actuate, the FIRE PROTECTION HDR PRESSURE LOW annunciator could sound in

the control room. If the pipe break is greater than 200 gpm (the capacity of the Turbine Building sump pumps), then a Turbine Building sump high-level alarm in the control room from level switch LA-16666 will sound in the control room. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. This investigation would be greatly hampered by the Turbine Building's steam environment and the hot water on the Turbine Building floor due to the Feedwater line break.

GOTHIC analysis shows this event to be self-limiting due to the isolation of the fire pumps when water level reaches the failure height(s) on the associated 480 VAC buses. Fire Pump A is fed from breaker 15106 on 480 VAC Bus 51. The static trip unit associated with this breaker will fail when the water level reaches 2.75 inches above the ground [CALC03]. Since the feed breaker for Fire Pump B is on the top row of 480 Bus 62, Fire Pump B will fail when water level reaches 11 inches and Bus 62 fails.

GOTHIC analysis [CALC01] indicates that the operator would have approximately 18 minutes to isolate a Feedwater pipe break with a 6000-gpm sprinkler discharge (by isolating flow from the Fire Protection pumps) to prevent eventual failure of 4 kVAC Bus 5 at 4 inches. Isolating the break within approximately 33 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room. The break must be isolated within approximately 40 minutes to prevent eventual failure of 4 kVAC Bus 6 at 4 inches. The self-limiting nature of the event prevents the water level from exceeding 13 inches in the MDAFP area and 18 inches in the TDAFP area, therefore the MDAFPs and the TDAFP are not subject to submergence failure. [CALC01]

Upon discovery of the sprinkler actuation location, the operator would attempt to isolate the sprinklers by closing a valve. However, most of the valves in the Fire Protection System simply isolate a branch off the main header (such as a deluge valve or a hose station) and do not isolate the header itself. Therefore the operator must trip the fire pumps to stop flow. The fire pumps, however, will continue to initiate automatically on low header pressure regardless of how many times the pumps are stopped. The only ways to definitively stop the sprinkler flow are to isolate the power supplies to the pumps by tripping the appropriate breakers on Buses 51 and 62 located in the Safeguards Alley, manually close the fire pump discharge valves in the Screenhouse, or manually isolate all the Turbine Building sprinklers by closing approximately 5 manual valves located on the mezzanine level of the Turbine Building.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the

Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 4 kVAC 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90 [CALC04].
Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

The initiating event for a Feedwater break leading to a 6000-gpm sprinkler discharge is named IE-WI06B. The timeline for operator actions associated with this event is provided in Attachment 2. This timeline is supported by Attachments 2 and 3 of the Fault Tree Analysis (Appendix C).

5.2.5.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

Feedwater Pipe Break (Large Fire Sprinkler Response) (WI06B)

This top event represents the initiator described as Feedwater Pipe Break that results in a fire sprinkler discharge of 6000 gpm into the Turbine Building.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the

basement of the Turbine Building within approximately 18 minutes of the pipe break to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 18 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump (ITD)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 33 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 33 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and 480 VAC Bus 61/62 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 40 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 40 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that stopping the sprinkler flow within approximately 40 minutes also will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 49 minutes of the initial break. Finally, if the turbine-driven pump is not restarted before 49 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition for the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal

LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal

LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least one hour [CALC01] before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 7 hours [CALC01]. The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.6 Feedwater Pipe Break (Moderate Fire Sprinkler Response)

5.2.6.1 Introduction

The event tree for a Feedwater Pipe Break resulting in a Moderate Fire Sprinkler Response (Figure 5-7) models the behavior of Kewaunee Power Station following a Feedwater pipe break that results in a fire sprinkler discharge of 2000 gpm. Normal mitigation of this event requires isolation of sprinkler flow. After termination of break flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

WX06B - Feedwater Pipe Break (Moderate Fire Sprinkler Response)

I5 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61 Due to Excessive Water Level in Safeguards Alley

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.6.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

A pipe break in the Feedwater System will deposit approximately 80,000 gallons of water onto the Turbine Building floor and result in the room temperature increasing to the point that the fire protection sprinklers will discharge. This event will result in a rapid reactor trip due to steam generator low level.

Fire sprinkler actuation would cause a decrease in Fire Protection system pressure and automatically initiate one or both of the fire pumps. This would result in a FIRE PUMP RUNNING alarm in the control room. If the pipe break is of sufficient size and large number of sprinklers actuate, the FIRE PROTECTION HDR PRESSURE LOW annunciator could sound in the control room. If the pipe break is greater than 200 gpm (the capacity of the Turbine Building sump pumps), then a Turbine Building sump high-level alarm in the control room from level switch LA-16666 will sound in the control room. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. This investigation would be greatly hampered by the Turbine Building's steam environment due to the Feedwater line break.

GOTHIC analysis shows this event to be self-limiting due to the isolation of the fire pumps when water level reaches the failure height(s) on the associated 480 VAC buses. Fire Pump A is fed

from breaker 15106 on 480 VAC Bus 51. The static trip unit associated with this breaker will fail when the water level reaches 2.75 inches above the ground [CALC03]. Since the feed breaker for Fire Pump B is on the top row of 480 Bus 62, Fire Pump B will fail when the water level reaches 11 inches and Bus 62 fails.

GOTHIC analysis [CALC01] indicates that the operator would have approximately 55 minutes to isolate a Feedwater pipe break with a 2000 gpm sprinkler discharge (by isolating flow from the Fire Protection pumps) to prevent eventual failure of 4 kVAC Bus 5 at 4 inches. Isolating the break within approximately 97 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room (the TDAFP auxiliary lube oil pump will fail if water level reaches 9 inches). The break must be isolated within approximately 120 minutes to prevent failure of 4 kVAC Bus 6 at 4 inches. The self-limiting nature of the event prevents the water level from exceeding 13 inches in the MDAFP area and 18 inches in the TDAFP area, therefore the MDAFPs and the TDAFP are not subject to submergence failure [CALC01].

Upon discovery of the pipe break location, the operator would attempt to isolate the break by closing a valve. However, most of the valves in the Fire Protection System simply isolate a branch off the main header (such as a deluge valve or a hose station) and do not isolate the header itself. Therefore the operator must trip the fire pumps to stop flow. The fire pumps, however, will continue to initiate automatically on low header pressure regardless of how many times the pumps are stopped. The only ways to definitively stop the sprinkler flow are to isolate the power supplies to the pumps by tripping the appropriate breakers on Buses 51 and 62 located in the Safeguards Alley, manually close the fire pump discharge valves in the Screenhouse, or manually isolate all the Turbine Building sprinklers by closing approximately 5 manual valves located on the mezzanine level of the Turbine Building.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 4 kVAC 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90. [CALC04]

Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

The Feedwater break leading to a 2000 gpm sprinkler discharge is named IE-WX06B.

5.2.5.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

Feedwater Pipe Break (Moderate Fire Sprinkler Response) (WX06B)

This top event represents the initiator described as Feedwater Pipe Break that results in a fire sprinkler discharge of 2000 gpm into the Turbine Building.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 55 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 55 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump (ITD)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 97 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 97 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and 480 VAC Bus 61/62 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 120 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 120 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that stopping the sprinkler flow within approximately 120 minutes also will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 108 minutes of the initial break [CALC01]. Finally, if the turbine-driven pump is not restarted before 108 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least two hours [CALC01] before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 11 hours [CALC01. The analyses of CALC06 have shown that if cooldown and

ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.7 Steamline Pipe Break (Large Fire Sprinkler Response)

5.2.7.1 Introduction

The event tree for a Steamline Pipe Break resulting in a Large Fire Sprinkler Response (Figure 5-8) models the behavior of Kewaunee Power Station following a Steamline pipe break that results in a fire sprinkler discharge of 6000 gpm. Normal mitigation of this event requires isolation of sprinkler flow. After termination of sprinkler flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

TI06B - Steamline Pipe Break (Large Fire Sprinkler Response)

I5 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61 Due to Excessive Water Level in Safeguards

Alley

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.7.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity

is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

A large pipe break in the Main Steam System will result in the room temperature increasing to the point that the fire protection sprinklers will discharge. Such a pipe break will cause high steam flow resulting in a cooldown of the RCS and subsequent addition of positive reactivity due to the negative moderator temperature coefficient. The RCS water volume also decreases due to the density change during this cooldown. This will generate an SI signal that will close the MSIVs and trip the reactor. Additionally, the SI signal will trip the Fire Protection pumps, which must be reset in the control room to be restarted. Thus, for Main Steam pipe breaks large enough to initiate an SI signal the Fire Protection pumps will not operate and water will not spill onto the Turbine Building floor. In essence, there will be no flooding event.

More moderately-sized Main Steam pipe breaks behave similarly to Feedwater breaks from the standpoint of flooding. Since no SI signal will be initiated the fire sprinklers will actuate due to the increased room temperature. This would cause a decrease in Fire Protection system pressure and automatically initiate one or both of the fire pumps. This would result in a FIRE PUMP RUNNING alarm in the control room. If the pipe break is of sufficient size and large number of sprinklers actuate, the FIRE PROTECTION HDR PRESSURE LOW annunciator could sound in the control room. If the sprinklers discharge more than 200 gpm (the capacity of the Turbine Building sump pumps), then a Turbine Building sump high level alarm in the control room from level switch LA-16666 will sound in the control room. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. This investigation would be greatly hampered by the Turbine Building's steam environment due to the Feedwater line break.

GOTHIC analysis shows this event to be self-limiting due to the isolation of the fire pumps when water level reaches the failure height(s) on the associated 480 VAC buses. Fire Pump A is fed from breaker 15106 on 480 VAC Bus 51. The static trip unit associated with this breaker will fail when the water level reaches 2.75 inches above the ground [CALC03]. Since the feed breaker for Fire Pump B is on the top row of 480 Bus 62, Fire Pump B will fail when water level reaches 11 inches and Bus 62 fails.

GOTHIC analysis [CALC01] indicates that the operator would have approximately 29 minutes to isolate a Steamline pipe break with a 6000-gpm sprinkler discharge (by isolating flow from the Fire Protection pumps) to prevent eventual failure of 4 kVAC Bus 5. Isolating the break within approximately 45 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room. The break must be isolated within approximately 62 minutes to prevent eventual failure of 4 kVAC Bus 6 at 4 inches. The self-limiting nature of the event prevents the water level from exceeding the 18-inch failure height of the TDAFP. [CALC01]

Upon discovery of the sprinkler actuation location, the operator would attempt to isolate the sprinklers by closing a valve. However, most of the valves in the Fire Protection System simply isolate a branch off the main header (such as a deluge valve or a hose station) and do not isolate the header itself. Therefore the operator must trip the fire pumps to stop flow. The fire pumps, however, will continue to initiate automatically on low header pressure regardless of how many times the pumps are stopped. The only ways to definitively stop the sprinkler flow are to isolate the power supplies to the pumps by tripping the appropriate breakers on Buses 51 and 62 located in the Safeguards Alley, manually close the fire pump discharge valves in the Screenhouse, or manually isolate all the Turbine Building sprinklers by closing approximately 5 manual valves located on the mezzanine level of the Turbine Building.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90. [CALC04]
Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

The Steamline break initiator leading to a 6000-gpm sprinkler discharge is named IE-TI06B. The timeline for operator actions associated with this event is provided in Attachment 2. This timeline is supported by Attachments 2 and 3 of the Fault Tree Analysis (Appendix C).

5.2.7.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

Steamline Pipe Break (Large Fire Sprinkler Response) (TI06B)

This top event represents the initiator described as Steamline Pipe Break that results in a fire sprinkler discharge of 6000 gpm into the Turbine Building.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 29 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 29 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump (ITD)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the

basement of the Turbine Building within approximately 45 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 45 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and 480 VAC Bus 61/62 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 62 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 62 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that stopping the sprinkler flow within approximately 56 minutes will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05]

have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 61 minutes of the initial break. Finally, if the turbine-driven pump is not restarted before 61 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition for the sequences where

top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor, C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03]

(which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA. Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least one hour before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 8 hours. [CALC01] The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

5.2.8 Steamline Pipe Break (Moderate Fire Sprinkler Response)

5.2.8.1 Introduction

The event tree for a Steamline Pipe Break resulting in a Moderate Fire Sprinkler Response (Figure 5-9) models the behavior of Kewaunee Power Station following a Steamline pipe break that results in a fire sprinkler discharge of 2000 gpm. Normal mitigation of this event requires isolation of sprinkler flow. After termination of break flow, decay heat removal and maintenance of RXCP seal integrity is required.

The following descriptors are used to identify systems and operator actions modeled within the event tree structure as top events:

TX06B - Steamline Pipe Break (Moderate Fire Sprinkler Response)

I5 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level

ITD - Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump

I6 - Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and Failure of 480 VAC Bus 61 Due to Excessive Water Level in Safeguards Alley

AFS - Motor Driven AFW Pump Failure to Start (Automatic Start)

AFR - Motor Driven AFW Pump Failure to Run

AFZ - Operator Failure to Start Turbine Driven AFW Pump

AFT - Turbine Driven AFW Pump Failure (Hardware)

AFX - Operator Failure to Take Manual Control of AFW System

RCP - Reactor Coolant Pump Seal Cooling Failure

OCD - RCS Cooldown

SLC - Small RCP Seal LOCA

HPI - ECCS Injection

RWC - Conservation of RWST Inventory per ECA-1.1

5.2.7.2 Accident Progression

After a successful reactor trip, decay heat must be removed. The first requirement for successful decay heat removal is reactor coolant flow. Reactor coolant flow ensures that a heat convection path exists between the core and the steam generators. Core heat removal by forced circulation is preferred over natural circulation since this minimizes pressurizer safety and relief valve challenges and results in rapid heat transport to the steam generators. Natural circulation flow nevertheless will also provide for effective decay heat removal. Since either method of coolant circulation will remove decay heat, reactor coolant pumps will not be explicitly modeled.

The heat removal path must be continued on the secondary side of the steam generators. This is accomplished with secondary steam release and feed from the AFW System since the MFW System is unavailable due to the pipe break. Since the steam dump valves are assumed to be unavailable due to the pipe break, initially the SG atmospheric relief valves automatically actuate to release steam to the condenser or the atmosphere and stabilize RCS temperature close to the no-load value of 547°F. Each SG has one atmospheric relief valve and five safety valves. If electric power to the SG PORV is unavailable, then the operator must open the valve manually.

Integrity of the reactor coolant system (RCS) must be maintained to ensure that decay heat removal can be accomplished. For the flooding scenarios, a short-term challenge to RCS integrity is the potential failure of RXCP seals. One of two means is available to maintain seal integrity: operation of a charging pump to ensure RXCP seal injection or operation of the CCW system to maintain thermal barrier cooling. For either of these methods, power must be available from one of the 480 VAC safety buses.

If failure of both trains of 480 VAC safety buses occurs because of excessive water levels, then cooldown of the RCS would reduce RCS pressure, thereby reducing the probability of a RXCP seal LOCA, or, if a seal LOCA occurs, reduce RCS flow from the failed seal or seals. By reducing the flow from any potential LOCA, RCS makeup requirements are minimized. RCS makeup flow (due to the Seal LOCA) will come from the ECCS injecting the RWST inventory and from the discharge of the accumulators. The operators must throttle SI flow to conserve the RWST inventory for 24 hours of SI operation while maintaining adequate RCS level.

A large pipe break in the Main Steam System will result in the room temperature increasing to the point that the fire protection sprinklers will discharge. Such a pipe break will cause high steam flow resulting in a cooldown of the RCS and subsequent addition of positive reactivity due to the negative moderator temperature coefficient. The RCS water volume also decreases due to the density change during this cooldown. This will generate an SI signal, which will close the MSIVs and trip the reactor. Additionally, the SI signal will trip the Fire Protection pumps, which must be reset in the control room to be restarted. Thus, for Main Steam pipe breaks large enough to initiate an SI signal the Fire Protection pumps will not operate and water will not spill onto the Turbine Building floor. In essence, there will be no flooding event.

More moderately-sized Main Steam pipe breaks behave similarly to Feedwater breaks from the standpoint of flooding. Since no SI signal will be initiated the fire sprinklers will actuate due to the increased room temperature. This would cause a decrease in Fire Protection system pressure and automatically initiate one or both of the fire pumps. This would result in a FIRE PUMP RUNNING alarm in the control room. If the pipe break is of sufficient size and large number of sprinklers actuate, the FIRE PROTECTION HDR PRESSURE LOW annunciator could sound in the control room. If the sprinklers discharge more than 200 gpm (the capacity of the Turbine Building sump pumps), then a Turbine Building sump high level alarm in the control room from level switch LA-16666 will sound in the control room. The drains and sumps procedure instructs the operator to dispatch someone to locally investigate the sump when this alarm sounds in the control room. This investigation would be greatly hampered by the Turbine Building's steam environment due to the Feedwater line break.

GOTHIC analysis shows this event to be self-limiting due to the isolation of the fire pumps when water level reaches the failure height(s) on the associated 480 VAC buses. Fire Pump A is fed from breaker 15106 on 480 VAC Bus 51. The static trip unit associated with this breaker will fail when the water level reaches 2.75 inches above the ground [CALC03]. Since the feed breaker for Fire Pump B is on the top row of 480 Bus 62, Fire Pump B will fail when water level reaches 11 inches and Bus 62 fails.

GOTHIC analysis [CALC01] indicates that the operator would have approximately 100 minutes to isolate a Steamline pipe break with a 2000-gpm sprinkler discharge (by isolating flow from the Fire Protection pumps) to prevent eventual failure of 4 kVAC Bus 5. Isolating the break within

approximately 150 minutes will prevent the water from ultimately reaching a level of 9 inches in the Turbine Driven AFW Pump room (the TDAFP auxiliary lube oil pump will fail if water level reaches 9 inches). The break must be isolated within approximately 170 minutes to prevent eventual failure of 4 kVAC Bus 6 at 4 inches. The self-limiting nature of the event prevents the water level from exceeding 13 inches in the MDAFP area or 18 inches in the TDAFP area, therefore the MDAFPs and the TDAFP are not subject to submergence failure [CALC01].

Upon discovery of the sprinkler actuation location, the operator would attempt to isolate the sprinklers by closing a valve. However, most of the valves in the Fire Protection System simply isolate a branch off the main header (such as a deluge valve or a hose station) and do not isolate the header itself. Therefore the operator must trip the fire pumps to stop flow. The fire pumps, however, will continue to initiate automatically on low header pressure regardless of how many times the pumps are stopped. The only ways to definitively stop the sprinkler flow are to isolate the power supplies to the pumps by tripping the appropriate breakers on Buses 51 and 62 located in the Safeguards Alley, manually close the fire pump discharge valves in the Screenhouse, or manually isolate all the Turbine Building sprinklers by closing approximately 5 manual valves located on the mezzanine level of the Turbine Building.

Water level in flood areas TU-95B-1, TU-95B-2, TU-95C, and TU-94 will closely match the water level in the Turbine Building because of the drain lines that connect these areas to the Turbine Building sump. These drain lines did not contain check valves and would have allowed water to flow freely from the sump to the areas. The water level in flood area TU-95A will be lower since water will be entering the room via leakage under doors 5, 263, and 268. Water will flow to the trench in TU-95A that communicates with TU-90. Thus the water level in areas TU-95A and TU-90 will rise simultaneously. Since the drain line in TU-90 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 2 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse. Results from GOTHIC analysis [CALC01] indicate that the water level will exceed 4 inches in TU-90, thereby resulting in failure of 4 kVAC Bus 5 and subsequent failure of 480 VAC Bus 51 (which is powered by 4 kVAC Bus 5) at 11 inches. Additionally, if the water level in TU-95B-1 reaches approximately 3 feet, the firewall (constructed of gypsum board) that contains doors 263 and 268 is expected to fail structurally allowing a significant volume of water to enter TU-95A and TU-90. [CALC04]

Similarly, the water level in TU-92 will be fed by leakage under door 3. Since the drain line in TU-92 will be filled between the Turbine Building sump and the check valve, the only drainage will be leakage under door 1 leading to the Screenhouse pipe tunnel. When water level exceeds the height of the seiche hump (approximately 2.78 inches relative to the floor around Bus 6 [REPORT03]) in this pipe tunnel, water will flow freely to the Screenhouse.

5.2.7.3 Top Event Description

The top events of the event tree are described in detail below to provide an understanding of the system functions involved.

The results of the event tree analysis are combinations of top events that together define a particular accident sequence that leads to a particular damage state. Each of these top events is associated with a particular fault tree. These fault trees are logically combined during the later fault tree linking process to yield the combinations of equipment failures and human errors that lead to a particular damage state.

Steamline Pipe Break (Moderate Fire Sprinkler Response) (TX06B)

This top event represents the initiator described as Steamline Pipe Break that results in a fire sprinkler discharge of 2000 gpm into the Turbine Building.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 5 in Safeguards Alley Due to Excessive Water Level (I5)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 100 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 5. While the water level near the bus might be negligible 100 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to eventually cause loss of the bus. Bus 5 supplies power to 480 VAC Bus 51/52 and failure of Bus 5 would result in the failure of Bus 51/52 also.

Isolation of Break in Time to Prevent Eventual Failure of Turbine Driven AFW Pump to Start Due to Submergence of Auxiliary Lube Oil Pump (ITD)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 150 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 9-inch failure height of the auxiliary lube oil pump, which is required for normal start of the TDAFP. While the water level near the TDAFP might be negligible 150 minutes after the pipe break, GOTHIC analysis [CALC01]

indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the auxiliary lube oil pump and prevent normal starting of the TDAFP.

Isolation of Break in Time to Prevent Eventual Failure of 4 kVAC Bus 6 and 480 VAC Bus 61/62 in Safeguards Alley Due to Excessive Water Level (I6)

The operator must isolate the sprinkler flow by either: 1) tripping the 480 VAC breaker associated with each pump or 2) locally closing each Fire Pump's manual discharge valve or 3) locally closing the Fire Protection Water header isolation valves on the mezzanine level of the Turbine Building and locally closing the isolation valve on the deluge valve supply line in the basement of the Turbine Building within approximately 170 minutes of the rupture to prevent the water level in Safeguards Alley from eventually reaching the 4-inch failure height of 4 kVAC Bus 6. While the water level near the bus might be negligible 170 minutes after the pipe break, GOTHIC analysis [CALC01] indicates that any further delay of the break isolation will result in a peak water level (several minutes later) that is sufficiently high to cause failure of the bus. GOTHIC analysis also shows that stopping the sprinkler flow within approximately 170 minutes also will prevent eventual failure of 480 VAC Bus 61/62. These two isolation actions are combined into Top Event I6.

Motor Driven AFW Pump Failure to Start (Automatic Start) (AFS)

Top Event AFS models the random hardware failures associated with the starting of Motor Driven AFW Pump B (MDAFP B). MDAFP B will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (powered by 480 VAC Bus 61/62) must be available for the AFW pump to start. Although the auxiliary lube oil pump is powered through the lowest row of circuit breakers on Bus 61/62, it is expected that the pump will start before its power supply is affected since the AFW Pump will receive a start signal within seconds of a reactor trip and GOTHIC analysis [CALC01] shows that water level in Safeguards Alley will not impact pump start that early in the event.

Motor Driven AFW Pump Failure to Run (AFR)

Top Event AFR models the random hardware failures associated with the running of MDAFP B. Given a successful start, MDAFP B must continue to run to ensure adequate core cooling. Power to MDAFP B is supplied by 4 kVAC Bus 6. The associated auxiliary lube oil pump is not required for continued operation of MDAFP B, only for starting the pump. Analyses [CALC05] have shown that room cooling is not required for long-term operation of the AFW pump.

Operator Failure to Start Turbine Driven AFW Pump (AFZ)

This top event is used to model failure of the operator to provide AFW flow for decay heat removal using the turbine-driven AFW pump. The top event is used to model operator action-related failures only. Other nodes in the event trees evaluate hardware-related failures of the turbine-driven AFW train.

For the sequences where top event AFZ is used, several potential success paths exist, depending on the failures that occurred previously in the event tree. First, the operators may have recognized that the flooding event could threaten the motor-driven AFW pumps and would maintain the turbine-driven AFW pump running throughout the event. Second, if the turbine-driven AFW pump were secured, it could be restarted. Depending on when the break flow is terminated, restart could merely require that the operators take the control switch from pull-to-lock. Then, even if the operators did not start the pump, it would automatically start on a low-low steam generator level signal. If break isolation occurred later, the pump would need to be restarted before the auxiliary lube oil pump was submerged, or within 148 minutes of the initial break. Finally, if the turbine-driven pump is not restarted before 148 minutes after flood initiation and then maintained running, then the pump could be started if the low oil pressure interlock is bypassed. Bypass of the low oil pressure interlock may be directed by personnel manning the technical support center and would need to be completed before water level in either of the steam generators dropped to less than 5-percent wide range, the point that bleed and feed cooling would be initiated.

Turbine Driven AFW Pump Failure (Hardware) (AFT)

Top Event AFT models the random hardware failures associated with the start and run of the TDAFP. The TDAFP will start on the low-low steam generator water level signal and provide auxiliary feedwater to the steam generators. The associated auxiliary lube oil pump (which is DC powered) must be available for the TDAFP pump to start normally. If the water level near the TDAFP is below the 9-inch failure height of the auxiliary lube oil pump, then the TDAFP will start normally. If the auxiliary lube oil pump is submerged, then additional operator actions, evaluated in top event AFZ, are required to start the TDAFP.

Operator Failure to Take Manual Control of AFW System (AFX)

This top event is used to model failure of the operator to control AFW flow to maintain level in the steam generators.

By definition, all equipment in the Turbine Building basement is assumed failed by the initiating event. Therefore, service air compressors are lost. Also by definition of the sequences where top event AFX is used, the B-train electrical safety buses (4kVAC and 480 VAC) are available. Because the B-train 480 VAC safety buses are available, the B-train instrument air compressor,

C1B, is potentially available. Even though the B-train 480 VAC safety buses are available, the bottom row of breakers on the 480 VAC buses will have opened. When these breakers open, the ability to operate the MDAFP auxiliary lube oil pump is lost.

Given the conditions described above, success of the AFX equation can be achieved by several means. First, the B-train motor-driven AFW pump could be maintained running and flow controlled using AFW-2B. If air and power are available, then flow can be controlled from the control room. If air or power is not available, then AFW-2B can be operated locally.

Second, if the operators secure the B-train AFW pump, then the turbine-driven AFW pump can be used. For sequences where top event AFZ follows success of top event AFR, the turbine-driven AFW pump is evaluated within the AFX node. Otherwise the TDAFP hardware is evaluated explicitly by other top events. Lastly, if the motor-driven AFW pump 1B has been secured, then the low oil pressure interlock can be bypassed to allow starting the motor-driven AFW pumps without the auxiliary lube oil pumps.

RXCP Seal Cooling (RCP)

Top Event RCP represents the failure of the hardware needed for RXCP seal cooling. If RXCP seal cooling is maintained, then failure of the RXCP seals would not be expected. Seal cooling can be maintained by charging system injection to the seals or by maintaining CCW cooling to the thermal barrier heat exchanger. Failure of this top event means that the possibility of a RXCP seal LOCA must be evaluated.

RCS Cooldown (OCD)

Top Event OCD represents the failure of the operator to initiate and continue RCS Cooldown. Success of this top event affects the probability and associated size of a RXCP seal LOCA. Should a LOCA occur, the cooldown affects the rate that coolant will be lost through the LOCA. Analyses [CALC06] have shown that if cooldown is successful, then core damage can be prevented regardless of the size of any RXCP seal LOCA provided that AFW is successful and that ECCS injection is available. Success of this top event requires opening of a Steam Generator PORV and ensuring that adequate shutdown margin is available.

If Buses 6, 61, and 62 remain available for 24 hours, then the cooldown will be conducted per ES-0.2 [PROC01], which requires that adequate shutdown margin from boration be available. In this case, the purpose of the RCS cooldown is first to prevent a RXCP seal LOCA and second to minimize leakage from the break if a LOCA were to occur.

If Buses 6, 61, and 62 fail early, then the cooldown will be conducted per ES-1.2 [PROC03] (which does not require normal boration) and a RXCP seal LOCA of some size can be assumed to occur. For these sequences, the purpose of the cooldown is to minimize flow from the LOCA.

Minimization of flow is needed so that adequate RCS inventory is available to maintain decay heat removal following loss of safety injection.

Small RCP Seal LOCA (SLC)

Top Event SLC is used to assign the probability of a large RCP Seal LOCA based on the NRC Safety Evaluation of the WOG2000 RCP Seal Leakage Model [WCAP01]. If seal cooling is lost, then the size of any potential RXCP seal LOCA impacts the success requirements for other systems needed to mitigate the accident.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, and cooldown was successful, analyses [CALC06] have shown that core damage can be prevented regardless of the size of any RXCP seal LOCA if ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) are successful.

For sequences where one train of safety related AC power is available, i.e., Buses 6, 61, and 62, but cooldown was failed, analyses [CALC06] have shown that core damage can be prevented provided that the seal LOCA is less than 480-gpm per pump. For sequences where RCS pressure is not reduced less than 1410 psig within two hours, REPORT04 indicates that the probability of a 480-gpm seal LOCA is 0.5. This analysis will assume that if cooldown fails (top event OCD) then RCS pressure will be above 1410 psig at two hours. For these sequences, if the RXCP seal LOCA is less than 480 gpm, success of ECCS injection (top event HPI described below) along with operator actions to conserve RWST inventory (top event RWC described below) will prevent core damage.

The last case to consider for top event SLC is for sequences where isolation of the flooding event did not occur before the volume of water released to the Turbine Building would eventually submerge Buses 6, 61, and 62. For these sequences, RXCP seal cooling would be available for at least two hours [CALC01] before electrical buses would submerge and fail the seal cooling systems. Provided that the break flow was isolated prior to level in the Turbine Building exceeding 18 inches, Bus 6 would be available to support safety injection pump operation for approximately 10 hours [CALC01]. The analyses of CALC06 have shown that if cooldown and ECCS injection are successful and that if AFW cooling is maintained after ECCS injection is lost, then core damage is prevented provided that the RXCP seal LOCA is less than 480 gpm per pump.

ECCS Injection (HPI)

Since an RCP Seal LOCA is assumed to occur if RXCP seal cooling is lost, RCS inventory must be maintained to ensure adequate decay heat removal. This is accomplished by using Safety Injection Pump B to inject the contents of the RWST into the RCS and by the discharge of the

accumulators. Safety Injection Pump A is assumed to be unavailable due to the failure of 4 kVAC Bus 5 due to the water level in Safeguards Alley.

Conservation of RWST Inventory per ECA-1.1 (RWC)

Top Event RWC models the operator action for throttling SI flow to conserve RWST inventory. This is done via procedure ECA-1.1 and allows for more than 24 hours of safety injection flow without refilling the RWST.

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
CI06B	Rupture of an Inlet Condenser Expansion Joint in TU-22-1	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B MCC-32D MCC-42B MCC-42D AOV PW-52	Detect: Reactor Trip due to Loss of Condenser Vacuum Isolate: Trip both Circulating Water Pumps	Initiating Event: IE-CI06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 40-BS-MCC32D-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
CX06B	Rupture of an Outlet Condenser Expansion Joint in TU-22-1	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B MCC-32D MCC-42B MCC-42D AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump) Isolate: Trip both Circulating Water Pumps	Initiating Event: IE-CX06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 40-BS-MCC32D-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
SI06B	Large Service Water Pipe Break in TU-22-1	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B MCC-32D MCC-42B MCC-42D AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump) Isolate: Close SW-4A/SW-4B (only one of them will be open)	Initiating Event: IE-SI06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 40-BS-MCC32D-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
FI06B	Large Fire Protection Water Pipe Break in TU-22-1	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B MCC-32D MCC-42B MCC-42D AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump); FIRE PUMP RUNNING Alarm Isolate: Close manual discharge valve on each Fire Pump OR Remove power to both Fire Pumps (might not be possible if water propagates throughout Safeguards Alley)	Initiating Event: IE-FI06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 40-BS-MCC32D-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
WI06B	Feedwater Pipe Break in TU-22-1 Leading to Large Fire Protection Water Discharge	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B AOV SD-11A1 AOV SD-11B1 Bus 3 Bus 4 Bus 32 Bus 35 Bus 42 Bus 45 MCC-32D MCC-32G MCC-42B MCC-42D MCC-42G AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump); FIRE PUMP RUNNING Alarm; Hotwell Low Level Alarm Isolate: Close manual discharge valve on each Fire Pump OR Remove power to both Fire Pumps (might not be possible if water propagates throughout Safeguards Alley) OR close manual sprinkler/deluge isolation valves on mezzanine level of Turbine Building	Initiating Event: IE-WI06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 06-AV-SD11A1-FO 06-AV-SD11B1-FO 39-BS-BUS3---SG 39-BS-BUS4---SG 40-BS-BUS32-SG 40-BS-BUS35-SG 40-BS-BUS42-SG 40-BS-BUS45-SG 40-BS-MCC32D-SG 40-BS-MCC32G-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 40-BS-MCC42G-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
WX06B	Feedwater Pipe Break in TU-22-1 Leading to Medium Fire Protection Water Discharge	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B AOV SD-11A1 AOV SD-11B1 Bus 3 Bus 4 Bus 32 Bus 35 Bus 42 Bus 45 MCC-32D MCC-32G MCC-42B MCC-42D MCC-42G AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump); FIRE PUMP RUNNING Alarm; Hotwell Low Level Alarm Isolate: Close manual discharge valve on each Fire Pump OR Remove power to both Fire Pumps (might not be possible if water propagates throughout Safeguards Alley) OR close manual sprinkler/deluge isolation valves on mezzanine level of Turbine Building	Initiating Event: IE-WX06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 06-AV-SD11A1-FO 06-AV-SD11B1-FO 39-BS-BUS3---SG 39-BS-BUS4---SG 40-BS-BUS32-SG 40-BS-BUS35-SG 40-BS-BUS42-SG 40-BS-BUS45-SG 40-BS-MCC32D-SG 40-BS-MCC32G-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 40-BS-MCC42G-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
TI06B	Steamline Pipe Break in TU-22-1 Leading to Large Fire Protection Water Discharge	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B AOV SD-11A1 AOV SD-11B1 Bus 3 Bus 4 Bus 32 Bus 35 Bus 42 Bus 45 MCC-32D MCC-32G MCC-42B MCC-42D MCC-42G AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump); FIRE PUMP RUNNING Alarm; Break Upstream of Turbine Throttle Valves Will Result in SI Signal, MSIV Closure, and Rx Trip Isolate: Close manual discharge valve on each Fire Pump OR Remove power to both Fire Pumps (might not be possible if water propagates throughout Safeguards Alley) OR close manual sprinkler/deluge isolation valves on mezzanine level of Turbine Building	Initiating Event: IE-TI06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 06-AV-SD11A1-FO 06-AV-SD11B1-FO 39-BS-BUS3---SG 39-BS-BUS4---SG 40-BS-BUS32-SG 40-BS-BUS35-SG 40-BS-BUS42-SG 40-BS-BUS45-SG 40-BS-MCC32D-SG 40-BS-MCC32G-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 40-BS-MCC42G-SG 26-AV-PW52---OC

Table 5-2
Summary of KPS Turbine Building Flood Scenarios

IE Name	Description	Flood Damage	Detection/ Isolation Means	Failed Gate or Component BEs
TX06B	Steamline Pipe Break in TU-22-1 Leading to Medium Fire Protection Water Discharge	Propagate: TU-94 TU-95B-1 Damage: Air Compressor 1F Air Compressor 1G Condensate Pump 1A Condensate Pump 1B Feedwater Pump 1A Feedwater Pump 1B Rx Makeup Pump 1A Rx Makeup Pump 1B Plt Equip Wtr Pump 1A Plt Equip Wtr Pump 1B AOV SD-11A1 AOV SD-11B1 Bus 3 Bus 4 Bus 32 Bus 35 Bus 42 Bus 45 MCC-32D MCC-32G MCC-42B MCC-42D MCC-42G AOV PW-52	Detect: Miscellaneous Sumps Alarm (Turbine Building sump); FIRE PUMP RUNNING Alarm; Break Upstream of Turbine Throttle Valves Will Result in SI Signal, MSIV Closure, and Rx Trip Isolate: Close manual discharge valve on each Fire Pump OR Remove power to both Fire Pumps (might not be possible if water propagates throughout Safeguards Alley) OR close manual sprinkler/deluge isolation valves on mezzanine level of Turbine Building	Initiating Event: IE-TX06B Failed BEs: 01-CM-SIAC1F-PR 01-CM-SIAC1G-PR 03-PM--CDP1A-PR 03-PM--CDP1B-PR 05APM--FWP1A-PR 05APM--FWP1B-PR 27APM--RMP1A-PR 27APM--RMP1B-PR 27BPM-PEWPA—PR 27BPM-PEWPB—PR 06-AV-SD11A1-FO 06-AV-SD11B1-FO 39-BS-BUS3---SG 39-BS-BUS4---SG 40-BS-BUS32-SG 40-BS-BUS35-SG 40-BS-BUS42-SG 40-BS-BUS45-SG 40-BS-MCC32D-SG 40-BS-MCC32G-SG 40-BS-MCC42B-SG 40-BS-MCC42D-SG 40-BS-MCC42G-SG 26-AV-PW52---OC

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[REPORT01] not used

[REPORT02] KPS System Description 30, "Miscellaneous Drains and Sumps (MDS)," Rev. 2.

[REPORT03] Letter from Robert E. Lee & Associates, Inc. to Tim Hanna (Dominion Energy Kewaunee, Inc.), September 27, 2005, "Results of Elevation Checks"

[WCAP01] WCAP-16141 "RCP Seal Leakage PRA Model Implementation Guidelines for Westinghouse PWRs," Westinghouse Electric Company, LLC, August 2003.

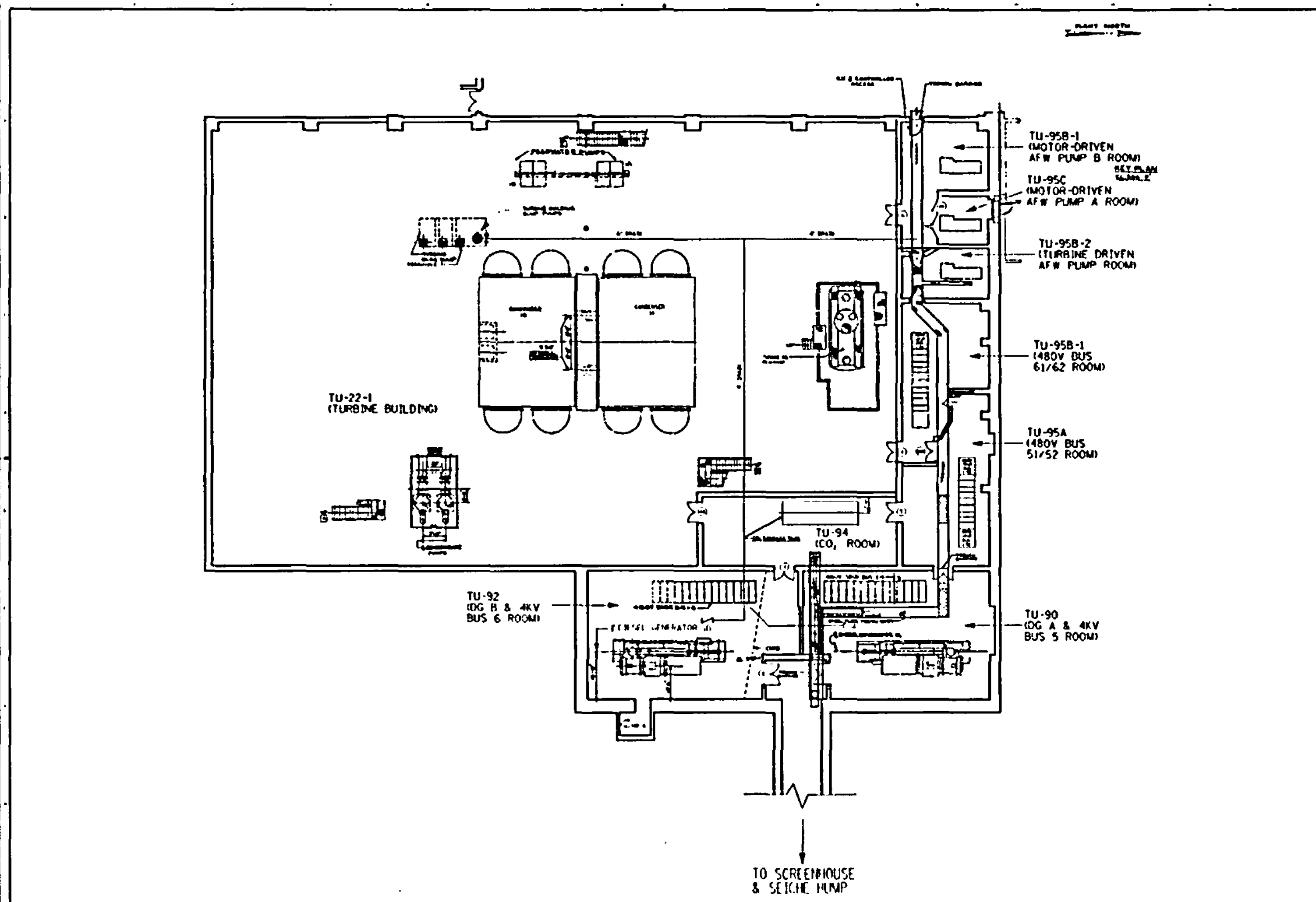

Figure 5-1 – Turbine Building Basement/Safeguards Alley Arrangement

Circulating Wtr Break Causes Large Flooding in Turbine Bldg Basement	Isolation Before Failure Of Any Equipment	SEQ #	SEQUENCE DESCRIPTOR	PDS #	FREQUENCY
CI06B	I5-				
		S01	CI06B	OK	
		S02	CI06BI5-	CD	

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INTERNAL FLOODING – Accident Sequence Analysis for Turbine Building Floods

Figure 5-2. CI06B Event Tree

CI06B.pdf

Circulating Wtr Break Causes Large Flooding in Turbine Bldg Basement	Isolation Before Failure Of Any Equipment	SEQ #	SEQUENCE DESCRIPTOR	PDS #	FREQUENCY
CI06B	I5-				
		S01	CI06B	OK	
		S02	CI06BI5-	CD	

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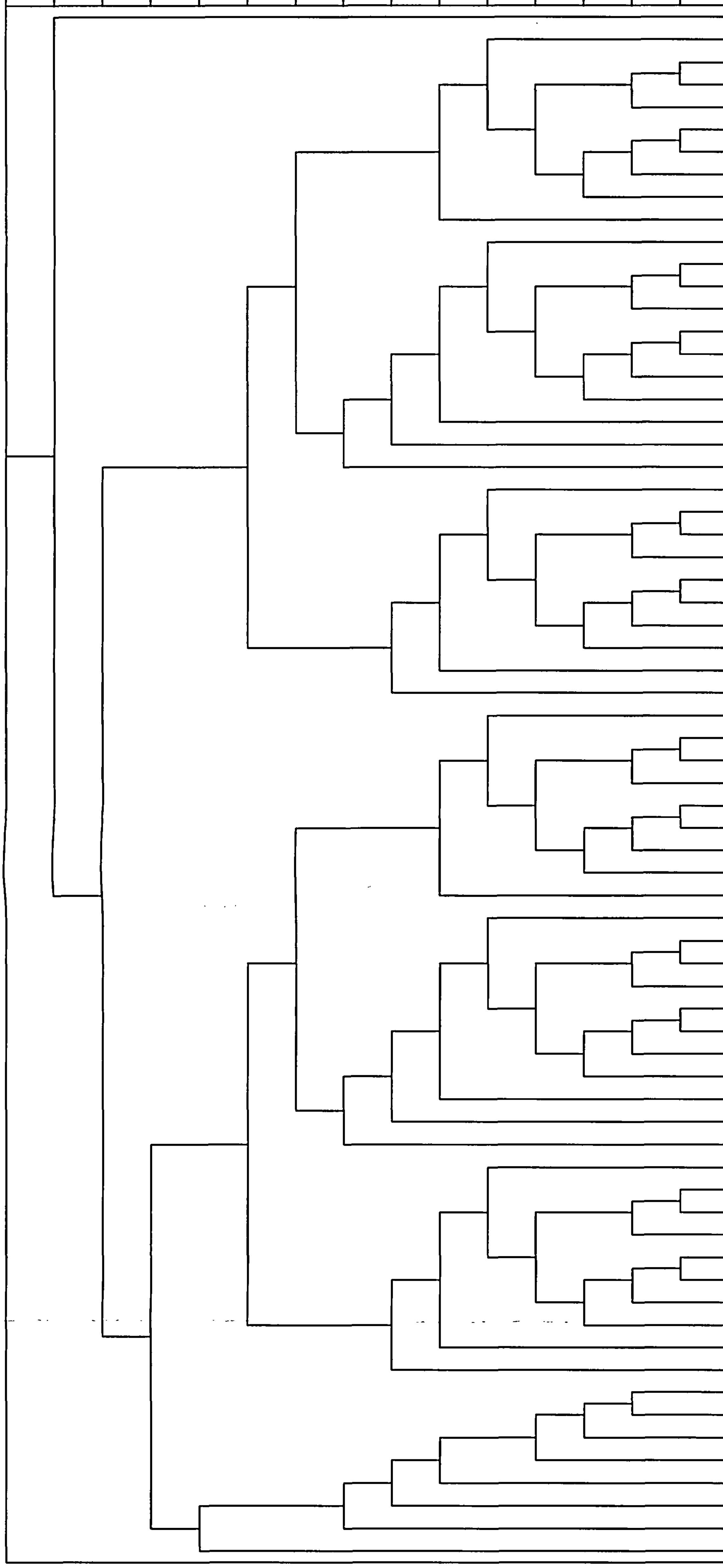
Figure 5-3. CX06B Event Tree

CX06B.pdf

Circulating Wtr Break Causes Moderate Flooding in Turbine Bldg Basement	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP Or Bus 6	Isolation Before 18 Inches In Turbine Building	Isolation Before 18 Inches In Turbine Building	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
CX06B	I5-	ITD	I6-	I18	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



SEQ #	SEQUENCE DESCRIPTOR	PDS #	FREQUENCY
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S02	CX06BI5-	OK	
S03	CX06BI5-RCP	OK	
S04	CX06BI5-RCPRWC	CD	
S05	CX06BI5-RCPHPI	CD	
S06	CX06BI5-RCPOCD	OK	
S07	CX06BI5-RCPOCDRWC	CD	
S08	CX06BI5-RCPOCDHPI	CD	
S09	CX06BI5-RCPOCDSLC	CD	
S10	CX06BI5-AFX	CD	
S11	CX06BI5-AFR	OK	
S12	CX06BI5-AFRRCP	OK	
S13	CX06BI5-AFRRCPRWC	CD	
S14	CX06BI5-AFRRCPHPI	CD	
S15	CX06BI5-AFRRCPOCD	OK	
S16	CX06BI5-AFRRCPOCDRWC	CD	
S17	CX06BI5-AFRRCPOCDHPI	CD	
S18	CX06BI5-AFRRCPOCDSLC	CD	
S19	CX06BI5-AFRAFX	CD	
S20	CX06BI5-AFRAFT	CD	
S21	CX06BI5-AFRAFZ	CD	
S22	CX06BI5-AFS	OK	
S23	CX06BI5-AFSRCP	OK	
S24	CX06BI5-AFSRCPRWC	CD	
S25	CX06BI5-AFSRCPHPI	CD	
S26	CX06BI5-AFSRCPOCD	OK	
S27	CX06BI5-AFSRCPOCDRWC	CD	
S28	CX06BI5-AFSRCPOCDHPI	CD	
S29	CX06BI5-AFSRCPOCDSLC	CD	
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S31	CX06BI5-AFSAFT	CD	
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S40	CX06BI5-ITDAFX	CD	
S41	CX06BI5-ITDAFR	OK	
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S66	CX06BI5-ITDI6-AFX	CD	
S67	CX06BI5-ITDI6-AFT	CD	
S68	CX06BI5-ITDI6-AFZ	CD	
S69	CX06BI5-ITDI6-I18	CD	

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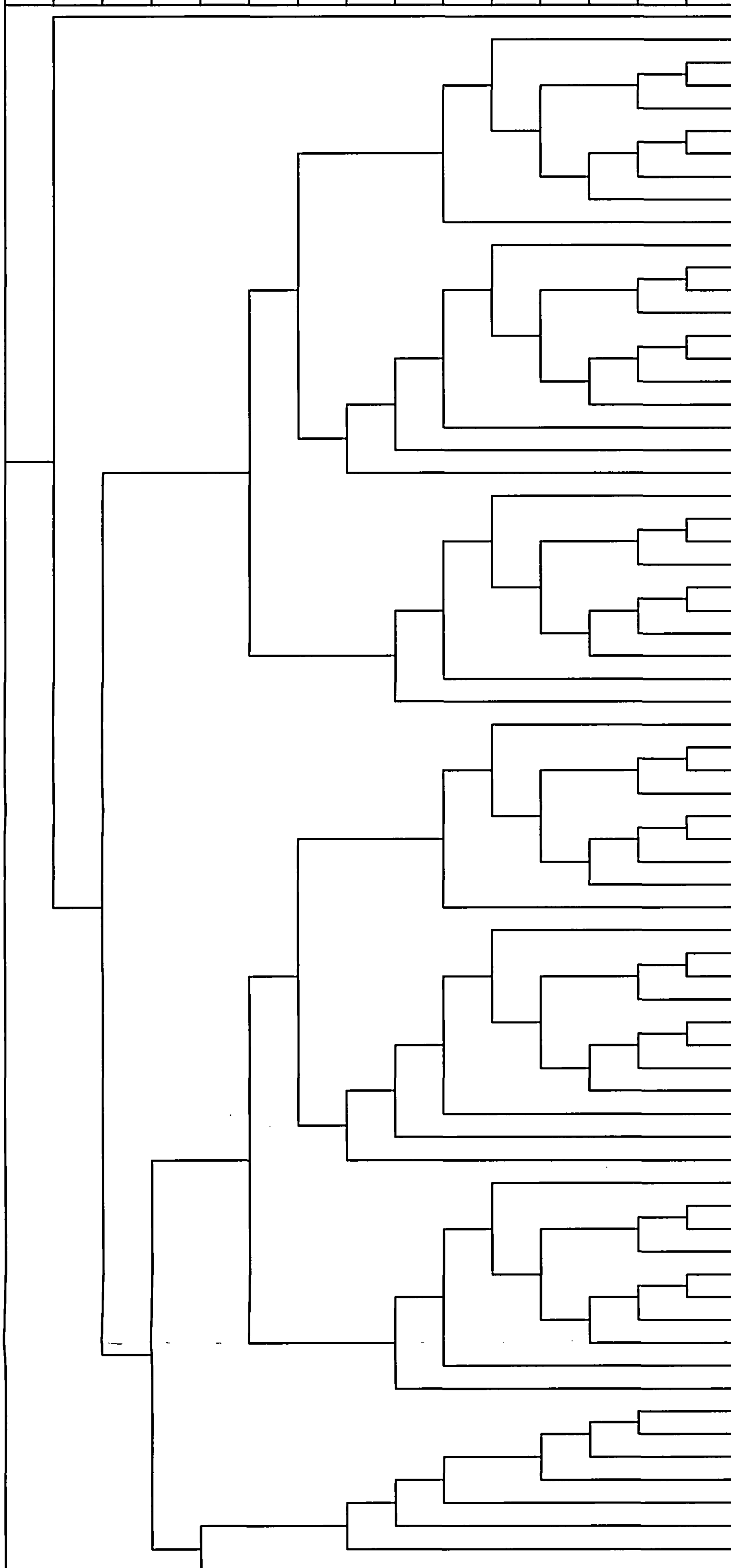
Figure 5-4. SI06B Event Tree

SI06B.pdf

Service Wtr Pipe Break Causes Large Flooding In Turbine Bldg Basement	Isolation Before Failure Of Bus 5	Isolation Before Failure Of AFWP ALOP Or Bus 61	Isolation Before Failure Of Bus 6	Isolation Before 18 Inches In Turbine Building	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
SI06B	I5-	ITD	I6-	I18	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



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S03	SI06BI5-RCP	OK	
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S06	SI06BI5-RCPOCD	OK	
S07	SI06BI5-RCPOCDRWC	CD	
S08	SI06BI5-RCPOCDHPI	CD	
S09	SI06BI5-RCPOCDSLC	CD	
S10	SI06BI5-AFX	CD	
S11	SI06BI5-AFR	OK	
S12	SI06BI5-AFRRCP	OK	
S13	SI06BI5-AFRRCPRWC	CD	
S14	SI06BI5-AFRRCPHPI	CD	
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S17	SI06BI5-AFRRCPOCDHPI	CD	
S18	SI06BI5-AFRRCPOCDSLC	CD	
S19	SI06BI5-AFRAFX	CD	
S20	SI06BI5-AFRAFT	CD	
S21	SI06BI5-AFRAFZ	CD	
S22	SI06BI5-AFS	OK	
S23	SI06BI5-AFSRCP	OK	
S24	SI06BI5-AFSRCPRWC	CD	
S25	SI06BI5-AFSRCPHPI	CD	
S26	SI06BI5-AFSRCPOCD	OK	
S27	SI06BI5-AFSRCPOCDRWC	CD	
S28	SI06BI5-AFSRCPOCDHPI	CD	
S29	SI06BI5-AFSRCPOCDSLC	CD	
S30	SI06BI5-AFSAFX	CD	
S31	SI06BI5-AFSAFT	CD	
S32	SI06BI5-ITD	OK	
S33	SI06BI5-ITDRCP	OK	
S34	SI06BI5-ITDRCPRWC	CD	
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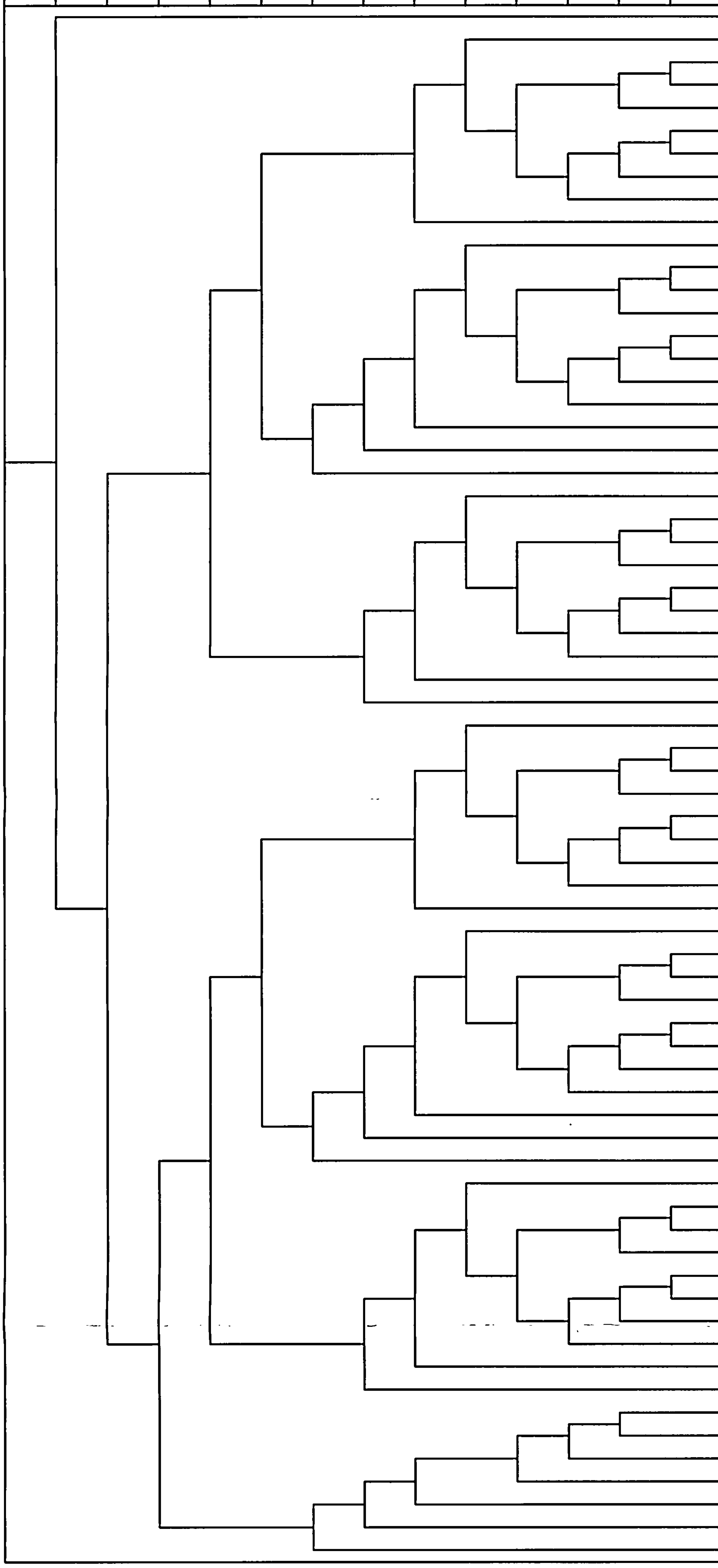
Figure 5-5. FI06B Event Tree

FI06B.pdf

Fire Prot Wtr Break Causes Large Flooding in Turbine Bldg Basement	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP	Isolation Before Failure of Buses 6, 61, 62	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
FI06B	I5-	ITD	I6-	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



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S05	FI06BI5-RCPHPI	CD	
S06	FI06BI5-RCPOCD	OK	
S07	FI06BI5-RCPOCDRWC	CD	
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S34	FI06BI5-ITDRCPRWC	CD	
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S36	FI06BI5-ITDRCPOCD	OK	
S37	FI06BI5-ITDRCPOCDRWC	CD	
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S46	FI06BI5-ITDAFRRCPOCDRWC	CD	
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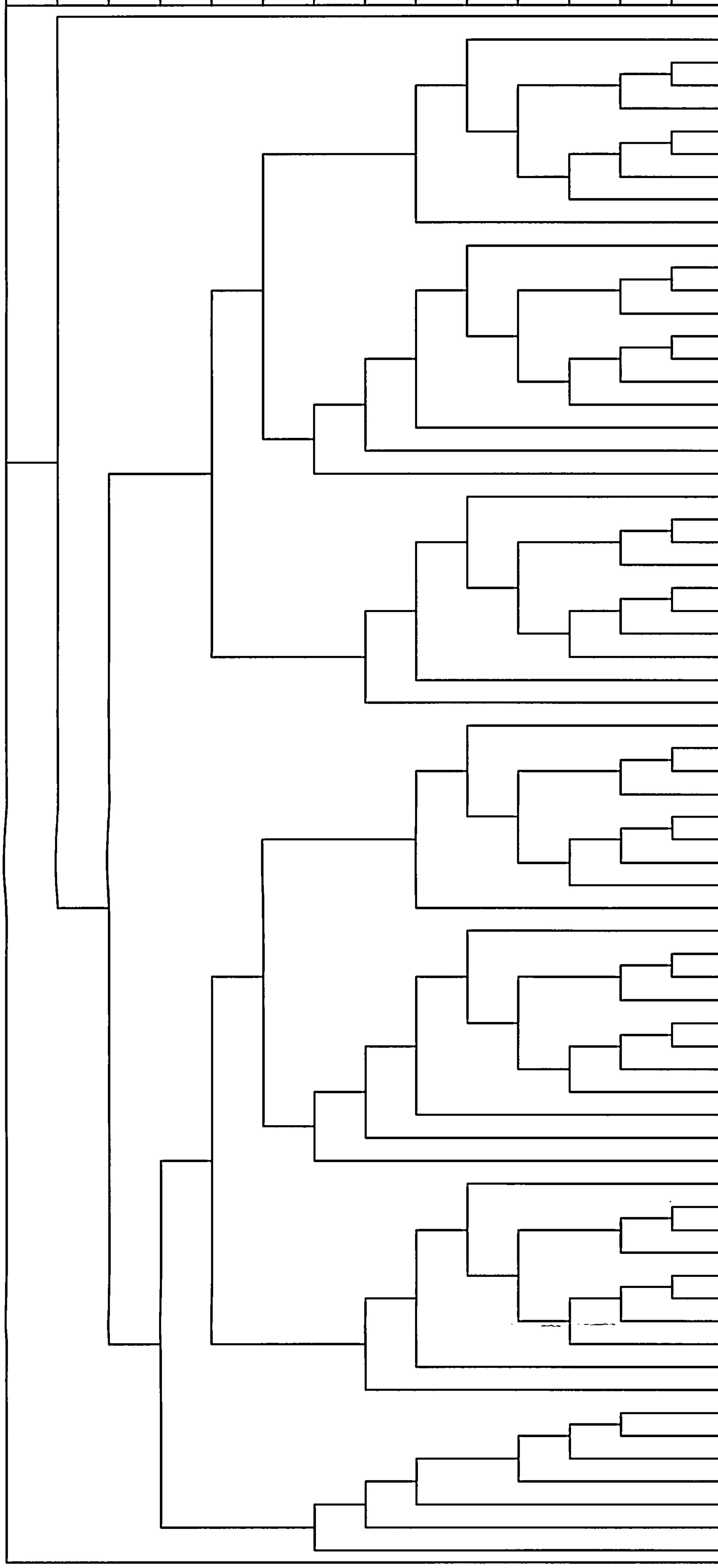
Figure 5-6. WI06B Event Tree

WI06B.pdf

Feedwater Line Break Causes Mod Sprinkler Discharge in Turbine Building	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP	Isolation Before Failure of Buses 6, 61, 62	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
WX06B	I5-	ITD	I6-	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



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S06	WX06BI5-RCPOCD	OK	
S07	WX06BI5-RCPOCDRWC	CD	
S08	WX06BI5-RCPOCDHPI	CD	
S09	WX06BI5-RCPOCDSLC	CD	
S10	WX06BI5-AFX	CD	
S11	WX06BI5-AFR	OK	
S12	WX06BI5-AFRRCP	OK	
S13	WX06BI5-AFRRCPRWC	CD	
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S21	WX06BI5-AFRAFZ	CD	
S22	WX06BI5-AFS	OK	
S23	WX06BI5-AFSRCP	OK	
S24	WX06BI5-AFSRCPRWC	CD	
S25	WX06BI5-AFSRCPHPI	CD	
S26	WX06BI5-AFSRCPOCD	OK	
S27	WX06BI5-AFSRCPOCDRWC	CD	
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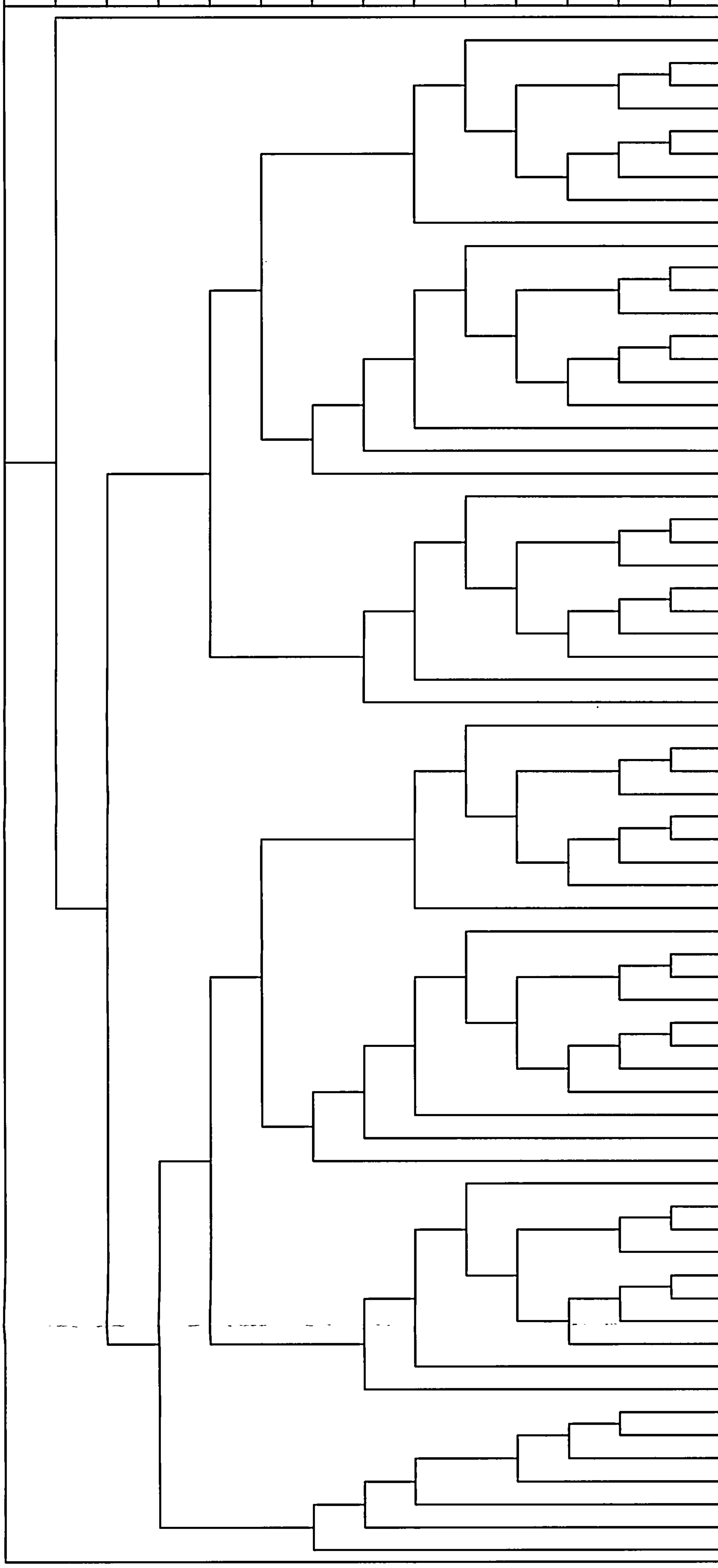
Figure 5-7. WX06B Event Tree

WX06B.pdf

Feedwater Line Break Causes Large Sprinkler Discharge in Turbine Building	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP	Isolation Before Failure of Buses 6, 61, 62	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
W106B	I5-	ITD	I6-	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



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S06	W106BI5-RCPOCD	OK	
S07	W106BI5-RCPOCDRWC	CD	
S08	W106BI5-RCPOCDHPI	CD	
S09	W106BI5-RCPOCDSLC	CD	
S10	W106BI5-AFX	CD	
S11	W106BI5-AFR	OK	
S12	W106BI5-AFRRCP	OK	
S13	W106BI5-AFRRCPRWC	CD	
S14	W106BI5-AFRRCPHPI	CD	
S15	W106BI5-AFRRCPOCD	OK	
S16	W106BI5-AFRRCPOCDRWC	CD	
S17	W106BI5-AFRRCPOCDHPI	CD	
S18	W106BI5-AFRRCPOCDSLC	CD	
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S41	W106BI5-ITDAFR	OK	
S42	W106BI5-ITDAFRRCP	OK	
S43	W106BI5-ITDAFRRCPRWC	CD	
S44	W106BI5-ITDAFRRCPHPI	CD	
S45	W106BI5-ITDAFRRCPOCD	OK	
S46	W106BI5-ITDAFRRCPOCDRWC	CD	
S47	W106BI5-ITDAFRRCPOCDHPI	CD	
S48	W106BI5-ITDAFRRCPOCDSLC	CD	
S49	W106BI5-ITDAFRAFX	CD	
S50	W106BI5-ITDAFRAFT	CD	
S51	W106BI5-ITDAFRAFZ	CD	
S52	W106BI5-ITDAFS	OK	
S53	W106BI5-ITDAFSRCP	OK	
S54	W106BI5-ITDAFSRCPRWC	CD	
S55	W106BI5-ITDAFSRCPHPI	CD	
S56	W106BI5-ITDAFSRCPOCD	OK	
S57	W106BI5-ITDAFSRCPOCDRWC	CD	
S58	W106BI5-ITDAFSRCPOCDHPI	CD	
S59	W106BI5-ITDAFSRCPOCDSLC	CD	
S60	W106BI5-ITDAFSAFX	CD	
S61	W106BI5-ITDAFSAFT	CD	
S62	W106BI5-ITDI6-	OK	
S63	W106BI5-ITDI6-HPI	CD	
S64	W106BI5-ITDI6-SLC	CD	
S65	W106BI5-ITDI6-OCD	CD	
S66	W106BI5-ITDI6-AFX	CD	
S67	W106BI5-ITDI6-AFT	CD	
S68	W106BI5-ITDI6-AFZ	CD	

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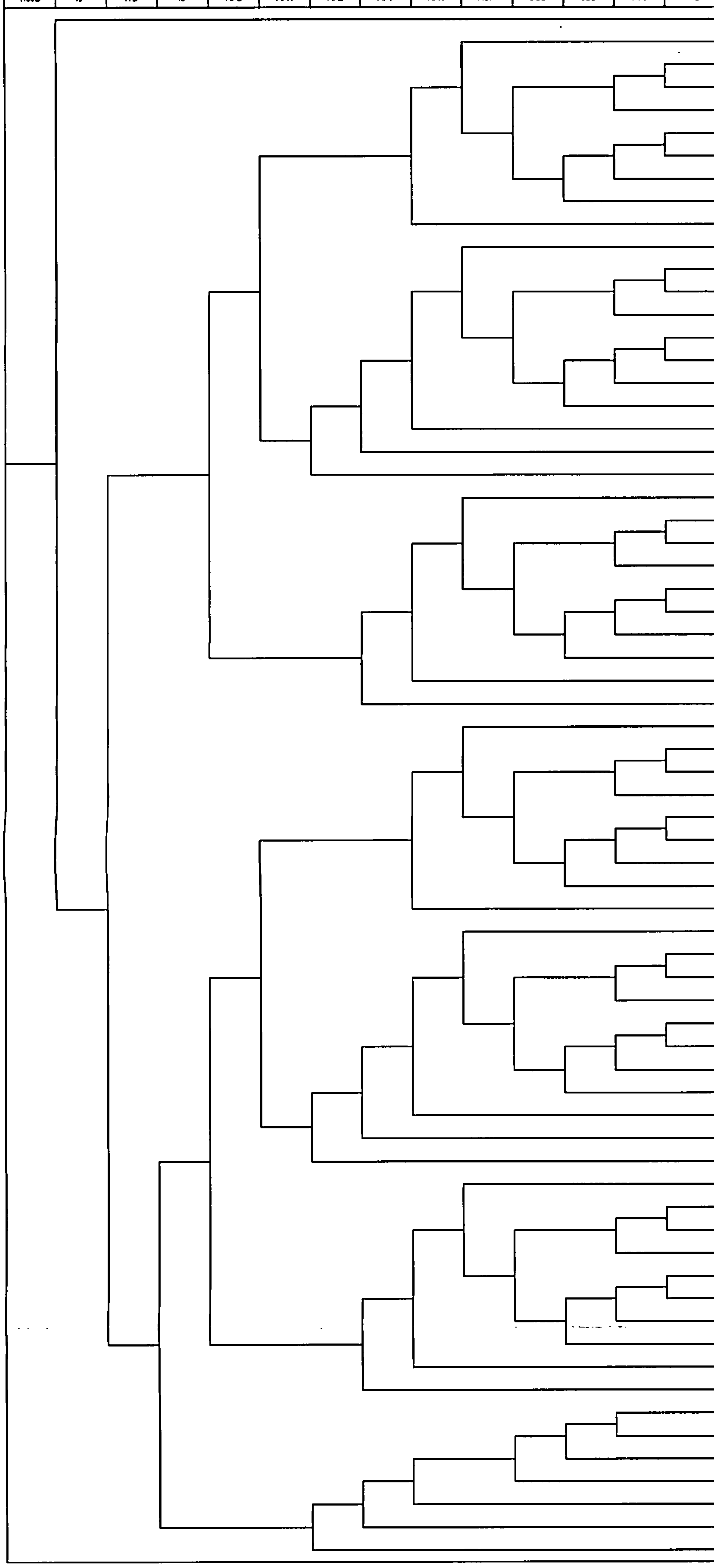
Figure 5-8. TI06B Event Tree

TI06B.pdf

Steam Line Break Causes Large Flood in Turbine Building	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP	Isolation Before Failure of Buses 6, 61, 62	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
TI06B	I5-	ITD	I6-	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



SEQ #	SEQUENCE DESCRIPTOR	PDS #	FREQUENCY
S01	TI06B	OK	
S02	TI06BI5-	OK	
S03	TI06BI5-RCP	OK	
S04	TI06BI5-RCPRWC	CD	
S05	TI06BI5-RCPHPI	CD	
S06	TI06BI5-RCPOCD	OK	
S07	TI06BI5-RCPOCDRWC	CD	
S08	TI06BI5-RCPOCDHPI	CD	
S09	TI06BI5-RCPOCDSLC	CD	
S10	TI06BI5-AFX	CD	
S11	TI06BI5-AFR	OK	
S12	TI06BI5-AFRRCP	OK	
S13	TI06BI5-AFRRCPRWC	CD	
S14	TI06BI5-AFRRCPHPI	CD	
S15	TI06BI5-AFRRCPOCD	OK	
S16	TI06BI5-AFRRCPOCDRWC	CD	
S17	TI06BI5-AFRRCPOCDHPI	CD	
S18	TI06BI5-AFRRCPOCDSLC	CD	
S19	TI06BI5-AFRAFX	CD	
S20	TI06BI5-AFRAFT	CD	
S21	TI06BI5-AFRAFZ	CD	
S22	TI06BI5-AFS	OK	
S23	TI06BI5-AFSRCP	OK	
S24	TI06BI5-AFSRCPRWC	CD	
S25	TI06BI5-AFSRCPHPI	CD	
S26	TI06BI5-AFSRCPOCD	OK	
S27	TI06BI5-AFSRCPOCDRWC	CD	
S28	TI06BI5-AFSRCPOCDHPI	CD	
S29	TI06BI5-AFSRCPOCDSLC	CD	
S30	TI06BI5-AFSAFX	CD	
S31	TI06BI5-AFSAFT	CD	
S32	TI06BI5-ITD	OK	
S33	TI06BI5-ITDRCP	OK	
S34	TI06BI5-ITDRCPRWC	CD	
S35	TI06BI5-ITDRCPHPI	CD	
S36	TI06BI5-ITDRCPOCD	OK	
S37	TI06BI5-ITDRCPOCDRWC	CD	
S38	TI06BI5-ITDRCPOCDHPI	CD	
S39	TI06BI5-ITDRCPOCDSLC	CD	
S40	TI06BI5-ITDAFX	CD	
S41	TI06BI5-ITDAFR	OK	
S42	TI06BI5-ITDAFRRCP	OK	
S43	TI06BI5-ITDAFRRCPRWC	CD	
S44	TI06BI5-ITDAFRRCPHPI	CD	
S45	TI06BI5-ITDAFRRCPOCD	OK	
S46	TI06BI5-ITDAFRRCPOCDRWC	CD	
S47	TI06BI5-ITDAFRRCPOCDHPI	CD	
S48	TI06BI5-ITDAFRRCPOCDSLC	CD	
S49	TI06BI5-ITDAFRAFX	CD	
S50	TI06BI5-ITDAFRAFT	CD	
S51	TI06BI5-ITDAFRAFZ	CD	
S52	TI06BI5-ITDAFS	OK	
S53	TI06BI5-ITDAFSRCP	OK	
S54	TI06BI5-ITDAFSRCPRWC	CD	
S55	TI06BI5-ITDAFSRCPHPI	CD	
S56	TI06BI5-ITDAFSRCPOCD	OK	
S57	TI06BI5-ITDAFSRCPOCDRWC	CD	
S58	TI06BI5-ITDAFSRCPOCDHPI	CD	
S59	TI06BI5-ITDAFSRCPOCDSLC	CD	
S60	TI06BI5-ITDAFSAFX	CD	
S61	TI06BI5-ITDAFSAFT	CD	
S62	TI06BI5-ITDI6-	OK	
S63	TI06BI5-ITDI6-HPI	CD	
S64	TI06BI5-ITDI6-SLC	CD	
S65	TI06BI5-ITDI6-OCD	CD	
S66	TI06BI5-ITDI6-AFX	CD	
S67	TI06BI5-ITDI6-AFT	CD	
S68	TI06BI5-ITDI6-AFZ	CD	

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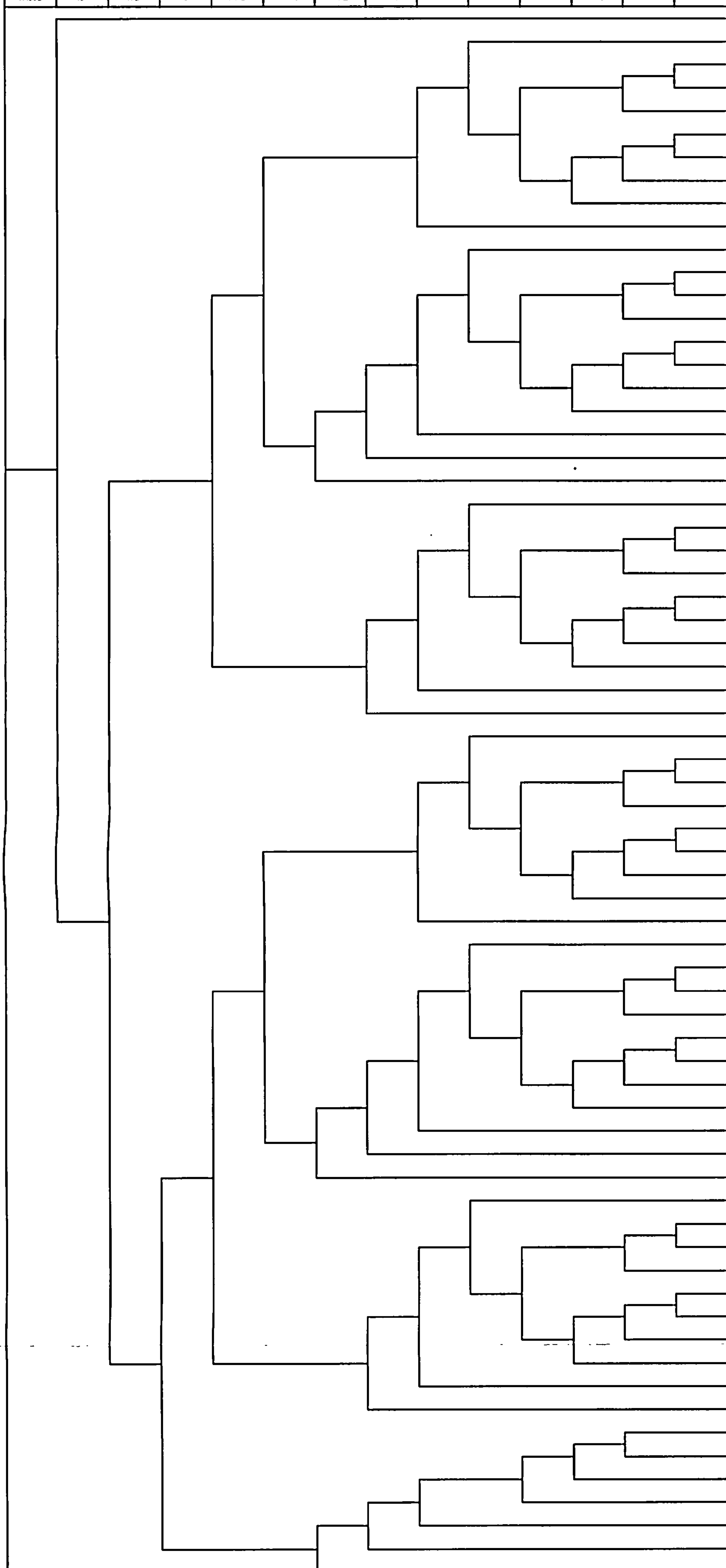
Figure 5-9. TX06B Event Tree

TX06B.pdf

Steam Line Break Causes Mod Flood in Turbine Building	Isolation Before Failure Of Any Buses	Isolation Before Failure Of AFWP ALOP	Isolation Before Failure of Buses 6, 61, 62	Motor Driven AFW Pump Starts	Motor Driven AFW Pump Runs	Operator Starts TDAFP	TDAFP Starts And Runs	Manual Control Of AFW System	RXCP Seal Cooling	RCS Cooldown	Small RCP Seal LOCA	ECCS Injection	Conserve RWST Inventory ECA-1.1
TX06B	I5-	ITD	I6-	AFS	AFR	AFZ	AFT	AFX	RCP	OCD	SLC	HPI	RWC



SEQ #	SEQUENCE DESCRIPTOR	PDS #	FREQUENCY
S01	TX06B	OK	
S02	TX06BI5-	OK	
S03	TX06BI5-RCP	OK	
S04	TX06BI5-RCPRWC	0	
S05	TX06BI5-RCPHPI	0	
S06	TX06BI5-RCPOCD	OK	
S07	TX06BI5-RCPOCDRWC	0	
S08	TX06BI5-RCPOCDHPI	0	
S09	TX06BI5-RCPOCDSLC	0	
S10	TX06BI5-AFX	0	
S11	TX06BI5-AFR	OK	
S12	TX06BI5-AFRRCP	OK	
S13	TX06BI5-AFRRCPRWC	0	
S14	TX06BI5-AFRRCPHPI	0	
S15	TX06BI5-AFRRCPOCD	OK	
S16	TX06BI5-AFRRCPOCDRWC	0	
S17	TX06BI5-AFRRCPOCDHPI	0	
S18	TX06BI5-AFRRCPOCDSLC	0	
S19	TX06BI5-AFRAFX	0	
S20	TX06BI5-AFRAFT	0	
S21	TX06BI5-AFRAFZ	0	
S22	TX06BI5-AFS	OK	
S23	TX06BI5-AFSRCP	OK	
S24	TX06BI5-AFSRCPRWC	0	
S25	TX06BI5-AFSRCPHPI	0	
S26	TX06BI5-AFSRCPOCD	OK	
S27	TX06BI5-AFSRCPOCDRWC	0	
S28	TX06BI5-AFSRCPOCDHPI	0	
S29	TX06BI5-AFSRCPOCDSLC	0	
S30	TX06BI5-AFSAFX	0	
S31	TX06BI5-AFSAFT	0	
S32	TX06BI5-ITD	OK	
S33	TX06BI5-ITDRCP	OK	
S34	TX06BI5-ITDRCPRWC	0	
S35	TX06BI5-ITDRCPHPI	0	
S36	TX06BI5-ITDRCPOCD	OK	
S37	TX06BI5-ITDRCPOCDRWC	0	
S38	TX06BI5-ITDRCPOCDHPI	0	
S39	TX06BI5-ITDRCPOCDSLC	0	
S40	TX06BI5-ITDAFX	0	
S41	TX06BI5-ITDAFR	OK	
S42	TX06BI5-ITDAFRRCP	OK	
S43	TX06BI5-ITDAFRRCPRWC	0	
S44	TX06BI5-ITDAFRRCPHPI	0	
S45	TX06BI5-ITDAFRRCPOCD	OK	
S46	TX06BI5-ITDAFRRCPOCDRWC	0	
S47	TX06BI5-ITDAFRRCPOCDHPI	0	
S48	TX06BI5-ITDAFRRCPOCDSLC	0	
S49	TX06BI5-ITDAFRAFX	0	
S50	TX06BI5-ITDAFRAFT	0	
S51	TX06BI5-ITDAFRAFZ	0	
S52	TX06BI5-ITDAFS	OK	
S53	TX06BI5-ITDAFSRCP	OK	
S54	TX06BI5-ITDAFSRCPRWC	0	
S55	TX06BI5-ITDAFSRCPHPI	0	
S56	TX06BI5-ITDAFSRCPOCD	OK	
S57	TX06BI5-ITDAFSRCPOCDRWC	0	
S58	TX06BI5-ITDAFSRCPOCDHPI	0	
S59	TX06BI5-ITDAFSRCPOCDSLC	0	
S60	TX06BI5-ITDAFSAFX	0	
S61	TX06BI5-ITDAFSAFT	0	
S62	TX06BI5-ITDI6-	OK	
S63	TX06BI5-ITDI6-HPI	0	
S64	TX06BI5-ITDI6-SLC	0	
S65	TX06BI5-ITDI6-OCD	0	
S66	TX06BI5-ITDI6-AFX	0	
S67	TX06BI5-ITDI6-AFT	0	
S68	TX06BI5-ITDI6-AFZ	0	

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Appendix D

Accident Sequence Analysis

Attachment 1 – Battery Discharge Analysis

Battery Discharge Analysis

Prepared by: Paul E Snyder (signature) — Paul E. Snyder

Signature — Print Name

10/26/05

Date

Reviewed by: DJ Will (signature) — Dave Will

Signature — Print Name

10/26/05

Date

This evaluation will determine whether the safeguards batteries can carry normal DC bus loading for a minimum of 24 hours following a flooding event that results in loss of the safeguards battery chargers, provided the inverters are disconnected from their associated battery within 4 hours of losing their associated battery charger.

The total amount of Amp-hours required from each battery during the 24 hour period will be determined by taking the amp-hours required during the first four hours that the inverters are connected, and adding the amp-hours required for the remaining 20 hours. The total amp-hours required will be corrected for battery temperature and load uncertainties, and then be compared to the rated capacity of the batteries to determine if there is adequate capacity for the desired 24 hour duration.

Safeguards Batteries BRA-101 and BRB-101 are C&D Technologies model LCR-19. The 8 hour rated capacity of a LCR-19 battery (Based on vendor instruction 12-334) is 1304 Amp-hours to a final voltage of 1.78 volts per cell at 77 degrees F. The minimum possible battery electrolyte temperature is 65 degrees F. The temperature correction factor based on IEEE-485-1983 for that temperature is 1.08.

Calculation C-038-002 Revision 4, titled "125VDC Battery BRA-101 and BRB-101 Duty Cycle" provides the expected loading on the safeguards batteries. The continuous loads have been rounded up to the nearest whole number. The calculated load for BRA-101 is 108 Amps with the inverters connected, and 18 Amps without. The calculated load for BRB-101 is 105 Amps with the inverters connected, and 15 Amps without.

The continuous loads are used in this evaluation, since the momentary loads that exist during the first minute of the calculated battery discharge are not expected to exist on the battery during the flooding event. Also, any momentary load that would exist on the battery during the initial stages of the event would be absorbed by their associated battery charger. The battery chargers will to be connected to their associated DC bus during the initial plant transient.

As a result of the flooding event, there will be additional load on the batteries due to leakage current through the control power circuitry for buses 1-5 and 1-6. Each control power circuit could have as much as 10.5 Amps, assuming that there is a resistance of 25 ohms between each of the secondary disconnect pins that are submerged. This assumption is based on testing performed by Bussmann. There are a total of 11 control power circuits for each of the two buses. Therefore, there will be an additional 115.5 Amps on each battery that may take up to 6 minutes to clear (based on the Westinghouse type EHD2070 circuit breaker time/current curve No. SC-4143-87A). The load would clear as a result of the 70 Amp circuit breaker that supplies the DC control power, opening on an overload condition.

The required capacity of each battery is determined below:

a. BRA-101:

- Required capacity during first four hours:

  108 Amps * 4 hours = 432 Amp-hours (calculated current)
  115.5 Amps * 6 minutes = 11.6 Amp-hours (additional leakage current)
  432 Amp-hours + 11.6 Amp-hours = 443.6 Amp-hours

- Amount of capacity required during the remaining 20 hours:

  18 Amps X 20 hours = 360 Amp-hours

- Total Amp-hours required during the 24 hour period:

  443.6 Amp-hours + 360 Amp-hours = **803.6 Amp-hours**

b. BRB-101:

- Required capacity during first four hours:

  105 Amps * 4 hours = 420 Amp-hours (calculated current)
  115.5 Amps * 6 minutes = 11.6 Amp-hours (additional leakage current)
  420 Amp-hours + 11.6 Amp-hours = 431.6 Amp-hours

- Amount of capacity required during the remaining 20 hours:

  15 Amps X 20 hours = 300 Amp-hours

- Total Amp-hours required during the 24 hour period:

  431.6 Amp-hours + 300 Amp-hours = **731.6 Amp-hours**

The total Amp-hours required for each battery are corrected for the lowest possible battery temperature of 65 degrees F. Applying the temperature correction factor of 1.08 to the required capacity of each battery shows that **867.9 Amp-hours** is required for BRA-101, and **790.1 Amp-hours** is required for BRB-101.

The required battery capacity is compared to the 8 hour discharge rating and the 3 hour discharge rating. There are no published Amp-Hour ratings for any duration greater than 8 hours. However, the published discharge ratings show the relationship between the battery discharge rate and capacity is not linear. The 8 hour rating for a C&D LCR-19 battery is 1304 Amp-hours and the 3 hour rating is 1054 Amp-hours. The ratings show that as you decrease the discharge rate, the overall capacity of the battery increases. Therefore, it is considered conservative to use the 8 hour discharge rate to determine the battery capacity for

a 24 hour discharge. BRA-101 requires the highest capacity, 866.2 Amp-hours, which is considerably less than the 8 hour rated capacity of the battery. The required capacity of each battery is also greater than the 3 hour rating.

Therefore, BRA-101 and BRB-101 are expected to provide adequate power to their respective DC buses for a minimum of 24 hours following the loss of the battery chargers, provided the inverters are secured within 4 hours of a loss of the battery chargers.

Appendix D

Accident Sequence Analysis

Attachment 2 – Timelines

Timelines

Prepared by: George E Baldwin (signature) — Signature

George E Baldwin — Print Name

10/28/05 — Date

Reviewed by: Jeffrey T. Stafford (signature) — Signature

JEFFREY T. STAFFORD — Print Name

10-28-05 — Date

Scenario 1 – Fire Water Line break in the Turbine Building.

Assumptions:

- Event happens prior to January 2005
- Leak rate is 6000 gpm
- Plant at 100% power

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
0	N/A	N/A	Annunciator 47054-L, Fire Pump Abnormal, and/or 47052-L, Fire Protection HDR Pressure Low, activates.	N/A	N/A	N/A	N/A	N/A	Normal* *** Normal conditions indicate the environment has not significantly changed by the event.**
0.8	ARP 47054-L Step 3 and/or ARP 47052-L	If no fire is detected, verify proper operation of Fire Jockey Pump and Check Fire Protection header for leaks	• NCO responds to alarm and opens ARP 47054-L, Fire Pump Abnormal, and/or ARP 47052-L, Fire Protection HDR Pressure Low. • NCO directs the NAO to investigate problem. **Note:** Start of both Fire Pumps would indicate a leak without fire indication, thus may direct search for leak first.	Control Room	N/A	N/A	N/A	N/A	Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
2.8	ARP 47054-L Step 3 and/or ARP 47052-L	Verify proper operation of Fire Jockey Pump and Check Fire Protection header for leaks	NAO starts investigation of the fire system problem **Note:** Start point would vary so it is assumed to be at the most remote position from leak.	Turbine Building	From where NAO is to Turbine Building Basement	1	N/A	N/A	Normal except in the leak area
7.8	ARP 47054-L Step 3 and/or ARP 47052-L	Check Fire Protection header for leaks	NAO reports fire header rupture to the Control Room		Around Turbine Building Basement	1	To Screenhouse	1	Approximate 30,000 gallons flow into the Turbine Building Basement. Below floor grade is about half full and increasing. Floor wet around leak and flow path to low point. Water temperature would be <70 degrees through out scenario due to cold water only from fire header.
18.6			Control Room directs the isolation of the Fire Pumps by closing pump discharge valves.	Turbine Building Basement	N/A	N/A	N/A	N/A	Same as previously identified for the operator.

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
23.6			NAO transit to Screenhouse	Turbine Building Basement to Screenhouse	Turbine Building Basement to Bus 61 room then to Bus 51 room. Bus 51 to Cardox room to D/G B room then to Screenhouse.	1	Turbine Building Basement to Cardox room to D/G B room then to Screenhouse.	5	Normal conditions once safeguard alley is entered.
26.6			Operator shuts FP-2A	Screenhouse	Screenhouse	1	N/A	N/A	Normal **Note: At approximately 9 minutes the trenches start to over flow putting water onto the floor.**
29.6			Operator shuts FP-2B	Screenhouse	Screenhouse	1	N/A	N/A	Normal

*** Normal conditions indicate the environment has not significantly changed by the event.**

Scenario 2 – Feedwater Line break in the Turbine Building, which activates all sprinklers

Assumptions:

- Event happens prior to January 2005
- Feedwater break injects 80,000 gallons into turbine building
- Sprinkler flow rate is 6000 gpm
- Plant at 100% power

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
0	N/A	N/A	• Annunciator 47033-P, Miscellaneous Sump Level High, activates. • Annunciator 47054-L, Fire Pump Abnormal, 47051-L, Fire Detection System Activation, and/or 47052-L, Fire Protection HDR Pressure Low, activates. • Reactor trip on Low S/G Level due to the loss of Feedwater.	N/A	N/A	N/A	N/A	N/A	Normal* *** Normal conditions indicate the environment has not significantly changed by the event.**
2	E-FP-08, Step 3.2.1.a	If fire detectors are actuated, then request NAO evaluate and report conditions.	• SM Directs NAO to Investigate	Control Room	N/A	N/A	N/A	N/A	Normal
3	E-0, Steps 1-4	1. Verify Reactor Trip 2. Verify Turbine Trip 3. Verify Power to Emergency AC Buses 4. Check SI Status	• Verify Reactor Trip • Verify Turbine Trip • Verify power to Bus 5 or 6 • Verify SI Actuation or if required	Control Room	N/A	N/A	N/A	N/A	Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
3.8	E-0, Step 4 RNO a.3	If SI is not required, then announce Reactor Trip and go to ES-0.1, Reactor	• Operators transition to ES-0.1 • Announce Fire in Turbine Building and Sound Alarm	Control Room	N/A	N/A	N/A	N/A	Normal
5	E-FP-08, Step 3.2.1.a	If fire detectors are actuated, then request NAO evaluate and report conditions.	• NAO reports lots of steam; too hot to enter.	Turbine Building	To Turbine Building entry	1	N/A	N/A	Turbine Building air temperature is about 145F or less.
5.4	ES-0.1, Step 2.d	Stop Both Main Feedwater Pumps and Place In Pullout	• Both Main Feedwater Pumps placed in pullout	Control Room	N/A	N/A	N/A	N/A	Normal
7		Shift Manager (SM) and Control Room Supervisor (CRS) split activities – CRS pursues reactor trip response and SM the perceived fire in the Turbine Building	• CRS, STA, and NCO continue in ES-0.1 to address the Rx trip. • SM and Fire Brigade address the perceived fire in the Turbine Building • **Note:** Fire Brigade is made of NAO (2), Health Physicist, and Security Force	Control Room	N/A	N/A	N/A	N/A	Normal
			Operators wait for environmental conditions to support entry into Turbine building.						The turbine Building air temperature is about 133F or less.
15	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	SM directs the isolation of the Turbine Building Fire Sprinkler on the Mezzanine level.	Control Room	N/A	N/A	N/A	N/A	Normal
18.4	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• NAO is dressed out in turnout gear (protective fire gear)	Control Room		N/A	N/A		Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
21	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-276 and FP-278	Turbine Mezzanine	Control Room to Turbine Mezzanine	0.5	N/A	N/A	
24.4	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-348 & FP-346	Turbine Mezzanine	Turbine Mezzanine	1.4	N/A	N/A	
28	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-270 and FP-336	Turbine Building Basement	Turbine Mezzanine to Turbine Building Basement	2.5	N/A	N/A	

*** Normal conditions indicate the environment has not significantly changed by the event.**

For a 50,000 gallon break:
At 8.4 minutes: Turbine Building Basement air temperature is about 111F or less. The liquid water temperature is about 111F.
At 10.5 minutes: The turbine Building air temperature is about 100F or less. The liquid water temperature is about 100F. Any water leaking into Safeguards Alley will be about this temperature. Safeguards Alley will be heated by the hot water to about the water temperature.

Scenario 3 – Steam Line break in the Turbine Building, which activates all sprinklers

Assumptions:

- Event happens prior to January 2005
- Steam Line break does not cause Safety injection
- Sprinkler flow rate is 6000 gpm
- Plant at 100% power

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
0	N/A	N/A	• Annunciator 47033-P, Miscellaneous Sump Level High, activates. • Annunciator 47054-L, Fire Pump Abnormal, 47051-L, Fire Detection System Activation, and/or 47052-L, Fire Protection HDR Pressure Low, activates. • Reactor trip on Low S/G Level due to the loss of Feedwater.	N/A	N/A	N/A	N/A	N/A	Normal* *** Normal conditions indicate the environment has not significantly changed by the event.**
2	E-FP-08, Step 3.2.1.a	If fire detectors are actuated, then request NAO evaluate and report conditions.	• SM Directs NAO to Investigate	Control Room	N/A	N/A	N/A	N/A	Normal
3	E-0, Steps 1-4	1) Verify Reactor Trip 2) Verify Turbine Trip 3) Verify Power to Emergency AC Buses 4) Check SI Status	• Verify Reactor Trip • Verify Turbine Trip • Verify power to Bus 5 or 6 • Verify SI Actuation or if required	Control Room	N/A	N/A	N/A	N/A	Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
3.8	E-0, Step 4 RNO a.3	If SI is not required, then announce Reactor Trip and go to ES-0.1, Reactor	• Operators transition to ES-0.1 • Announce Fire in Turbine Building and Sound Alarm	Control Room	N/A	N/A	N/A	N/A	Normal
5	E-FP-08, Step 3.2.1.a	If fire detectors are actuated, then request NAO evaluate and report conditions.	• NAO reports lots of steam; too hot to enter.	Turbine Building	To Turbine Building entry	1	N/A	N/A	Turbine Building air temperature is about 145F or less.
5.4	ES-0.1, Step 2.d	Stop Both Main Feedwater Pumps and Place In Pullout	• Both Main Feedwater Pumps placed in pullout	Control Room	N/A	N/A	N/A	N/A	Normal
7		Shift Manager (SM) and Control Room Supervisor (CRS) split activities – CRS pursues reactor trip response and SM the perceived fire in the Turbine Building	• CRS, STA, and NCO continue in ES-0.1 to address the Rx trip. • SM and Fire Brigade address the perceived fire in the Turbine Building • **Note:** Fire Brigade is made of NAO (2), Health Physicist, and Security Force	Control Room	N/A	N/A	N/A	N/A	Normal
			Operators wait for environmental conditions to support entry into Turbine building.						The turbine Building air temperature is about 133F or less.
15	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	SM directs the isolation of the Turbine Building Fire Sprinkler on the Mezzanine level.	Control Room	N/A	N/A	N/A	N/A	Normal
18.4	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• NAO is dressed out in turnout gear (protective fire gear)	Control Room		N/A	N/A		Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
21	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-276 and FP-278	Turbine Mezzanine	Control Room to Turbine Mezzanine	0.5	N/A	N/A	
24.4	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-348 & FP-346	Turbine Mezzanine	Turbine Mezzanine	1.4	N/A	N/A	
28	N-FP-08, Step 4.3.1.a	Manually, Isolate actuated sprinkler systems for replacement of fusible links.	• Operator shuts FP-270 and FP-336	Turbine Building Basement	Turbine Mezzanine to Turbine Building Basement	2.5	N/A	N/A	

*** Normal conditions indicate the environment has not significantly changed by the event.**

Scenario 4 – Service Water Line break in the Turbine Building.

Assumptions:

- Event happens prior to January 2005
- Leak rate is 6000 gpm
- Plant at 100% power

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
0		N/A	Annunciator 47033-P, Miscellaneous Sump Level High, activates	N/A	N/A	N/A	N/A	N/A	Normal* *** Normal conditions indicate the environment has not significantly changed by the event.**
1		ARP 47033-P, Miscellaneous Sump Level High	Enter A-MDS-30	Control Room	N/A	N/A	N/A	N/A	Normal
1.8	A-MDS-30, Step 4.1	Dispatch Operator to Investigate alarm	Control directs NAO to Investigate	Control Room	N/A	N/A	N/A	N/A	Normal except in the leak area
5.8	A-MDS-30, Step 4.1	Dispatch Operator to Investigate alarm	NAO tours Turbine Building Basement and reports Service Water (SW) break	Turbine Building	Turbine Building	1	N/A	N/A	Normal except in the leak area
6.7			Operators enter A-SW-02, Abnormal Service Water Operation.	Control Room	N/A	N/A	N/A	N/A	Normal
13	A-SW-02, step 6, RNO b.3	Position Turbine Bldg SW Header Selector switch to ISOL	Operator shifts header and then isolates header when leak continues.	Control Room	N/A	N/A	N/A	N/A	Normal

*** Normal conditions indicate the environment has not significantly changed by the event.**

Scenario 5 – Circulating Water Line break in the Turbine Building.

Assumptions:

- Event happens prior to January 2005
- Leak rate is 14,000 gpm
- Plant at 100% power

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
0		N/A	Annunciator 47033-P, Miscellaneous Sump Level High, activates	N/A	N/A	N/A	N/A	N/A	Normal* *** Normal conditions indicate the environment has not significantly changed by the event.**
1		ARP 47033-P, Miscellaneous Sump Level High	Enter A-MDS-30	Control Room	N/A	N/A	N/A	N/A	Normal
1.8	A-MDS-30, Step 4.1	Dispatch Operator to Investigate alarm	Control directs NAO to Investigate	Control Room	N/A	N/A	N/A	N/A	Normal
5.8	A-MDS-30, Step 4.1	Dispatch Operator to Investigate alarm	NAO tours Turbine Building Basement and reports Circ. Water (CW) break	Turbine Building	Turbine Building	1	N/A	N/A	Normal except in the leak area
6.6			Control Room Supervisor directs the tripping of the plant	Control Room	N/A	N/A	N/A	N/A	Normal
7.4			Control Room operators trip the plant	Control Room	N/A	N/A	N/A	N/A	Normal
8.2			Control Room Supervisor directs the tripping of the CW Pumps	Control Room	N/A	N/A	N/A	N/A	Normal

Time from start of event (minutes)	Procedure and step Number	Procedure direction	Operator Action	Location Of Operator Action	Transit Path	Transit Time	Alternate Path	Alternate Path additional Transit Time	Expected Environment
9			Control Room operators trip the CW pumps	Control Room	N/A	N/A	N/A	N/A	Normal

*** Normal conditions indicate the environment has not significantly changed by the event**

Appendix D

Accident Sequence Analysis

Attachment 3 - Assessment of Potential for Spray on RAT Breakers on Mezzanine Level

Assessment of Potential for Spray on RAT Breakers on Mezzanine Level

Prepared by: ______________________ Raymond Dremel
Signature Print Name

10/28/05
Date

Reviewed by: ______________________ Diane M Jones
Signature Print Name

10/28/05
Date

N/A
Date

Assessment of Potential for Spray on RAT Breakers on Mezzanine Level

The purpose of this document is to address the likelihood of spray-induced failure of buses 3 and 4 resulting in loss of the Reserve Auxiliary Transformer (RAT). These buses are located on the mezzanine level of the Turbine Building between column lines 8 and 9 and lines A and C. Loss of the RAT could occur if the flooding shorts the power supply connections to the RAT.

No fire protection water, service water, circulating water, condensate, or feedwater piping is located in the vicinity of Buses 3 and 4. Therefore, failure of the buses from these sources is not credible.

Several large main steam pipes are located in the overhead near buses 3 and 4. A failure of one of these pipes could spray buses 3 and 4, however, such an event is considered unlikely for several reasons. First, only a small portion of the main steam piping is located in the area near the buses. Using the pipe data generated for the initiating event frequency calculation, less than 110 linear feet of steam piping is located north of column line 7 and west of column line C. This total overstates the amount of piping of concern because some of the piping in that total originates near column line 5 and continues to column line 7. Other piping originates near column line D and continues to column line C. No steam piping was identified between column lines A and B on the mezzanine level. Therefore of a total length of 2590 linear feet of piping, only a 110 feet, or 4.2% is located such that a pipe break could impact bus 3 or 4.

Second, of the pipe located in the vicinity of buses 3 and 4, any break must spray directly on the buses to be of concern. Any break which sprays away from the buses would not challenge the buses such that offsite power from the RAT would be challenged. From visual inspections of the area, only spray in a 45-degree horizontal arc toward the buses would be of concern. Therefore only 12% of the breaks in the piping located near the buses would potentially threaten the buses.

From the above conservative estimates, only 0.0053 of the total steam line break frequency could potentially impact the availability of offsite power to other buses.

In event of a steam line break impinging on Bus 3 and/or Bus 4, the loss of the bus has little impact on the recovery of a battery charger. Steam impingement would cause a loss of Reserve Auxiliary Transformer (RAT) however the Tertiary Auxiliary Transformer (TAT) would remain available as the TAT supplies only Buses 5 and 6. Bus 6 is normally powered from RAT however the Diesel would automatically on load on the bus. Additionally the operator could also manually load Bus 6 on to the TAT.

As discussed above, feedwater, condensate, fire protection water, service water, and circulating water pipes are located away from buses 3 and 4. Therefore only steam line breaks could potentially fail bus 3 or 4 by direct spray. Of the steam line breaks, only a small fraction (0.0053) of the potential steam line breaks could potentially impinge on bus3 or 4. Even if a break does impact buses 3 and 4, the impact of the failure on the

overall accident progression is minimal. Therefore, it is concluded that the risk from spray-induced failure of buses 3 or 4 resulting in loss of the RAT is a negligible contribution to overall plant flooding risk.

Appendix D

Accident Sequence Analysis

Attachment 4 – Loss of Reserve Auxiliary Transformer (RAT) Auxiliaries

Loss of Reserve Auxiliary Transformer (RAT) Auxiliaries

Prepared by: George E Baldwin (signature) — George E Baldwin
Signature — Print Name

10/18/05
Date

Reviewed by: Paul E Snyder (signature) — Paul E. Snyder
Signature — Print Name

10/21/05
Date

Loss of Reserve Auxiliary Transformer (RAT) Auxiliaries

The RAT Auxiliaries provide oil circulation and fans for transformer cooling. These auxiliaries are power from MCC-42A[1], which is located in the southeast corner area of the Turbine Building Basement[2]. MCC-42A and MCC-42G share a common breaker on 480V Bus 42[3]. MCC-42G is located on the west side of Turbine Mezzanine between the Feedwater heaters[4].

The loss of the RAT auxiliaries reduces the RAT capacity from 40 MVA to 24 MVA[5]. The stopping of the Main Feedwater (5000 hp)[6] or Reactor Coolant (6000 hp)[7] Pumps would reduce the load with in this limit. The flooding event will cause a loss of Main Feedwater Pumps early in the event thus reducing load on the RAT to less than 24 MVA. In general, as the flood causes breakers to trip the load on RAT is reduced.

[1] DWG. E-410
[2] DWG. A-203
[3] DWG. E-240
[4] DWG. A-205
[5] Kewaunee System Description 39, page 6
[6] Kewaunee System Description 05A, page 8
[7] Kewaunee System Description 36, page 19

Appendix D

Accident Sequence Analysis

Attachment 5 - Steam Generator (S/G) Power Operated Relief Valve (PORV) Operation During Turbine Building Flood Event

Steam Generator (S/G) Power Operated Relief Valve (PORV) Operation During Turbine Building Flood Event

Prepared by: George E Baldwin (signature) George E. Baldwin
Signature Print Name

10/18/05
Date

Reviewed by: Jeffrey T. Stafford (signature) JEFFREY T. STAFFORD
Signature Print Name

10-18-05
Date

Steam Generator (S/G) Power Operated Relief Valve (PORV) Operation During Turbine Building Flood Event

In a Turbine Building Basement flood event, the operators by procedure would eventually operate the S/G PORV by local manual means to cooldown the Reactor Coolant System (RCS). This would happen approximately four hours into the event due to a loss of Instrument Air. DC control power would remain available for a minimum of 8-9 hours into the event, however the backup nitrogen would run out in approximately 4 hours after loss of the air compressors[1].

The loss of Instrument Air occurs sequential with the flood. Both "F" and "G" Air Compressors are located in the Turbine Building Basement[2] and would be lost early in the flood. Instrument Air compressors "A" and "C" is powered off Bus 52 via MCC-5262[3] and MCC-52A[4] and would be lost with the loss of Bus 52. Instrument Air Compressor "B" is powered off MCC-62A[5] and would be lost with the loss of Bus 62. With the loss of the air compressors, Instrument Air pressure would decrease. Once the Instrument Air pressure goes less than 60 psig, E-AS-01, *Loss of Instrument Air*, would be entered. Both S/G PORVs (SD-3A and SD-3B) are equipped with a 4-hour Nitrogen backup. However the procedure also directs the operator to locally operate SD-3A and SD-3B if the valves fail to operate, which would be the case when the nitrogen flask is emptied.

[1] Kewaunee System Description 06, page 8 and E-AS-01
[2] DWG. A-203
[3] DWG. E-416 and N-ELV-40
[4] DWG. E-417
[5] DWG. E-417

Appendix E

Non-Seismic Quantification

Non-Seismic Quantification

Owner's Acceptance: Thomas G Hook (signature) THOMAS G HOOK

Signature / Print Name

10-30-05

Date

Kewaunee Nuclear Power Plant

Quantification for Turbine Building Floods

Effective Date: October 2005

S E Guokas — 10/29/05

Prepared By: S. E. Guokas — Date

D M Jones — 10/29/05

Reviewed By: D. M. Jones — Date

Table of Contents

List of Tables

INTERNAL FLOODING – Quantification for Turbine Building Floods

1.0 PURPOSE

The purpose of this quantification appendix is to document the quantification of the core damage frequency (CDF) for floods due to pipe breaks in the Turbine Building at Kewaunee Power Station (KPS). This model applies to the plant configuration before February 2005.

2.0 UNIT DIFFERENCES

Kewaunee is a single unit site so there are no unit differences.

3.0 RISK MONITOR CONSIDERATIONS

The risk monitor used at KPS is the Safety Monitor. Modification of the Safety Monitor model is outside the scope of this analysis.

4.0 METHODOLOGY

The core damage frequency (CDF) for pipe breaks in the Turbine Building is quantified using the WinNUPRA 3.0 software package [SOFT01]. A batch quantification file, IE-FLOOD1.IN, was developed to perform all of the quantification steps needed to calculate the CDF. This batch file is displayed in Table 1. The quantification was initiated by selecting "Batch Processing" in the "Tools" menu in the WinNUPRA 3.0 Calculation Module.

Batch job FLOOD.BCL was run using the Initiating Event BED File, FLDINIT.BED and KNPP.BED as inputs to create the FLOOD.BED file that was used for the quantification. FLDINIT.BED contained the values for the initiating events. KNPP.BED contained the basic events from the Kewaunee Nuclear Plant Internal Events PRA.

House event BED files were developed that overwrite the existing random failure rates of various components to reflect the failed state of such equipment due to a flooding event. Three such house event BED files were developed for each initiator. The first house event BED file (***BA.BED**) assigns a logical TRUE (1.0) as the failure rates of equipment in the Turbine Building that will fail due to the flooding initiator. *BA.BED files were used for the Auxiliary Feedwater Start branches only and were required to show that the pumps had started before the bottom row of breakers failed. The second house event BED file (***BB.BED**) builds on the first case by adding in the failure of the bottom row of breakers. This BED file also assigns a logical TRUE (1.0) to the 480 V buses in Safeguards Alley and 4 kV Bus 5. This represents the case where the water level inside Safeguards Alley has risen to the failure height of this equipment. The third house event BED file (***B4.BED**) builds on the second case by assigning a logical TRUE (1.0) as the failure rate of 4 kV Bus 6, representing the case where the water level inside Safeguards Alley has risen to the failure level of 4 kV Bus 6. Most of the equations developed by WinNUPRA as part of the quantification use one of these house event BED files.

Auto editing of the cutsets was performed to apply the correct human error probabilities to flood isolation and to eliminate invalid cutsets containing the failure of DC power early due to failure of battery room cooling. Isolation-related events are represented by top events I5-, ITD, I6-, and I18, which appear in succession on the event trees and represent failure of the operator to isolate the break in different time periods. Obviously, these events are dependent because they are the same actions performed in different times. To correctly quantify the failure probability of these actions, the event trees were quantified using a dummy event for each of the isolation-related events. The dummy event was assigned a value of 0.5 to ensure that truncation errors would not eliminate any significant cutsets. After the initial cutset generation, the cutset equation files were edited and the various combinations of the dummy events were replaced with a single basic event that used the correct probability for the associated isolation.

Auto editing of the cutsets containing failure of DC power early due to failure of battery room cooling was required to remove illogical cutsets. Numerous basic events were generated that represented failure of the B-train CCW pump to start because of failure of battery room cooling. The B-train CCW pump would be demanded within the first two hours of the event for all flooding sequences.

Letter, C.A. Schrock (WPSC) to US Nuclear Regulatory Commission, Station Blackout Response dated September 18, 1992, Attachment 3 addresses loss of ventilation conditions associated with a Station Blackout event of four-hour duration. NUMARC 87-00 methodology was used to determine the final Battery Room 1A and 1B temperatures reported in that document. The initial room temperature for each room was 104F, a temperature considerably higher than normally observed. The final room temperatures were determined to be less than 120F, the acceptance criterion that provides reasonable assurance of equipment operability.

Since the DC power system would be available to support starting the B-train CCW pump when demanded, it is appropriate to eliminate these cutsets.

The overall list of cutsets for floods due to pipe breaks in the Turbine Building associated with this model is documented in Table 2. Tables 3 through 10 document the cutsets for each individual Turbine Building flooding initiator in the model. Basic event descriptions and values for this model are provided in Table 11.

Sensitivities were performed for the quantification. These were:

- HEPs for operator actions with less than a 30-minute time window were increased by 100%
- HEPs for operator actions with less than a one- hour time window were increased by 100%
- HEPs for unproceduralized (i.e., skill-based or not well proceduralized, such as transferring inverters to an alternate source at four hours) operator actions were increased by 100%
- High energy (main steam and feedwater) line break frequencies were increased by 100%
- Circulating water expansion joint break frequencies were increased by 100%
- Random pipe break frequencies were increased by 100%

5.0 RESULTS AND CONCLUSIONS

The results of the above evaluation show that the non-seismic CDF for floods due to pipe beaks in the Turbine Building at KPS is 5.24E-05 per year.

The biggest contributors to the non-seismic CDF are the HEPs associated with tripping the Circulating Water pumps following a condenser expansion joint rupture and the HEP associated with the operators controlling steam generator level after losing all DC power due to battery depletion. This action would be required at more than 8 hours into the event.

Of the total non-seismic CDF, over 50% is due to a large Circulating Water break due to a rupture of the condenser inlet expansion joint. This event assumes a 58,000 gpm rupture which does not allow the operator sufficient time to trip the Circulating Water pumps before failure of most of the equipment in Safeguards Alley.

The second highest contribution to non-seismic CDF is a Feedwater Line break resulting in a 6,000 gpm discharge of the Fire Protection System. This event contributes 17% to the overall risk. The operator actions associated with isolating the flood are challenged by the Turbine Building environmental conditions, e.g., temperature and humidity, and the fact that the Feedwater System discharges so much inventory onto the Turbine Building floor that the time available to the operators to isolate the break is greatly reduced.

When the HEPs for operator actions with less than a 30-minute time window were increased by 100%, the non-seismic CDF increased from the base case value of 5.24E-5 per year to a sensitivity value of 5.79E-5 per year. Details of this sensitivity are provided in Attachment A.

For the sensitivity case where the HEPs for operator actions with less than a one- hour time window were increased by 100%, the non-seismic CDF increased from the base case value of 5.24E-5 per year to a sensitivity value of 7.53E-5 per year. Details of this sensitivity are provided in Attachment B.

Increasing the HEPs for unproceduralized operator actions by 100% changed the non-seismic CDF from the base case value of 5.24E-5 per year to a sensitivity value of 6.48E-5 per year. Details of this sensitivity are provided in Attachment C.

When the value for High Energy Line Breaks (HELBs) was increased by 100% the non-seismic CDF increased from the base value of 5.24E-5 per year to a sensitivity value of 6.92E-5 per year. Details of this sensitivity are provided in Attachment D.

Increasing the circulating water expansion joint break frequencies by 100% resulted in an increase in the non-seismic CDF from the base case value of 5.24E-5 per year to 7.04E-5 per year. Details of this sensitivity are provided in Attachment E.

Finally, doubling the value for random pipe break frequencies increased the non-seismic CDF from the base value of 5.24E-5 per year to 7.01E-5 per year. Details of this sensitivity are provided in Attachment F.

6.0 REFERENCES

[SOFT01] WinNUPRA User's Manual, Version 3.0.

Table 1 – Batch File IE-FLOOD1.IN

```
MAXTIM = 3600
MAXPRT = 100
BED=MEX.BCL
SEQ=CDF-FLD.SEQ
solve equation           tree           gate          House BED
truncation
TABLE =
YP   ,MEX               ,MEX.LGC       ,GMEX100      ,HMEXFLD.BED               ,1.00E-12
BED=FLOOD.BCL
YP   ,IE-CI06B          ,FLOODING.LGC  ,GFLD111      ,NA                        ,1.00E-12
YP   ,I5-CI06B          ,FLOODING.LKC  ,GFLD2110     ,NA                        ,1.00E-12
YP   ,IE-CX06B          ,FLOODING.LGC  ,GFLD114      ,NA                        ,1.00E-12
YP   ,I5-CX06B          ,FLOODING.LKC  ,GFLD453      ,NA                        ,1.00E-12
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YP   ,I18CX06B          ,FLOODING.LKC  ,GFLD475      ,NA                        ,1.00E-12
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YP   ,AFRCX06B          ,AFM.LKC       ,GAFM502      ,HCX06BB.BED               ,1.00E-09
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YP   ,AFZ-BCX4          ,FLOODING.LKC  ,GFLD4114     ,HCX06B4.BED               ,1.00E-12
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YP   ,AFTCX064          ,AFM.LKC       ,GAFM1002     ,HCX06B4.BED               ,1.00E-09
YP   ,AFX-1CXB          ,FLOODING.LKC  ,GFLD142      ,HCX06BB.BED               ,1.00E-12
YP   ,AFX-1ACX          ,FLOODING.LKC  ,GFLD4132     ,HCX06BB.BED               ,1.00E-12
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YP   ,AFZ-BFIB          ,FLOODING.LKC  ,GFLD4214     ,HFI06BB.BED               ,1.00E-12
YP   ,AFZ-BFI4          ,FLOODING.LKC  ,GFLD4214     ,HFI06B4.BED               ,1.00E-12
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YP   ,AFTFI064          ,AFM.LKC       ,GAFM1002     ,HFI06B4.BED               ,1.00E-09
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YP   ,AFX-2FIB          ,FLOODING.LKC  ,GFLD4292     ,HFI06BB.BED               ,1.00E-12
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YP   ,RCPFI06B          ,FLOODING.LKC  ,GFLD140      ,HFI06BB.BED               ,1.00E-12
YP   ,OCFI06BB          ,FLOODING.LKC  ,GFLD4264     ,HFI06BB.BED               ,1.00E-09
YP   ,OCFI06B4          ,FLOODING.LKC  ,GFLD160      ,HFI06B4.BED               ,1.00E-09
YP   ,SLCFI06B          ,FLOODING.LKC  ,GFLD3140     ,HFI06BB.BED               ,1.00E-09
YP   ,SLCFI064          ,FLOODING.LKC  ,GFLD3140     ,HFI06B4.BED               ,1.00E-09
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YP   ,HPIFI064          ,FLOODING.LKC  ,GFLD310      ,HFI06B6.BED               ,1.00E-09
YP   ,RWCFI06B          ,FLOODING.LKC  ,GFLD3210     ,HFI06BB.BED               ,1.00E-09
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```

Table 1 – Batch File IE-FLOOD1.IN (continued)

YP	,I5-SI06B	,FLOODING.LKC	,GFLD490	,NA	,1.00E-12
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YP	,I6-SI06B	,FLOODING.LKC	,GFLD494	,NA	,1.00E-12
YP	,I18SI06B	,FLOODING.LKC	,GFLD213	,NA	,1.00E-12
YP	,AFSSI06B	,AFM.LGC	,GAFM111	,HSI06BA.BED	,1.00E-09
YP	,AFRSI06B	,AFM.LKC	,GAFM502	,HSI06BB.BED	,1.00E-09
YP	,AFZ-ASIB	,FLOODING.LKC	,GFLD4312	,HSI06BB.BED	,1.00E-12
YP	,AFZ-BSI4	,FLOODING.LKC	,GFLD4314	,HSI06B4.BED	,1.00E-12
YP	,AFZ-BSI4	,FLOODING.LKC	,GFLD4314	,HSI06B4.BED	,1.00E-12
YP	,AFZ-BSIB	,FLOODING.LKC	,GFLD4314	,HSI06BB.BED	,1.00E-12
YP	,AFTSI06B	,AFM.LKC	,GAFM1002	,HSI06BB.BED	,1.00E-09
YP	,AFTSI064	,AFM.LKC	,GAFM1002	,HSI06B4.BED	,1.00E-09
YP	,AFX-1SIB	,FLOODING.LKC	,GFLD142	,HSI06BB.BED	,1.00E-12
YP	,AFX-1ASI	,FLOODING.LKC	,GFLD4332	,HSI06BB.BED	,1.00E-12
YP	,AFX-2SIB	,FLOODING.LKC	,GFLD4392	,HSI06BB.BED	,1.00E-12
YP	,AFX-2SI4	,FLOODING.LKC	,GFLD4394	,HSI06B4.BED	,1.00E-12
YP	,RCPSI06B	,FLOODING.LKC	,GFLD140	,HSI06BB.BED	,1.00E-12
YP	,OCSI06B4	,FLOODING.LKC	,GFLD160	,HSI06B4.BED	,1.00E-09
YP	,OCSI06BB	,FLOODING.LKC	,GFLD4364	,HSI06BB.BED	,1.00E-09
YP	,SLCSI06B	,FLOODING.LKC	,GFLD3140	,HSI06BB.BED	,1.00E-09
YP	,SLCSI064	,FLOODING.LKC	,GFLD3142	,HSI06B4.BED	,1.00E-09
YP	,HPISI06B	,FLOODING.LKC	,GFLD310	,HSI06BB.BED	,1.00E-09
YP	,HPISI064	,FLOODING.LKC	,GFLD310	,HSI06B6.BED	,1.00E-09
YP	,ACCSI064	,ACC.LGC	,GACC100	,HSI06B4.BED	,1.00E-09
YP	,RWCSI06B	,FLOODING.LKC	,GFLD3210	,HSI06BB.BED	,1.00E-09
YP	,IE-TI06B	,FLOODING.LGC	,GFLD134	,NA	,1.00E-12
YP	,I5-TI06B	,FLOODING.LKC	,GFLD430	,NA	,1.00E-12
YP	,ITDTI06B	,FLOODING.LKC	,GFLD431	,NA	,1.00E-12
YP	,I6-TI06B	,FLOODING.LKC	,GFLD432	,NA	,1.00E-12
YP	,AFSTI06B	,AFM.LGC	,GAFM111	,HTI06BA.BED	,1.00E-09
YP	,AFRTI06B	,AFM.LKC	,GAFM502	,HTI06BB.BED	,1.00E-09
YP	,AFZ-ATIB	,FLOODING.LKC	,GFLD4412	,HTI06BB.BED	,1.00E-12
YP	,AFZ-BTIB	,FLOODING.LKC	,GFLD4414	,HTI06BB.BED	,1.00E-12
YP	,AFZ-BTI4	,FLOODING.LKC	,GFLD4414	,HTI06B4.BED	,1.00E-12
YP	,AFTTI06B	,AFM.LKC	,GAFM1002	,HTI06BB.BED	,1.00E-09
YP	,AFTTI064	,AFM.LKC	,GAFM1002	,HTI06B4.BED	,1.00E-09
YP	,AFX-1TIB	,FLOODING.LKC	,GFLD142	,HTI06BB.BED	,1.00E-12
YP	,AFX-1ATI	,FLOODING.LKC	,GFLD4472	,HTI06BB.BED	,1.00E-12
YP	,AFX-2TIB	,FLOODING.LKC	,GFLD4442	,HTI06BB.BED	,1.00E-12
YP	,AFX-2TI4	,FLOODING.LKC	,GFLD4444	,HTI06B4.BED	,1.00E-12
YP	,RCPTI06B	,FLOODING.LKC	,GFLD140	,HTI06BB.BED	,1.00E-12
YP	,OCTI06B4	,FLOODING.LKC	,GFLD160	,HTI06B4.BED	,1.00E-09
YP	,OCTI06BB	,FLOODING.LKC	,GFLD4464	,HTI06BB.BED	,1.00E-09
YP	,SLCTI06B	,FLOODING.LKC	,GFLD3140	,HTI06BB.BED	,1.00E-09
YP	,SLCTI064	,FLOODING.LKC	,GFLD3142	,HTI06B4.BED	,1.00E-09
YP	,HPITI06B	,FLOODING.LKC	,GFLD310	,HTI06BB.BED	,1.00E-09
YP	,HPITI064	,FLOODING.LKC	,GFLD310	,HTI06B6.BED	,1.00E-09
YP	,ACCTI064	,ACC.LGC	,GACC100	,HTI06B4.BED	,1.00E-09
YP	,RWCTI06B	,FLOODING.LKC	,GFLD3210	,HTI06BB.BED	,1.00E-09
YP	,IE-TX06B	,FLOODING.LGC	,GFLD135	,NA	,1.00E-12
YP	,I5-TX06B	,FLOODING.LKC	,GFLD433	,NA	,1.00E-12
YP	,ITDTX06B	,FLOODING.LKC	,GFLD434	,NA	,1.00E-12
YP	,I6-TX06B	,FLOODING.LKC	,GFLD435	,NA	,1.00E-12
YP	,AFSTX06B	,AFM.LGC	,GAFM111	,HTX06BA.BED	,1.00E-09
YP	,AFRTX06B	,AFM.LKC	,GAFM502	,HTX06BB.BED	,1.00E-09
YP	,AFZ-ATXB	,FLOODING.LKC	,GFLD4512	,HTX06BB.BED	,1.00E-12
YP	,AFZ-BTXB	,FLOODING.LKC	,GFLD4514	,HTX06BB.BED	,1.00E-12
YP	,AFZ-BTX4	,FLOODING.LKC	,GFLD4514	,HTX06B4.BED	,1.00E-12

Table 1 – Batch File IE-FLOOD1.IN (continued)

YP	,AFTTX06B	,AFM.LKC	,GAFM1002	,HTX06BB.BED	,1.00E-09
YP	,AFTTX064	,AFM.LKC	,GAFM1002	,HTX06B4.BED	,1.00E-09
YP	,AFX-1TXB	,FLOODING.LKC	,GFLD142	,HTX06BB.BED	,1.00E-12
YP	,AFX-1ATX	,FLOODING.LKC	,GFLD4572	,HTX06BB.BED	,1.00E-12
YP	,AFX-2TXB	,FLOODING.LKC	,GFLD4542	,HTX06BB.BED	,1.00E-12
YP	,AFX-2TX4	,FLOODING.LKC	,GFLD4544	,HTX06B4.BED	,1.00E-12
YP	,RCPTX06B	,FLOODING.LKC	,GFLD140	,HTX06BB.BED	,1.00E-12
YP	,OCTX06B4	,FLOODING.LKC	,GFLD160	,HTX06B4.BED	,1.00E-09
YP	,OCTX06BB	,FLOODING.LKC	,GFLD4564	,HTX06BB.BED	,1.00E-09
YP	,SLCTX06B	,FLOODING.LKC	,GFLD3140	,HTX06BB.BED	,1.00E-09
YP	,SLCTX064	,FLOODING.LKC	,GFLD3142	,HTX06B4.BED	,1.00E-09
YP	,HPITX06B	,FLOODING.LKC	,GFLD310	,HTX06BB.BED	,1.00E-09
YP	,HPITX064	,FLOODING.LKC	,GFLD310	,HTX06B6.BED	,1.00E-09
YP	,ACCTX064	,ACC.LGC	,GACC100	,HTX06B4.BED	,1.00E-09
YP	,RWCTX06B	,FLOODING.LKC	,GFLD3210	,HTX06BB.BED	,1.00E-09
YP	,IE-WI06B	,FLOODING.LGC	,GFLD110	,NA	,1.00E-12
YP	,I5-WI06B	,FLOODING.LKC	,GFLD410	,NA	,1.00E-12
YP	,ITDWI06B	,FLOODING.LKC	,GFLD411	,NA	,1.00E-12
YP	,I6-WI06B	,FLOODING.LKC	,GFLD412	,NA	,1.00E-12
YP	,AFSWI06B	,AFM.LGC	,GAFM111	,HWI06BA.BED	,1.00E-09
YP	,AFRWI06B	,AFM.LKC	,GAFM502	,HWI06BB.BED	,1.00E-09
YP	,AFZ-AWIB	,FLOODING.LKC	,GFLD4612	,HWI06BB.BED	,1.00E-12
YP	,AFZ-BWIB	,FLOODING.LKC	,GFLD4614	,HWI06BB.BED	,1.00E-12
YP	,AFZ-BWI4	,FLOODING.LKC	,GFLD4614	,HWI06B4.BED	,1.00E-12
YP	,AFTWI06B	,AFM.LKC	,GAFM1002	,HWI06BB.BED	,1.00E-09
YP	,AFTWI064	,AFM.LKC	,GAFM1002	,HWI06B4.BED	,1.00E-09
YP	,AFX-1WIB	,FLOODING.LKC	,GFLD142	,HWI06BB.BED	,1.00E-12
YP	,AFX-1AWI	,FLOODING.LKC	,GFLD4672	,HWI06BB.BED	,1.00E-12
YP	,AFX-2WIB	,FLOODING.LKC	,GFLD4642	,HWI06BB.BED	,1.00E-12
YP	,AFX-2WI4	,FLOODING.LKC	,GFLD4644	,HWI06B4.BED	,1.00E-12
YP	,RCPWI06B	,FLOODING.LKC	,GFLD140	,HWI06BB.BED	,1.00E-12
YP	,OCWI06B4	,FLOODING.LKC	,GFLD160	,HWI06B4.BED	,1.00E-09
YP	,OCWI06BB	,FLOODING.LKC	,GFLD4664	,HWI06BB.BED	,1.00E-09
YP	,SLCWI06B	,FLOODING.LKC	,GFLD3140	,HWI06BB.BED	,1.00E-09
YP	,SLCWI064	,FLOODING.LKC	,GFLD3142	,HWI06B4.BED	,1.00E-09
YP	,HPIWI06B	,FLOODING.LKC	,GFLD310	,HWI06BB.BED	,1.00E-09
YP	,HPIWI064	,FLOODING.LKC	,GFLD310	,HWI06B6.BED	,1.00E-09
YP	,ACCWI064	,ACC.LGC	,GACC100	,HWI06B4.BED	,1.00E-09
YP	,RWCWI06B	,FLOODING.LKC	,GFLD3210	,HWI06BB.BED	,1.00E-09
YP	,IE-WX06B	,FLOODING.LGC	,GFLD115	,NA	,1.00E-12
YP	,I5-WX06B	,FLOODING.LKC	,GFLD413	,NA	,1.00E-12
YP	,ITDWX06B	,FLOODING.LKC	,GFLD414	,NA	,1.00E-12
YP	,I6-WX06B	,FLOODING.LKC	,GFLD415	,NA	,1.00E-12
YP	,AFSWX06B	,AFM.LGC	,GAFM111	,HWX06BA.BED	,1.00E-09
YP	,AFRWX06B	,AFM.LKC	,GAFM502	,HWX06BB.BED	,1.00E-09
YP	,AFZ-AWXB	,FLOODING.LKC	,GFLD4712	,HWX06BB.BED	,1.00E-12
YP	,AFZ-BWXB	,FLOODING.LKC	,GFLD4714	,HWX06BB.BED	,1.00E-12
YP	,AFZ-BWX4	,FLOODING.LKC	,GFLD4714	,HWX06B4.BED	,1.00E-12
YP	,AFTWX06B	,AFM.LKC	,GAFM1002	,HWX06BB.BED	,1.00E-09
YP	,AFTWX064	,AFM.LKC	,GAFM1002	,HWX06B4.BED	,1.00E-09
YP	,AFX-1WXB	,FLOODING.LKC	,GFLD142	,HWX06BB.BED	,1.00E-12
YP	,AFX-1AWX	,FLOODING.LKC	,GFLD4772	,HWX06BB.BED	,1.00E-12
YP	,AFX-2WXB	,FLOODING.LKC	,GFLD4742	,HWX06BB.BED	,1.00E-12
YP	,AFX-2WX4	,FLOODING.LKC	,GFLD4744	,HWX06B4.BED	,1.00E-12
YP	,RCPWX06B	,FLOODING.LKC	,GFLD140	,HWX06BB.BED	,1.00E-12
YP	,OCWX06B4	,FLOODING.LKC	,GFLD160	,HWX06B4.BED	,1.00E-09
YP	,OCWX06BB	,FLOODING.LKC	,GFLD4764	,HWX06BB.BED	,1.00E-09
YP	,SLCWX06B	,FLOODING.LKC	,GFLD3140	,HWX06BB.BED	,1.00E-09

Table 1 – Batch File IE-FLOOD1.IN (continued)

```
YP    ,SLCWX064        ,FLOODING.LKC    ,GFLD3142     ,HWX06B4.BED                ,1.00E-09
YP    ,HPIWX06B        ,FLOODING.LKC    ,GFLD310      ,HWX06BB.BED                ,1.00E-09
YP    ,HPIWX064        ,FLOODING.LKC    ,GFLD310      ,HWX06B6.BED                ,1.00E-09
YP    ,ACCWX064        ,ACC.LKC         ,GACC100      ,HWX06B4.BED                ,1.00E-09
YP    ,RWCWX06B        ,FLOODING.LKC    ,GFLD3210     ,HWX06BB.BED                ,1.00E-09
YR, NA,      CI06B.OCL
YR, NA,      CX06B.OCL
YR, NA,      FI06B.OCL
YR, NA,      WI06B.OCL
YR, NA,      WX06B.OCL
YR, NA,      SI06B.OCL
YR, NA,      TI06B.OCL
YR, NA,      TX06B.OCL
SEQ = CDFTBFLD.SEQ
Y , *,       SEQ
Y , CDFTBFLD,  SEQ
Y , CDFTBFLD, MIN,  NA, CDF-TBFLDMIN
SEQ = CI06B.SEQ
Y , *,       SEQ
Y , CI06B,    SEQ
SEQ = CX06B.SEQ
Y , *,       SEQ
Y , CX06B,    SEQ
Y   ,CX06B            ,CX06ISOL.TBL   ,CX06B.APP     ,CX1.PRT                  ,
Y   ,CX06B            ,BATCLGCC.TBL   ,BATCLGCX.APP     ,BATCLGCX.PRT
 ,
SEQ = FI06B.SEQ
Y , *,       SEQ
Y , FI06B,    SEQ
Y   ,FI06B            ,FI06ISOL.TBL   ,FI06B.APP     ,FI1.PRT                  ,
Y   ,FI06B            ,BATCLGCC.TBL   ,BATCLGFI.APP     ,BATCLGFI.PRT
 ,
SEQ = WI06B.SEQ
Y , *,       SEQ
Y , WI06B,   SEQ
Y   ,WI06B            ,WI06ISOL.TBL   ,WI06B.APP     ,WI1.PRT                  ,
Y   ,WI06B            ,BATCLGCC.TBL   ,BATCLGWI.APP     ,BATCLGWI.PRT
 ,
SEQ = WX06B.SEQ
Y , *,       SEQ
Y , WX06B,   SEQ
Y   ,WX06B            ,WX06ISOL.TBL   ,WX06B.APP     ,WX1.PRT                  ,
Y   ,WX06B            ,BATCLGCC.TBL   ,BATCLGWX.APP     ,BATCLGWX.PRT
 ,
SEQ = SI06B.SEQ
Y , *,       SEQ
Y , SI06B,   SEQ
Y   ,SI06B            ,SI06ISOL.TBL   ,SI06B.APP     ,SI1.PRT                  ,
Y   ,SI06B            ,BATCLGCC.TBL   ,BATCLGSI.APP     ,BATCLGSI.PRT
 ,
SEQ = TI06B.SEQ
Y , *,       SEQ
Y , TI06B,    SEQ
Y   ,TI06B            ,TI06ISOL.TBL   ,TI06B.APP     ,TI1.PRT                  ,
Y   ,TI06B            ,BATCLGCC.TBL   ,BATCLGTI.APP     ,BATCLGTI.PRT
 ,
SEQ = TX06B.SEQ
Y , *,       SEQ
Y , TX06B,    SEQ
Y   ,TX06B            ,TX06ISOL.TBL   ,TX06B.APP     ,TX1.PRT                  ,
```

INTERNAL FLOODING – Quantification for Turbine Building Floods

```
Y    ,TX06B              ,BATCLGCC.TBL    ,BATCLGTX.APP       ,BATCLGTX.PRT
 ,
SEQ = CDFTBFLD.SEQ
Y , *,          SEQ
Y , CDFTBFLD,  SEQ
```

Table 1 – Batch File IE-FLOOD1.IN (continued)

```
Y   ,CDFTBFLD            ,CDFTBFLD.TBL   ,CDFTBFLD.APP    ,CDF.PRT          ,
Y   ,CDFTBFLD            ,BATCLGCC.TBL   ,BATCLGCC.APP    ,BATCLGCC.PRT
    ,
Y , CDFTBFLD, MIN,  NA, CDF-TBFLDMIN
Y , CI06B,    MIN,  NA, CI06B-CDMIN
Y , CX06B,    MIN,  NA, CX06B-CDMIN
Y , FI06B,    MIN,  NA, FI06B-CDMIN
Y , WI06B,    MIN,  NA, WI06B-CDMIN
Y , WX06B,    MIN,  NA, WX06B-CDMIN
Y , SI06B,    MIN,  NA, SI06B-CDMIN
Y , TI06B,    MIN,  NA, TI06B-CDMIN
Y , TX06B,    MIN,  NA, TX06B-CDMIN
Y , CDF-TBFLDMIN,   NA
Y , CI06B-CDMIN,  NA
Y , CX06B-CDMIN,  NA
Y , FI06B-CDMIN,  NA
Y , WI06B-CDMIN,  NA
Y , WX06B-CDMIN,  NA
Y , SI06B-CDMIN,  NA
Y , TI06B-CDMIN,  NA
Y , TX06B-CDMIN,  NA
```

INTERNAL FLOODING – Quantification for Turbine Building Floods

Table 2
KNPP Turbine Building Flood CDF Cutsets

WinNUPRA 3.0 Production — Licensed to: KNP
CDFTBFLD.EQP — File created: 10-28-2005

Equation File	= CDFTBFLD.EQN
Basic Event Data file referenced	= FLOOD.BED
Number of cut sets in equation	= 23595
Top event unavailability (rare event)	= 5.242E-005

1	2.7900E-005	IE-CI06B	04-CW-TRIP-F-HE	
2	4.7114E-006	XCOM-AFZ-BWI4	06-BLINDAFWF-HE	IE-WI06B
		08-ISO-FS40F-HE		
3	4.2613E-006	XCOM-AFZ-BTI4	06-BLINDAFWF-HE	IE-TI06B
		08-FPSISO56F-HE		
4	2.3640E-006	IE-CX06B	04-CWSTP25-F-HE	
5	1.6835E-006	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD49F-HE
		IE-WI06B	08-ISO-FS40F-HE	
6	1.2314E-006	XCOM-AFZ-BCX4	06-BLINDAFWF-HE	IE-CX06B
		04-CWSTP22-F-HE		
7	9.5399E-007	XCOM-AFZ-BFI4	06-BLINDAFWF-HE	IE-FI06B
		08-FPISO56-F-HE		
8	9.3175E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-TI06B	08-FPSISO56F-HE	
9	8.7199E-007	IE-WI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
10	7.3538E-007	IE-TI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
11	6.4400E-007	IE-SI06B	02-SW4A-B66F-HE	
12	4.7794E-007	XCOM-AFZ-BWX4	06-BLINDAFWF-HE	IE-WX06B
		08-ISO-FS2HF-HE		
13	4.5731E-007	IE-FI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
14	4.3999E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD36F-HE
		IE-CX06B	04-CWSTP22-F-HE	
15	3.6156E-007	XCOM-AFZ-BSI4	06-BLINDAFWF-HE	IE-SI06B
		02-SW4A-B51F-HE		
16	3.5904E-007	06-BLINDAFWF-HE	IE-TX06B	08-FPSISO3CF-HE
17	2.4381E-007	XCOM-AFX-2WI4	XCOM-AFZ-BWI4	06--OC6----F-HE
		IE-WI06B	08-ISO-FS40F-HE	
18	2.4362E-007	XCOM-OCFI06B4	XCOM-AFX-2FI4	XCOM-AFZ-BFI4
		SL182	IE-FI06B	08-FPISO56-F-HE
19	2.3773E-007	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS18F-HE
20	2.2052E-007	XCOM-AFX-2TI4	XCOM-AFZ-BTI4	06--OC6----F-HE
		IE-TI06B	08-FPSISO56F-HE	
21	2.0859E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-FI06B	08-FPISO56-F-HE	
22	2.0049E-007	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO29F-HE
23	1.9184E-007	IE-WI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
24	1.4819E-007	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PS
		08-ISO-FS40F-HE		
25	1.3403E-007	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PS
		08-FPSISO56F-HE		

INTERNAL FLOODING – Quantification for Turbine Building Floods

Table 2
KNPP Turbine Building Flood CDF Cutsets (continued)

26	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
27	8.5293E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
28	7.9057E-008	05B-BYALOP-F-HE IE-SI06B	05B-FRACTDP-OFF 02-SW4A-B51F-HE	05B-MDPTD61F-HE
29	7.1930E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
30	6.3733E-008	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
31	6.3723E-008	XCOM-AFX-2CX4 IE-CX06B	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	06--OC6----F-HE
32	5.2302E-008	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
33	5.1847E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-SWS--HE
34	5.0517E-008	05B-BYALOP-F-HE IE-WX06B	05B-FRACTDP-OFF 08-ISO-FS2HF-HE	05B-MDPTD1CF-HE
35	4.9369E-008	XCOM-AFX-2FI4 IE-FI06B	XCOM-AFZ-BFI4 08-FPISO56-F-HE	06--OC6----F-HE
36	4.6894E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-SWS--HE
37	4.6592E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
38	4.4731E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
39	3.8730E-008	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PS
40	3.5867E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
41	3.3084E-008	IE-CX06B 04-CWSTP13-F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
42	3.0248E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
43	3.0182E-008	IE-FI06B 08-FPISO45-F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
44	3.0006E-008	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PS
45	2.5917E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
46	2.4733E-008	XCOM-AFX-2WX4 IE-WX06B	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	06--OC6----F-HE
47	1.9409E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BPT--AFW1C-PR
48	1.8810E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
49	1.8764E-008	IE-WI06B 08-ISO-FS33F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
50	1.8711E-008	XCOM-AFX-2SI4 IE-SI06B	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	06--OC6----F-HE
51	1.8580E-008	XCOM-AFX-2TX4 08-FPSISO3CF-HE	06--OC6----F-HE	IE-TX06B
52	1.7757E-008	SL182 31-PM--CCW1B-TM	06--OC2----F-HE STBY-CCWPB	IE-WI06B 08-ISO-FS18F-HE

Table 2
KNPP Turbine Building Flood CDF Cutsets (continued)

53	1.7555E-008	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PR
		08-FPSISO56F-HE		
54	1.7484E-008	XCOM-AFZ-BWI4	IE-WI06B	05BMVI-MS102-FO
		08-ISO-FS40F-HE		
55	1.7376E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE
56	1.6117E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
57	1.5813E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
58	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
59	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
60	1.5269E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
61	1.5033E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
62	1.4975E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE
63	1.3551E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE
		04-CWSTP22-F-HE		
64	1.2964E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
65	1.1725E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
66	1.1372E-008	XCOM-AFZ-BSI4	IE-SI06B	05BPT--AFW1C-PS
		02-SW4A-B51F-HE		
67	1.1293E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
68	1.1251E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
69	1.0498E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		
70	1.0010E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
71	9.4883E-009	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
72	9.3127E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO29-F-HE
73	9.1084E-009	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
74	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
75	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
76	9.0198E-009	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
77	8.4414E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
78	8.2288E-009	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
79	7.8907E-009	IE-WI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
80	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		

Table 2
KNPP Turbine Building Flood CDF Cutsets (continued)

81	6.9986E-009	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
82	6.3722E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-DIAG-HE
83	6.2619E-009	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
84	6.2619E-009	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
85	6.2340E-009	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
86	6.1902E-009	XCOM-OCWI06BB STBY-CCWPB	38-BY-BRB101-OP 08-ISO-FS18F-HE	IE-WI06B
87	6.0159E-009	XCOM-OCWI06B4 SL480	XCOM-AFX-2WI4 IE-WI06B	XCOM-AFZ-BWI4 08-ISO-FS40F-HE
88	6.0055E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BFAFWA-CAL-AE
89	6.0055E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BFAFWB-CAL-AE
90	5.9022E-009	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
91	5.9022E-009	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
92	5.9005E-009	IE-FI06B 08-FPISO29-F-HE	01-CMSKPRCCF123	86-INSTRRCRF-HE
93	5.8320E-009	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS18F-HE
94	5.7634E-009	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-DIAG-HE
95	5.4411E-009	XCOM-OCTI06B4 SL480	XCOM-AFX-2TI4 IE-TI06B	XCOM-AFZ-BTI4 08-FPSISO56F-HE
96	5.4318E-009	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BFAFWB-CAL-AE
97	5.4318E-009	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BFAFWA-CAL-AE
98	5.2809E-009	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
99	5.2809E-009	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
100	5.2731E-009	IE-WI06B 08-ISO-FS18F-HE	01-CMSKPRCCF23	86-INSTRRCRF-HE

Table 3
Large Circulating Water Pipe Break in Turbine Building CDF Cutsets (CI06B)

```
===========================================================================
WinNUPRA 3.0 Production      File: CI06B-CDMIN     Licensed to: KNP
===========================================================================
   Equation File                              = CI06B-CDMIN.EQN
   Basic Event Data file referenced           = FLOOD.BED
   Number of cut sets in equation             = 1
   Top event unavailability  (rare event)     = 2.790E-005
---------------------------------------------------------------------------
     1   2.79E-005   IE-CI06B         04-CW-TRIP-F-HE
```

Table 4
Moderate Circulating Water Pipe Break in Turbine Building CDF Cutsets (CX06B)

```
===========================================================================
WinNUPRA 3.0 Production                                Licensed to: KPS
CX06B.EQP                                              File created: 10-28-2005
===========================================================================
   Equation File                                = CX06B.EQN
   Basic Event Data file referenced             = FLOOD.BED
   Number of cut sets in equation               = 1912
   Top event unavailability  (rare event)       = 4.258E-006
---------------------------------------------------------------------------
     1  2.3640E-006   IE-CX06B          04-CWSTP25-F-HE
     2  1.2314E-006   XCOM-AFZ-BCX4     06-BLINDAFWF-HE  IE-CX06B
                      04-CWSTP22-F-HE
     3  4.3999E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF  05B-MDPTD36F-HE
                      IE-CX06B          04-CWSTP22-F-HE
     4  6.3723E-008   XCOM-AFX-2CX4     XCOM-AFZ-BCX4    06--OC6----F-HE
                      IE-CX06B          04-CWSTP22-F-HE
     5  3.8730E-008   XCOM-AFZ-BCX4     IE-CX06B         05BPT--AFW1C-PS
                      04-CWSTP22-F-HE
     6  3.3084E-008   IE-CX06B          01-CMSIAC1B--PR  86-INSTRRCRF-HE
                      04-CWSTP13-F-HE
     7  1.5269E-008   IE-CX06B          01-CMSIAC1B--PR  86-INSTRFCRF-HE
                      04-CWSTP19-F-HE
     8  1.3551E-008   XCOM-AFZ-BCX4     IE-CX06B         05B-CST-SWS--HE
                      04-CWSTP22-F-HE
     9  9.0198E-009   IE-CX06B          36--LHS-DIAG-HE  04-CWSTP13-F-HE
    10  5.0727E-009   XCOM-AFZ-BCX4     IE-CX06B         05BPT--AFW1C-PR
                      04-CWSTP22-F-HE
    11  4.5695E-009   XCOM-AFZ-BCX4     IE-CX06B         05BMVI-MS102-FO
                      04-CWSTP22-F-HE
    12  4.1630E-009   IE-CX06B          36--LHS-DIAG-HE  04-CWSTP19-F-HE
    13  3.3882E-009   XCOM-AFZ-BCX4     IE-CX06B         36--LHS-DIAG-HE
                      04-CWSTP22-F-HE
    14  3.2361E-009   IE-CX06B          01-CMSIAC1B--TM  86-INSTRRCRF-HE
                      04-CWSTP13-F-HE
    15  1.7677E-009   05B-FRACTDP-OFF   05B-MDPTD36F-HE  IE-CX06B
                      05BPM--AFW1B-PR   04-CWSTP13-F-HE
    16  1.6654E-009   XCOM-AFZ-BCX4     IE-CX06B         05B-CST-DIAG-HE
                      04-CWSTP22-F-HE
    17  1.5723E-009   XCOM-OCCX06B4     XCOM-AFX-2CX4    XCOM-AFZ-BCX4
                      SL480             IE-CX06B         04-CWSTP22-F-HE
    18  1.5696E-009   XCOM-AFZ-BCX4     IE-CX06B         05BFAFWB-CAL-AE
                      04-CWSTP22-F-HE
    19  1.5696E-009   XCOM-AFZ-BCX4     IE-CX06B         05BFAFWA-CAL-AE
                      04-CWSTP22-F-HE
    20  1.4936E-009   IE-CX06B          01-CMSIAC1B--TM  86-INSTRFCRF-HE
                      04-CWSTP19-F-HE
    21  1.3608E-009   IE-CX06B          01-CMSIAC1B--PS  86-INSTRRCRF-HE
                      04-CWSTP13-F-HE
    22  1.2578E-009   XCOM-OCCX06B4     XCOM-AFX-2CX4    XCOM-AFZ-BCX4
                      IE-CX06B          33-PM---SI1B-TM  04-CWSTP22-F-HE
```

```
23  9.6181E-010   XCOM-AFZ-BCX4    IE-CX06B          05BSVAFW111C-FO
                  04-CWSTP22-F-HE
```

Table 4
Moderate Circulating Water Pipe Break in Turbine Building CDF Cutsets (CX06B) (continued)

24	8.1588E-010	05B-FRACTDP-OFF	05B-MDPTD36F-HE	IE-CX06B
		05BPM--AFW1B-PR	04-CWSTP19-F-HE	
25	6.7372E-010	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-TM	STBY-CCWPB	04-CWSTP13-F-HE
26	6.5848E-010	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33-PM---SI1B-PS	04-CWSTP22-F-HE
27	6.2886E-010	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33-CV---SI6A-FC	04-CWSTP22-F-HE
28	6.2807E-010	IE-CX06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
29	5.1314E-010	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33-PM---SI1B-PR	04-CWSTP22-F-HE
30	5.0257E-010	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33-XV---SI7B-AE	04-CWSTP22-F-HE
31	4.2687E-010	IE-CX06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
32	3.7977E-010	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-PR	04-CWSTP13-F-HE	
33	3.1095E-010	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-TM	STBY-CCWPB	04-CWSTP19-F-HE
34	2.7886E-010	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33--MAN-HPI--HE	04-CWSTP22-F-HE
35	2.6553E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		04-CWSTP13-F-HE		
36	2.6553E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		04-CWSTP13-F-HE		
37	2.3758E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		04-CWSTP13-F-HE		
38	2.3758E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		04-CWSTP13-F-HE		
39	2.3486E-010	XCOM-OCCX06BB	IE-CX06B	38-BY-BRB101-OP
		STBY-CCWPB	04-CWSTP13-F-HE	
40	2.2127E-010	IE-CX06B	05BPMSKPSCCF23	04-CWSTP13-F-HE
41	2.0779E-010	XCOM-AFZ-BCX4	IE-CX06B	06-CV-KFOCCF12
		04-CWSTP22-F-HE		
42	2.0007E-010	IE-CX06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
43	2.0007E-010	IE-CX06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
44	1.9988E-010	IE-CX06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
45	1.9702E-010	IE-CX06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
46	1.9158E-010	XCOM-AFZ-BCX4	IE-CX06B	38-BY-BRA101-OP
		04-CWSTP22-F-HE		

47	1.7528E-010	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-PR	04-CWSTP19-F-HE	

Table 4
Moderate Circulating Water Pipe Break in Turbine Building CDF Cutsets (CX06B)
(continued)

48	1.2255E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		04-CWSTP19-F-HE		
49	1.2255E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		04-CWSTP19-F-HE		
50	1.0965E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		04-CWSTP19-F-HE		
51	1.0965E-010	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		04-CWSTP19-F-HE		
52	1.0840E-010	XCOM-OCCX06BB	IE-CX06B	38-BY-BRB101-OP
		STBY-CCWPB	04-CWSTP19-F-HE	
53	1.0212E-010	IE-CX06B	05BPMSKPSCCF23	04-CWSTP19-F-HE
54	9.6201E-011	XCOM-AFZ-BCX4	IE-CX06B	05BCVD-AFW1C-FO
		04-CWSTP22-F-HE		
55	9.4748E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-CV---CC3A-FC	STBY-CCWPB	04-CWSTP13-F-HE
56	9.2338E-011	IE-CX06B	01-CMSKPRCCF12	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
57	9.2338E-011	IE-CX06B	01-CMSKPRCCF23	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
58	9.2253E-011	IE-CX06B	01-AV-SW420B-FO	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
59	9.2187E-011	IE-CX06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
60	8.3852E-011	XCOM-OCCX06BB	27A-ORR----F-HE	IE-CX06B
		31-PM--CCW1B-TM	STBY-CCWPB	04-CWSTP13-F-HE
61	8.3117E-011	XCOM-AFZ-BCX4	IE-CX06B	05BPMSKPSCCF23
		04-CWSTP22-F-HE		
62	8.2990E-011	IE-CX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		04-CWSTP13-F-HE		
63	7.7820E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	04-CWSTP13-F-HE	
64	7.7820E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	04-CWSTP13-F-HE	
65	7.5720E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-XV---CC4B-AE	STBY-CCWPB	04-CWSTP13-F-HE
66	7.4209E-011	86-INSTRFCRF-HE	IE-CX06B	05BPM--AFW1B-PS
		04-CWSTP13-F-HE		
67	7.3152E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-PS	STBY-CCWPB	04-CWSTP13-F-HE
68	6.9628E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	04-CWSTP13-F-HE	
69	6.9628E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR

```
01-CV-IA503-2FC  02-PM-SW1B1--TM  STBY-SWPA1
STBY-SWPB1       04-CWSTP13-F-HE
```

Table 4
Moderate Circulating Water Pipe Break in Turbine Building CDF Cutsets (CX06B) (continued)

70	6.9181E-011	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	33-PM-KPSCCF12	04-CWSTP22-F-HE
71	6.2622E-011	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	38-BY-BRB101-OP	04-CWSTP22-F-HE
72	5.1543E-011	IE-CX06B	05BSVAFW111B-FO	05BPT--AFW1C-PS
		04-CWSTP13-F-HE		
73	5.1424E-011	XCOM-AFZ-ACXB	IE-CX06B	05BPMRKPRCCF23
		04-CWSTP13-F-HE		
74	4.8540E-011	XCOM-AFZ-ACXB	IE-CX06B	05BPM--AFW1B-PR
		05BPT--AFW1C-PS	04-CWSTP13-F-HE	
75	4.7267E-011	XCOM-OCCX06BB	27A-ORR----F-HE	IE-CX06B
		31-PM--CCW1B-PR	04-CWSTP13-F-HE	
76	4.6089E-011	IE-CX06B	01-SV-SW402B-FO	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
77	4.6089E-011	86-INSTRFCRF-HE	IE-CX06B	05BSVAFW111B-FO
		04-CWSTP13-F-HE		
78	4.3730E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-CV---CC3A-FC	STBY-CCWPB	04-CWSTP19-F-HE
79	4.3404E-011	XCOM-AFZ-ACXB	86-INSTRFCRF-HE	IE-CX06B
		05BPM--AFW1B-PR	04-CWSTP13-F-HE	
80	4.2548E-011	IE-CX06B	27BCV-SWT242-FC	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
81	3.8701E-011	XCOM-OCCX06BB	27A-ORR----F-HE	IE-CX06B
		31-PM--CCW1B-TM	STBY-CCWPB	04-CWSTP19-F-HE
82	3.8303E-011	IE-CX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		04-CWSTP19-F-HE		
83	3.7699E-011	05B-FRACTDP-OFF	05B-MDPTD36F-HE	IE-CX06B
		05BPMRKPRCCF23	04-CWSTP13-F-HE	
84	3.5917E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	04-CWSTP19-F-HE	
85	3.5917E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	04-CWSTP19-F-HE	
86	3.5400E-011	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	04-CWSTP22-F-HE
87	3.5400E-011	XCOM-OCCX06B4	XCOM-AFX-2CX4	XCOM-AFZ-BCX4
		IE-CX06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	04-CWSTP22-F-HE
88	3.5219E-011	IE-CX06B	01-CMAKPSCCF123	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
89	3.4948E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-XV---CC4B-AE	STBY-CCWPB	04-CWSTP19-F-HE
90	3.4284E-011	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--TM
		02-PM-SW1B2--TM	STBY-SWPB1	STBY-SWPB2
		04-CWSTP13-F-HE		
91	3.4250E-011	86-INSTRFCRF-HE	IE-CX06B	05BPM--AFW1B-PS
		04-CWSTP19-F-HE		

92	3.3763E-011	SL182	06--OC2----F-HE	IE-CX06B
		31-PM--CCW1B-PS	STBY-CCWPB	04-CWSTP19-F-HE

Table 4
Moderate Circulating Water Pipe Break in Turbine Building CDF Cutsets (CX06B) (continued)

93	3.3751E-011	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--PS
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		04-CWSTP13-F-HE		
94	3.3751E-011	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--PS
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		04-CWSTP13-F-HE		
95	3.3751E-011	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B1--PS
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		04-CWSTP13-F-HE		
96	3.3751E-011	XCOM-OCCX06BB	IE-CX06B	02-PM-SW1B2--PS
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		04-CWSTP13-F-HE		
97	3.3541E-011	XCOM-OCCX06BB	IE-CX06B	31-PM--CCW1B-TM
		STBY-CCWPB	33-PM---SI1B-TM	04-CWSTP13-F-HE
98	3.3478E-011	XCOM-AFZ-BCX4	IE-CX06B	05BPMRKPRCCF23
		04-CWSTP22-F-HE		
99	3.2136E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	04-CWSTP19-F-HE	
100	3.2136E-011	XCOM-OCCX06BB	IE-CX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	04-CWSTP19-F-HE	

Table 5
Large Service Water Pipe Break in Turbine Building CDF Cutsets (SI06B)

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==========================================================================
WinNUPRA 3.0 Production                           Licensed to: KNP
SI06B.EQP                                         File created: 10-28-2005
==========================================================================
   Equation File                            = SI06B.EQN
   Basic Event Data file referenced         = FLOOD.BED
   Number of cut sets in equation           = 2317
   Top event unavailability  (rare event)   = 1.170E-006
--------------------------------------------------------------------------
     1  6.4400E-007   IE-SI06B          02-SW4A-B66F-HE
     2  3.6156E-007   XCOM-AFZ-BSI4     06-BLINDAFWF-HE  IE-SI06B
                      02-SW4A-B51F-HE
     3  7.9057E-008   05B-BYALOP-F-HE   05B-FRACTDP-OFF  05B-MDPTD61F-HE
                      IE-SI06B          02-SW4A-B51F-HE
     4  1.8711E-008   XCOM-AFX-2SI4     XCOM-AFZ-BSI4    06--OC6----F-HE
                      IE-SI06B          02-SW4A-B51F-HE
     5  1.5321E-008   02-AV-SW4B---FC   IE-SI06B
     6  1.5321E-008   02-AV-SW4A---FC   IE-SI06B
     7  1.1372E-008   XCOM-AFZ-BSI4     IE-SI06B         05BPT--AFW1C-PS
                      02-SW4A-B51F-HE
     8  4.1597E-009   IE-SI06B          01-CMSIAC1B--PR  86-INSTRRCRF-HE
                      02-SW4A-B29F-HE
     9  4.1597E-009   IE-SI06B          01-CMSIAC1B--PR  86-INSTRFCRF-HE
                      02-SW4A-B45F-HE
    10  3.9789E-009   XCOM-AFZ-BSI4     IE-SI06B         05B-CST-SWS--HE
                      02-SW4A-B51F-HE
    11  1.4895E-009   XCOM-AFZ-BSI4     IE-SI06B         05BPT--AFW1C-PR
                      02-SW4A-B51F-HE
    12  1.3417E-009   XCOM-AFZ-BSI4     IE-SI06B         05BMVI-MS102-FO
                      02-SW4A-B51F-HE
    13  1.1341E-009   36--LHS-DIAG-HE   IE-SI06B         02-SW4A-B29F-HE
    14  1.1341E-009   36--LHS-DIAG-HE   IE-SI06B         02-SW4A-B45F-HE
    15  9.9486E-010   XCOM-AFZ-BSI4     IE-SI06B         36--LHS-DIAG-HE
                      02-SW4A-B51F-HE
    16  4.8901E-010   XCOM-AFZ-BSI4     IE-SI06B         05B-CST-DIAG-HE
                      02-SW4A-B51F-HE
    17  4.6167E-010   XCOM-OCSI06B4     XCOM-AFX-2SI4    XCOM-AFZ-BSI4
                      SL480             IE-SI06B         02-SW4A-B51F-HE
    18  4.6088E-010   XCOM-AFZ-BSI4     IE-SI06B         05BFAFWB-CAL-AE
                      02-SW4A-B51F-HE
    19  4.6088E-010   XCOM-AFZ-BSI4     IE-SI06B         05BFAFWA-CAL-AE
                      02-SW4A-B51F-HE
    20  4.0688E-010   IE-SI06B          01-CMSIAC1B--TM  86-INSTRFCRF-HE
                      02-SW4A-B45F-HE
    21  4.0688E-010   IE-SI06B          01-CMSIAC1B--TM  86-INSTRRCRF-HE
                      02-SW4A-B29F-HE
    22  3.6934E-010   XCOM-OCSI06B4     XCOM-AFX-2SI4    XCOM-AFZ-BSI4
                      IE-SI06B          33-PM---SI1B-TM  02-SW4A-B51F-HE
    23  2.8241E-010   XCOM-AFZ-BSI4     IE-SI06B         05BSVAFW111C-FO
                      02-SW4A-B51F-HE
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24	1.9335E-010	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-PM---SI1B-PS	02-SW4A-B51F-HE

Table 5
Large Service Water Pipe Break in Turbine Building CDF Cutsets (SI06B) (continued)

25	1.8465E-010	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-CV---SI6A-FC	02-SW4A-B51F-HE
26	1.7110E-010	IE-SI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
27	1.7110E-010	IE-SI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
28	1.5067E-010	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-PM---SI1B-PR	02-SW4A-B51F-HE
29	1.4757E-010	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-XV---SI7B-AE	02-SW4A-B51F-HE
30	8.4709E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-TM	STBY-CCWPB	02-SW4A-B29F-HE
31	8.4709E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-TM	STBY-CCWPB	02-SW4A-B45F-HE
32	8.1882E-011	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33--MAN-HPI--HE	02-SW4A-B51F-HE
33	7.5664E-011	05B-FRACTDP-OFF	05B-MDPTD1CF-HE	IE-SI06B
		05BPM--AFW1B-PR	02-SW4A-B29F-HE	
34	6.4504E-011	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-SI06B	05BPM--AFW1B-PR	02-SW4A-B45F-HE
35	6.1014E-011	XCOM-AFZ-BSI4	IE-SI06B	06-CV-KFOCCF12
		02-SW4A-B51F-HE		
36	5.6252E-011	XCOM-AFZ-BSI4	IE-SI06B	38-BY-BRA101-OP
		02-SW4A-B51F-HE		
37	5.3671E-011	IE-SI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
38	5.3671E-011	IE-SI06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
39	4.7749E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-PR	02-SW4A-B45F-HE	
40	4.7749E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-PR	02-SW4A-B29F-HE	
41	3.3386E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		02-SW4A-B45F-HE		
42	3.3386E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		02-SW4A-B29F-HE		
43	3.3386E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		02-SW4A-B45F-HE		
44	3.3386E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		02-SW4A-B29F-HE		
45	2.9872E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		02-SW4A-B45F-HE		
46	2.9872E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1

INTERNAL FLOODING – Quantification for Turbine Building Floods

02-SW4A-B45F-HE

Table 5
Large Service Water Pipe Break in Turbine Building CDF Cutsets (SI06B) (continued)

47	2.9872E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		02-SW4A-B29F-HE		
48	2.9872E-011	XCOM-OCSI06BB	IE-SI06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		02-SW4A-B29F-HE		
49	2.9529E-011	XCOM-OCSI06BB	IE-SI06B	38-BY-BRB101-OP
		STBY-CCWPB	02-SW4A-B45F-HE	
50	2.9529E-011	XCOM-OCSI06BB	IE-SI06B	38-BY-BRB101-OP
		STBY-CCWPB	02-SW4A-B29F-HE	
51	2.8247E-011	XCOM-AFZ-BSI4	IE-SI06B	05BCVD-AFW1C-FO
		02-SW4A-B51F-HE		
52	2.7821E-011	05BPMSKPSCCF23	IE-SI06B	02-SW4A-B45F-HE
53	2.7821E-011	05BPMSKPSCCF23	IE-SI06B	02-SW4A-B29F-HE
54	2.5155E-011	IE-SI06B	01-CMSKPRCCF23	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
55	2.5155E-011	IE-SI06B	01-CMSKPRCCF12	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
56	2.5155E-011	IE-SI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
57	2.5155E-011	IE-SI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
58	2.5131E-011	IE-SI06B	01-AV-SW420B-FO	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
59	2.5131E-011	IE-SI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
60	2.4406E-011	XCOM-AFZ-BSI4	IE-SI06B	05BPMSKPSCCF23
		02-SW4A-B51F-HE		
61	2.0314E-011	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-PM-KPSCCF12	02-SW4A-B51F-HE
62	1.8388E-011	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	38-BY-BRB101-OP	02-SW4A-B51F-HE
63	1.1913E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-CV---CC3A-FC	STBY-CCWPB	02-SW4A-B29F-HE
64	1.1913E-011	SL182	06--OC2----F-HE	IE-SI06B
		31-CV---CC3A-FC	STBY-CCWPB	02-SW4A-B45F-HE
65	1.1591E-011	IE-SI06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
66	1.1591E-011	IE-SI06B	27BCV-SWT242-FC	86-INSTRFCRF-HE
		02-SW4A-B45F-HE		
67	1.0543E-011	XCOM-OCSI06BB	27A-ORR----F-HE	IE-SI06B
		31-PM--CCW1B-TM	STBY-CCWPB	02-SW4A-B45F-HE
68	1.0543E-011	XCOM-OCSI06BB	27A-ORR----F-HE	IE-SI06B
		31-PM--CCW1B-TM	STBY-CCWPB	02-SW4A-B29F-HE
69	1.0434E-011	05BPT--AFW1C-PS	IE-SI06B	05BPM--AFW1B-PS
		02-SW4A-B45F-HE		
70	1.0434E-011	05BPT--AFW1C-PS	IE-SI06B	05BPM--AFW1B-PS
		02-SW4A-B29F-HE		
71	1.0395E-011	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4

IE-SI06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
STBY-SWPA2	STBY-SWPB2	02-SW4A-B51F-HE

Table 5
Large Service Water Pipe Break in Turbine Building CDF Cutsets (SI06B) (continued)

72	1.0395E-011	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	02-SW4A-B51F-HE
73	9.8300E-012	XCOM-AFZ-BSIB	IE-SI06B	05BPMRKPRCCF23
		02-SW4A-B45F-HE		
74	9.8300E-012	XCOM-AFZ-BSI4	IE-SI06B	05BPMRKPRCCF23
		02-SW4A-B51F-HE		
75	9.7844E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	02-SW4A-B29F-HE	
76	9.7844E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	02-SW4A-B29F-HE	
77	9.7844E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	02-SW4A-B45F-HE	
78	9.7844E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	02-SW4A-B45F-HE	
79	9.5920E-012	XCOM-AFZ-ASIB	IE-SI06B	05BPMRKPRCCF23
		02-SW4A-B29F-HE		
80	9.5205E-012	SL182	06--OC2----F-HE	IE-SI06B
		31-XV---CC4B-AE	STBY-CCWPB	02-SW4A-B29F-HE
81	9.5205E-012	SL182	06--OC2----F-HE	IE-SI06B
		31-XV---CC4B-AE	STBY-CCWPB	02-SW4A-B45F-HE
82	9.3304E-012	86-INSTRFCRF-HE	IE-SI06B	05BPM--AFW1B-PS
		02-SW4A-B29F-HE		
83	9.3304E-012	86-INSTRFCRF-HE	IE-SI06B	05BPM--AFW1B-PS
		02-SW4A-B45F-HE		
84	9.3004E-012	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	02-SW4A-B51F-HE
85	9.3004E-012	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	02-SW4A-B51F-HE
86	9.2787E-012	XCOM-AFZ-BSIB	IE-SI06B	05BPM--AFW1B-PR
		05BPT--AFW1C-PS	02-SW4A-B45F-HE	
87	9.2334E-012	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-CV---SI6B-FO	02-SW4A-B51F-HE
88	9.1976E-012	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-PS	STBY-CCWPB	02-SW4A-B29F-HE
89	9.1976E-012	SL182	06--OC2----F-HE	IE-SI06B
		31-PM--CCW1B-PS	STBY-CCWPB	02-SW4A-B45F-HE
90	9.0541E-012	XCOM-AFZ-ASIB	IE-SI06B	05BPM--AFW1B-PR
		05BPT--AFW1C-PS	02-SW4A-B29F-HE	
91	8.7545E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	02-SW4A-B29F-HE	
92	8.7545E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR

01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
STBY-SWPB1	02-SW4A-B29F-HE	

Table 5
Large Service Water Pipe Break in Turbine Building CDF Cutsets (SI06B)
(continued)

93	8.7545E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	02-SW4A-B45F-HE	
94	8.7545E-012	XCOM-OCSI06BB	IE-SI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	02-SW4A-B45F-HE	
95	8.2969E-012	XCOM-AFZ-BSIB	86-INSTRFCRF-HE	IE-SI06B
		05BPM--AFW1B-PR	02-SW4A-B45F-HE	
96	8.0960E-012	XCOM-AFZ-ASIB	86-INSTRFCRF-HE	IE-SI06B
		05BPM--AFW1B-PR	02-SW4A-B29F-HE	
97	6.4806E-012	05BPT--AFW1C-PS	IE-SI06B	05BSVAFW111B-FO
		02-SW4A-B29F-HE		
98	6.4806E-012	05BPT--AFW1C-PS	IE-SI06B	05BSVAFW111B-FO
		02-SW4A-B45F-HE		
99	6.1864E-012	XCOM-OCSI06B4	XCOM-AFX-2SI4	XCOM-AFZ-BSI4
		IE-SI06B	33-PM-KPRCCF12	02-SW4A-B51F-HE
100	5.9429E-012	XCOM-OCSI06BB	27A-ORR----F-HE	IE-SI06B
		31-PM--CCW1B-PR	02-SW4A-B45F-HE	

Table 6
Large Fire Protection Break in Turbine Building CDF Cutsets (FI06B)

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===========================================================================
WinNUPRA 3.0 Production                                  Licensed to: KNP
FI06B.EQP                                                File created: 10-28-2005
===========================================================================
   Equation File                              = FI06B.EQN
   Basic Event Data file referenced           = FLOOD.BED
   Number of cut sets in equation             = 3210
   Top event unavailability  (rare event)     = 2.323E-006
---------------------------------------------------------------------------
     1  9.5399E-007   XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                      08-FPISO56-F-HE
     2  4.5731E-007   IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
     3  2.4362E-007   XCOM-OCFI06B4     XCOM-AFX-2FI4     XCOM-AFZ-BFI4
                      SL182             IE-FI06B          08-FPISO56-F-HE
     4  2.0859E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-FI06B          08-FPISO56-F-HE
     5  1.2468E-007   36--LHS-DIAG-HE   IE-FI06B          08-FPISO29-F-HE
     6  4.9369E-008   XCOM-AFX-2FI4     XCOM-AFZ-BFI4     06--OC6----F-HE
                      IE-FI06B          08-FPISO56-F-HE
     7  4.4731E-008   IE-FI06B          01-CMSIAC1B--TM   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
     8  3.0182E-008   IE-FI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                      08-FPISO45-F-HE
     9  3.0006E-008   XCOM-AFZ-BFI4     IE-FI06B          05BPT--AFW1C-PS
                      08-FPISO56-F-HE
    10  1.8810E-008   IE-FI06B          01-CMSIAC1B--PS   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
    11  1.6117E-008   05B-FRACTDP-OFF   05B-MDPTD61F-HE   IE-FI06B
                      05BPM--AFW1B-PR   08-FPISO29-F-HE
    12  1.0498E-008   XCOM-AFZ-BFI4     IE-FI06B          05B-CST-SWS--HE
                      08-FPISO56-F-HE
    13  9.3127E-009   SL182             06--OC2----F-HE   IE-FI06B
                      31-PM--CCW1B-TM   STBY-CCWPB        08-FPISO29-F-HE
    14  8.2288E-009   36--LHS-DIAG-HE   IE-FI06B          08-FPISO45-F-HE
    15  5.9005E-009   IE-FI06B          01-CMSKPRCCF123   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
    16  5.2494E-009   SL182             06--OC2----F-HE   IE-FI06B
                      31-PM--CCW1B-PR   08-FPISO29-F-HE
    17  3.9300E-009   XCOM-AFZ-BFI4     IE-FI06B          05BPT--AFW1C-PR
                      08-FPISO56-F-HE
    18  3.6704E-009   XCOM-OCFI06BB     IE-FI06B          02-PM-SW1B2--TM
                      16-BATCLG--F-HE   STBY-SWPA2        STBY-SWPB2
                      08-FPISO29-F-HE
    19  3.6704E-009   XCOM-OCFI06BB     IE-FI06B          02-PM-SW1B2--TM
                      16-BATCLG--F-HE   STBY-SWPA1        STBY-SWPB2
                      08-FPISO29-F-HE
    20  3.5402E-009   XCOM-AFZ-BFI4     IE-FI06B          05BMVI-MS102-FO
                      08-FPISO56-F-HE
    21  3.2840E-009   XCOM-OCFI06BB     IE-FI06B          02-PM-SW1B1--TM
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16-BATCLG--F-HE  STBY-SWPA1        STBY-SWPB1
08-FPISO29-F-HE
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Table 6
Large Fire Protection Break in Turbine Building CDF Cutsets (FI06B)
(continued)

22	3.2840E-009	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPISO29-F-HE		
23	3.2464E-009	XCOM-OCFI06BB	IE-FI06B	38-BY-BRB101-OP
		STBY-CCWPB	08-FPISO29-F-HE	
24	3.0586E-009	05BPMSKPSCCF23	IE-FI06B	08-FPISO29-F-HE
25	2.9523E-009	IE-FI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
26	2.7654E-009	IE-FI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
27	2.7654E-009	IE-FI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
28	2.7629E-009	IE-FI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
29	2.6250E-009	XCOM-AFZ-BFI4	IE-FI06B	36--LHS-DIAG-HE
		08-FPISO56-F-HE		
30	1.3097E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-CV---CC3A-FC	STBY-CCWPB	08-FPISO29-F-HE
31	1.2903E-009	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-DIAG-HE
		08-FPISO56-F-HE		
32	1.2743E-009	IE-FI06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
33	1.2415E-009	IE-FI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
34	1.2160E-009	XCOM-AFZ-BFI4	IE-FI06B	05BFAFWA-CAL-AE
		08-FPISO56-F-HE		
35	1.2160E-009	XCOM-AFZ-BFI4	IE-FI06B	05BFAFWB-CAL-AE
		08-FPISO56-F-HE		
36	1.1591E-009	XCOM-OCFI06BB	27A-ORR----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO29-F-HE
37	1.1471E-009	05BPT--AFW1C-PS	IE-FI06B	05BPM--AFW1B-PS
		08-FPISO29-F-HE		
38	1.0757E-009	XCOM-OCFI06BB	IE-FI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-FPISO29-F-HE	
39	1.0757E-009	XCOM-OCFI06BB	IE-FI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-FPISO29-F-HE	
40	1.0467E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-XV---CC4B-AE	STBY-CCWPB	08-FPISO29-F-HE
41	1.0258E-009	86-INSTRFCRF-HE	IE-FI06B	05BPM--AFW1B-PS
		08-FPISO29-F-HE		
42	1.0112E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-FPISO29-F-HE
43	9.6245E-010	XCOM-OCFI06BB	IE-FI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-FPISO29-F-HE	
44	9.6245E-010	XCOM-OCFI06BB	IE-FI06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1

		STBY-SWPB1	08-FPISO29-F-HE	
45	8.8821E-010	XCOM-AFZ-AFIB	05BPMRKPRCCF23	IE-FI06B
		08-FPISO29-F-HE		

Table 6
Large Fire Protection Break in Turbine Building CDF Cutsets (FI06B)
(continued)

46	8.3840E-010	XCOM-AFZ-AFIB	05BPT--AFW1C-PS	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
47	7.4969E-010	XCOM-AFZ-AFIB	86-INSTRFCRF-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
48	7.4515E-010	XCOM-AFZ-BFI4	IE-FI06B	05BSVAFW111C-FO
		08-FPISO56-F-HE		
49	7.1246E-010	05BPT--AFW1C-PS	IE-FI06B	05BSVAFW111B-FO
		08-FPISO29-F-HE		
50	6.5335E-010	XCOM-OCFI06BB	27A-ORR----F-HE	IE-FI06B
		31-PM--CCW1B-PR	08-FPISO29-F-HE	
51	6.3707E-010	IE-FI06B	01-SV-SW402B-FO	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
52	6.3707E-010	86-INSTRFCRF-HE	IE-FI06B	05BSVAFW111B-FO
		08-FPISO29-F-HE		
53	6.1464E-010	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO45-F-HE
54	4.8725E-010	XCOM-SLCFI064	XCOM-OCFI06B4	XCOM-AFX-2FI4
		XCOM-AFZ-BFI4	IE-FI06B	33-PM---SI1B-TM
		08-FPISO56-F-HE		
55	4.8682E-010	IE-FI06B	01-CMAKPSCCF123	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
56	4.7390E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--TM
		02-PM-SW1B2--TM	STBY-SWPB1	STBY-SWPB2
		08-FPISO29-F-HE		
57	4.6803E-010	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-FI06B	05BPM--AFW1B-PR	08-FPISO45-F-HE
58	4.6652E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--PS
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-FPISO29-F-HE		
59	4.6652E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--PS
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPISO29-F-HE		
60	4.6652E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--PS
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPISO29-F-HE		
61	4.6652E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--PS
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPISO29-F-HE		
62	4.6363E-010	XCOM-OCFI06BB	IE-FI06B	31-PM--CCW1B-TM
		STBY-CCWPB	33-PM---SI1B-TM	08-FPISO29-F-HE
63	4.2834E-010	05BSV-KFOCCF23	IE-FI06B	08-FPISO29-F-HE
64	4.2742E-010	05BPT--AFW1C-PS	IE-FI06B	47-CN-AFP1XB-RC
		08-FPISO29-F-HE		
65	4.2742E-010	05BPT--AFW1C-PS	IE-FI06B	47-CN-AFP2XB-RC
		08-FPISO29-F-HE		
66	4.0580E-010	XCOM-OCFI06BB	IE-FI06B	38-BY-BRB101-OP
		STBY-SWPB1	STBY-SWPB2	08-FPISO29-F-HE
67	4.0327E-010	XCOM-AFZ-AFIB	03-XV--MU2A--FC	16-BATCLG--F-HE
		IE-FI06B	08-FPISO29-F-HE	

68	4.0136E-010	05B-CST-SWS--HE 08-FPISO29-F-HE	IE-FI06B	05BPM--AFW1B-PS

Table 6
Large Fire Protection Break in Turbine Building CDF Cutsets (FI06B) (continued)

69	3.9845E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--TM
		02-TURB-HDR--HE	STBY-SWPA1	STBY-SWPB2
		08-FPISO29-F-HE		
70	3.9845E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--TM
		02-TURB-HDR--HE	STBY-SWPA2	STBY-SWPB2
		08-FPISO29-F-HE		
71	3.8943E-010	IE-FI06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
72	3.8219E-010	86-INSTRFCRF-HE	IE-FI06B	47-CN-AFP1XB-RC
		08-FPISO29-F-HE		
73	3.8219E-010	86-INSTRFCRF-HE	IE-FI06B	47-CN-AFP2XB-RC
		08-FPISO29-F-HE		
74	3.5650E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--TM
		02-TURB-HDR--HE	STBY-SWPA2	STBY-SWPB1
		08-FPISO29-F-HE		
75	3.5650E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--TM
		02-TURB-HDR--HE	STBY-SWPA1	STBY-SWPB1
		08-FPISO29-F-HE		
76	3.4646E-010	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-PR	08-FPISO45-F-HE	
77	3.4371E-010	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPMRKPRCCF23	08-FPISO29-F-HE	
78	3.2193E-010	XCOM-OCFI06BB	IE-FI06B	02-CV--SW1B2-FC
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPISO29-F-HE		
79	3.2193E-010	XCOM-OCFI06BB	IE-FI06B	02-CV--SW1B1-FC
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPISO29-F-HE		
80	3.2193E-010	XCOM-OCFI06BB	IE-FI06B	02-CV--SW1B1-FC
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPISO29-F-HE		
81	3.2193E-010	XCOM-OCFI06BB	IE-FI06B	02-CV--SW1B2-FC
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-FPISO29-F-HE		
82	2.9334E-010	XCOM-AFZ-AFIB	05B-CST-SWS--HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
83	2.9025E-010	XCOM-AFZ-AFIB	03-AS-HTLVLC-OP	16-BATCLG--F-HE
		IE-FI06B	08-FPISO29-F-HE	
84	2.7714E-010	SL182	39-CB--1-607-CO	IE-FI06B
		08-FPISO29-F-HE		
85	2.6501E-010	05BPT--AFW1C-PS	IE-FI06B	47-RE-AFP1XB-RF
		08-FPISO29-F-HE		
86	2.6501E-010	05BPT--AFW1C-PS	IE-FI06B	47-RE-AFP2XB-RF
		08-FPISO29-F-HE		
87	2.6134E-010	XCOM-OCFI06BB	IE-FI06B	31-PM--CCW1B-PR
		33-PM---SI1B-TM	08-FPISO29-F-HE	
88	2.5728E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--AE
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPISO29-F-HE		

89	2.5728E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--AE
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-FPISO29-F-HE		

Table 6
Large Fire Protection Break in Turbine Building CDF Cutsets (FI06B)
(continued)

90	2.5728E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--AE
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPISO29-F-HE		
91	2.5728E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B1--AE
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPISO29-F-HE		
92	2.5508E-010	XCOM-SLCFI064	XCOM-OCFI06B4	XCOM-AFX-2FI4
		XCOM-AFZ-BFI4	IE-FI06B	33-PM---SI1B-PS
		08-FPISO56-F-HE		
93	2.4927E-010	05B-CST-SWS--HE	IE-FI06B	05BSVAFW111B-FO
		08-FPISO29-F-HE		
94	2.4492E-010	XCOM-OCFI06BB	IE-FI06B	38-CBB101----CO
		STBY-CCWPB	08-FPISO29-F-HE	
95	2.4492E-010	XCOM-OCFI06BB	38-CBB102-04-CO	IE-FI06B
		STBY-CCWPB	08-FPISO29-F-HE	
96	2.4360E-010	XCOM-SLCFI064	XCOM-OCFI06B4	XCOM-AFX-2FI4
		XCOM-AFZ-BFI4	IE-FI06B	33-CV---SI6A-FC
		08-FPISO56-F-HE		
97	2.4271E-010	XCOM-OCFI06BB	IE-FI06B	31-PM--CCW1B-TM
		STBY-CCWPB	33-PM---SI1B-PS	08-FPISO29-F-HE
98	2.4225E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPISO45-F-HE		
99	2.4225E-010	XCOM-OCFI06BB	IE-FI06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPISO45-F-HE		
100	2.3697E-010	86-INSTRFCRF-HE	IE-FI06B	47-RE-AFP2XB-RF
		08-FPISO29-F-HE		

Table 7
Steamline Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (TI06B)

```
==============================================================================
WinNUPRA 3.0 Production                                  Licensed to: KNP
TI06B.EQP                                                File created: 10-28-2005
==============================================================================
   Equation File                                 = TI06B.EQN
   Basic Event Data file referenced              = FLOOD.BED
   Number of cut sets in equation                = 5686
   Top event unavailability  (rare event)        = 7.012E-006
------------------------------------------------------------------------------
    1  4.2613E-006    XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                      08-FPSISO56F-HE
    2  9.3175E-007    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-TI06B          08-FPSISO56F-HE
    3  7.3538E-007    IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
    4  2.2052E-007    XCOM-AFX-2TI4     XCOM-AFZ-BTI4     06--OC6----F-HE
                      IE-TI06B          08-FPSISO56F-HE
    5  2.0049E-007    36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
    6  1.3403E-007    XCOM-AFZ-BTI4     IE-TI06B          05BPT--AFW1C-PS
                      08-FPSISO56F-HE
    7  7.1930E-008    IE-TI06B          01-CMSIAC1B--TM   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
    8  6.3733E-008    IE-TI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                      08-FPSISO45F-HE
    9  4.6894E-008    XCOM-AFZ-BTI4     IE-TI06B          05B-CST-SWS--HE
                      08-FPSISO56F-HE
   10  3.0248E-008    IE-TI06B          01-CMSIAC1B--PS   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
   11  2.5917E-008    05B-FRACTDP-OFF   05B-MDPTD61F-HE   IE-TI06B
                      05BPM--AFW1B-PR   08-FPSISO29F-HE
   12  1.7555E-008    XCOM-AFZ-BTI4     IE-TI06B          05BPT--AFW1C-PR
                      08-FPSISO56F-HE
   13  1.7376E-008    36--LHS-DIAG-HE   IE-TI06B          08-FPSISO45F-HE
   14  1.5813E-008    XCOM-AFZ-BTI4     IE-TI06B          05BMVI-MS102-FO
                      08-FPSISO56F-HE
   15  1.4975E-008    SL182             06--OC2----F-HE   IE-TI06B
                      31-PM--CCW1B-TM   STBY-CCWPB        08-FPSISO29F-HE
   16  1.1725E-008    XCOM-AFZ-BTI4     IE-TI06B          36--LHS-DIAG-HE
                      08-FPSISO56F-HE
   17  9.4883E-009    IE-TI06B          01-CMSKPRCCF123   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
   18  8.4414E-009    SL182             06--OC2----F-HE   IE-TI06B
                      31-PM--CCW1B-PR   08-FPSISO29F-HE
   19  6.2340E-009    IE-TI06B          01-CMSIAC1B--TM   86-INSTRFCRF-HE
                      08-FPSISO45F-HE
   20  5.9022E-009    XCOM-OCTI06BB     02-PM-SW1B2--TM   16-BATCLG--F-HE
                      STBY-SWPA2        STBY-SWPB2        IE-TI06B
                      08-FPSISO29F-HE
   21  5.9022E-009    XCOM-OCTI06BB     02-PM-SW1B2--TM   16-BATCLG--F-HE
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STBY-SWPA1 STBY-SWPB2 IE-TI06B
08-FPSISO29F-HE

Table 7
Steamline Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (TI06B) (continued)

22	5.7634E-009	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-DIAG-HE
		08-FPSIS056F-HE		
23	5.4411E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		SL480	IE-TI06B	08-FPSIS056F-HE
24	5.4318E-009	XCOM-AFZ-BTI4	IE-TI06B	05BFAFWA-CAL-AE
		08-FPSIS056F-HE		
25	5.4318E-009	XCOM-AFZ-BTI4	IE-TI06B	05BFAFWB-CAL-AE
		08-FPSIS056F-HE		
26	5.2809E-009	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-TI06B
		08-FPSIS029F-HE		
27	5.2809E-009	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-TI06B
		08-FPSIS029F-HE		
28	5.2204E-009	XCOM-OCTI06BB	38-BY-BRB101-OP	IE-TI06B
		STBY-CCWPB	08-FPSIS029F-HE	
29	4.9183E-009	05BPMSKPSCCF23	IE-TI06B	08-FPSIS029F-HE
30	4.4470E-009	IE-TI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-FPSIS029F-HE		
31	4.4470E-009	IE-TI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-FPSIS029F-HE		
32	4.4429E-009	IE-TI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-FPSIS029F-HE		
33	4.3529E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33-PM---SI1B-TM	08-FPSIS056F-HE
34	3.3285E-009	XCOM-AFZ-BTI4	IE-TI06B	05BSVAFW111C-FO
		08-FPSIS056F-HE		
35	2.6215E-009	IE-TI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-FPSIS045F-HE		
36	2.2787E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33-PM---SI1B-PS	08-FPSIS056F-HE
37	2.1762E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33-CV---SI6A-FC	08-FPSIS056F-HE
38	2.1060E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-CV---CC3A-FC	STBY-CCWPB	08-FPSIS029F-HE
39	2.0491E-009	IE-TI06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		08-FPSIS029F-HE		
40	1.8638E-009	XCOM-OCTI06BB	27A-ORR----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSIS029F-HE
41	1.8447E-009	05BPT--AFW1C-PS	IE-TI06B	05BPM--AFW1B-PS
		08-FPSIS029F-HE		
42	1.7758E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33-PM---SI1B-PR	08-FPSIS056F-HE
43	1.7392E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33-XV---SI7B-AE	08-FPSIS056F-HE
44	1.7297E-009	XCOM-OCTI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B2--TM	STBY-SWPA1	STBY-SWPB2
		IE-TI06B	08-FPSIS029F-HE	
45	1.7297E-009	XCOM-OCTI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC

02-PM-SW1B2--TM	STBY-SWPA2	STBY-SWPB2
IE-TI06B	08-FPSISO29F-HE	

Table 7
Steamline Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (TI06B) (continued)

46	1.6831E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-XV---CC4B-AE	STBY-CCWPB	08-FPSISO29F-HE
47	1.6495E-009	86-INSTRFCRF-HE	IE-TI06B	05BPM--AFW1B-PS
		08-FPSISO29F-HE		
48	1.6260E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-FPSISO29F-HE
49	1.5477E-009	XCOM-OCTI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B1--TM	STBY-SWPA1	STBY-SWPB1
		IE-TI06B	08-FPSISO29F-HE	
50	1.5477E-009	XCOM-OCTI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B1--TM	STBY-SWPA2	STBY-SWPB1
		IE-TI06B	08-FPSISO29F-HE	
51	1.4283E-009	XCOM-AFZ-ATIB	05BPMRKPRCCF23	IE-TI06B
		08-FPSISO29F-HE		
52	1.3482E-009	XCOM-AFZ-ATIB	05BPT--AFW1C-PS	IE-TI06B
		05BPM--AFW1B-PR	08-FPSISO29F-HE	
53	1.2979E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO45F-HE
54	1.2055E-009	XCOM-AFZ-ATIB	86-INSTRFCRF-HE	IE-TI06B
		05BPM--AFW1B-PR	08-FPSISO29F-HE	
55	1.1457E-009	05BPT--AFW1C-PS	IE-TI06B	05BSVAFW111B-FO
		08-FPSISO29F-HE		
56	1.0506E-009	XCOM-OCTI06BB	27A-ORR----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
57	1.0244E-009	IE-TI06B	01-SV-SW402B-FO	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
58	1.0244E-009	86-INSTRFCRF-HE	IE-TI06B	05BSVAFW111B-FO
		08-FPSISO29F-HE		
59	9.8829E-010	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-TI06B	05BPM--AFW1B-PR	08-FPSISO45F-HE
60	9.6504E-010	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		IE-TI06B	33--MAN-HPI--HE	08-FPSISO56F-HE
61	8.2232E-010	IE-TI06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
62	7.8283E-010	IE-TI06B	01-CMAKPSCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
63	7.6205E-010	XCOM-OCTI06BB	02-PM-SW1B1--TM	02-PM-SW1B2--TM
		STBY-SWPB1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
64	7.5020E-010	XCOM-OCTI06BB	02-PM-SW1B2--PS	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
65	7.5020E-010	XCOM-OCTI06BB	02-PM-SW1B1--PS	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-TI06B
		08-FPSISO29F-HE		
66	7.5020E-010	XCOM-OCTI06BB	02-PM-SW1B1--PS	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-TI06B
		08-FPSISO29F-HE		
67	7.5020E-010	XCOM-OCTI06BB	02-PM-SW1B2--PS	16-BATCLG--F-HE

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STBY-SWPA2        STBY-SWPB2        IE-TI06B
08-FPSISO29F-HE
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Table 7
Steamline Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (TI06B) (continued)

68	7.4554E-010	XCOM-OCTI06BB 31-PM--CCW1B-TM	33-PM---SI1B-TM STBY-CCWPB	IE-TI06B 08-FPSISO29F-HE
69	7.3159E-010	SL182 31-PM--CCW1B-PR	06--OC2----F-HE 08-FPSISO45F-HE	IE-TI06B
70	7.1909E-010	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	06-CV-KFOCCF12
71	6.8879E-010	05BSV-KFOCCF23	IE-TI06B	08-FPSISO29F-HE
72	6.8731E-010	05BPT--AFW1C-PS 08-FPSISO29F-HE	IE-TI06B	47-CN-AFP1XB-RC
73	6.8731E-010	05BPT--AFW1C-PS 08-FPSISO29F-HE	IE-TI06B	47-CN-AFP2XB-RC
74	6.6297E-010	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	38-BY-BRA101-OP
75	6.5255E-010	XCOM-OCTI06BB STBY-SWPB1	38-BY-BRB101-OP STBY-SWPB2	IE-TI06B 08-FPSISO29F-HE
76	6.4848E-010	XCOM-AFZ-ATIB IE-TI06B	03-XV--MU2A--FC 08-FPSISO29F-HE	16-BATCLG--F-HE
77	6.4541E-010	05B-CST-SWS--HE 08-FPSISO29F-HE	IE-TI06B	05BPM--AFW1B-PS
78	6.4072E-010	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	02-TURB-HDR--HE IE-TI06B
79	6.4072E-010	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	02-TURB-HDR--HE IE-TI06B
80	6.1459E-010	86-INSTRFCRF-HE 08-FPSISO29F-HE	IE-TI06B	47-CN-AFP1XB-RC
81	6.1459E-010	86-INSTRFCRF-HE 08-FPSISO29F-HE	IE-TI06B	47-CN-AFP2XB-RC
82	5.7328E-010	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	02-TURB-HDR--HE IE-TI06B
83	5.7328E-010	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	02-TURB-HDR--HE IE-TI06B
84	5.5270E-010	05B-FRACTDP-OFF 05BPMRKPRCCF23	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
85	5.1768E-010	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-CV--SW1B2-FC STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
86	5.1768E-010	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-CV--SW1B1-FC STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
87	5.1768E-010	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-CV--SW1B1-FC STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
88	5.1768E-010	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-CV--SW1B2-FC STBY-SWPB1	16-BATCLG--F-HE IE-TI06B

89	5.1152E-010	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-TI06B
		08-FPSISO45F-HE		

Table 7
Steamline Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (TI06B) (continued)

90	5.1152E-010	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO45F-HE		
91	4.7170E-010	XCOM-AFZ-ATIB	05B-CST-SWS--HE	IE-TI06B
		05BPM--AFW1B-PR	08-FPSISO29F-HE	
92	4.6673E-010	XCOM-AFZ-ATIB	03-AS-HTLVLC-OP	16-BATCLG--F-HE
		IE-TI06B	08-FPSISO29F-HE	
93	4.5768E-010	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-TI06B
		08-FPSISO45F-HE		
94	4.5768E-010	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-TI06B
		08-FPSISO45F-HE		
95	4.5243E-010	XCOM-OCTI06BB	38-BY-BRB101-OP	IE-TI06B
		STBY-CCWPB	08-FPSISO45F-HE	
96	4.4565E-010	SL182	39-CB--1-607-CO	IE-TI06B
		08-FPSISO29F-HE		
97	4.2625E-010	05BPMSKPSCCF23	IE-TI06B	08-FPSISO45F-HE
98	4.2615E-010	05BPT--AFW1C-PS	IE-TI06B	47-RE-AFP2XB-RF
		08-FPSISO29F-HE		
99	4.2615E-010	05BPT--AFW1C-PS	IE-TI06B	47-RE-AFP1XB-RF
		08-FPSISO29F-HE		
100	4.2025E-010	XCOM-OCTI06BB	33-PM---SI1B-TM	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	

Table 8
Steamline Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (TX06B)

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===========================================================================
WinNUPRA 3.0 Production                                Licensed to: KNP
TX06B.EQP                                              File created: 10-28-2005
===========================================================================
   Equation File                                 = TX06B.EQN
   Basic Event Data file referenced              = FLOOD.BED
   Number of cut sets in equation                = 1883
   Top event unavailability  (rare event)        = 4.212E-007
---------------------------------------------------------------------------
    1  3.5904E-007   06-BLINDAFWF-HE  IE-TX06B         08-FPSISO3CF-HE
    2  1.8580E-008   XCOM-AFX-2TX4    06--OC6----F-HE  IE-TX06B
                     08-FPSISO3CF-HE
    3  1.1293E-008   IE-TX06B         05BPT--AFW1C-PS  08-FPSISO3CF-HE
    4  9.1084E-009   05B-BYALOP-F-HE  05B-FRACTDP-OFF  05B-MDPTD2HF-HE
                     IE-TX06B         08-FPSISO3CF-HE
    5  3.9511E-009   IE-TX06B         05B-CST-SWS--HE  08-FPSISO3CF-HE
    6  3.6236E-009   IE-TX06B         01-CMSIAC1B--PR  86-INSTRRCRF-HE
                     08-FPSISO1CF-HE
    7  3.6236E-009   IE-TX06B         01-CMSIAC1B--PR  86-INSTRFCRF-HE
                     08-FPSISO2CF-HE
    8  1.4791E-009   IE-TX06B         05BPT--AFW1C-PR  08-FPSISO3CF-HE
    9  1.3324E-009   IE-TX06B         05BMVI-MS102-FO  08-FPSISO3CF-HE
   10  9.8792E-010   IE-TX06B         36--LHS-DIAG-HE  08-FPSISO2CF-HE
   11  9.8792E-010   IE-TX06B         36--LHS-DIAG-HE  08-FPSISO1CF-HE
   12  9.8792E-010   IE-TX06B         36--LHS-DIAG-HE  08-FPSISO3CF-HE
   13  4.8560E-010   IE-TX06B         05B-CST-DIAG-HE  08-FPSISO3CF-HE
   14  4.5845E-010   XCOM-OCTX06B4    XCOM-AFX-2TX4    SL480
                     IE-TX06B         08-FPSISO3CF-HE
   15  4.5766E-010   IE-TX06B         05BFAFWB-CAL-AE  08-FPSISO3CF-HE
   16  4.5766E-010   IE-TX06B         05BFAFWA-CAL-AE  08-FPSISO3CF-HE
   17  3.6676E-010   XCOM-OCTX06B4    XCOM-AFX-2TX4    IE-TX06B
                     33-PM---SI1B-TM  08-FPSISO3CF-HE
   18  3.5444E-010   IE-TX06B         01-CMSIAC1B--TM  86-INSTRFCRF-HE
                     08-FPSISO2CF-HE
   19  3.5444E-010   IE-TX06B         01-CMSIAC1B--TM  86-INSTRRCRF-HE
                     08-FPSISO1CF-HE
   20  2.8044E-010   IE-TX06B         05BSVAFW111C-FO  08-FPSISO3CF-HE
   21  1.9200E-010   XCOM-OCTX06B4    XCOM-AFX-2TX4    IE-TX06B
                     33-PM---SI1B-PS  08-FPSISO3CF-HE
   22  1.8336E-010   XCOM-OCTX06B4    XCOM-AFX-2TX4    IE-TX06B
                     33-CV---SI6A-FC  08-FPSISO3CF-HE
   23  1.4962E-010   XCOM-OCTX06B4    XCOM-AFX-2TX4    IE-TX06B
                     33-PM---SI1B-PR  08-FPSISO3CF-HE
   24  1.4905E-010   IE-TX06B         01-CMSIAC1B--PS  86-INSTRRCRF-HE
                     08-FPSISO1CF-HE
   25  1.4905E-010   IE-TX06B         01-CMSIAC1B--PS  86-INSTRFCRF-HE
                     08-FPSISO2CF-HE
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26	1.4654E-010	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		33-XV---SI7B-AE	08-FPSISO3CF-HE	
27	8.1311E-011	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		33--MAN-HPI--HE	08-FPSISO3CF-HE	

Table 8
Steamline Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (TX06B) (continued)

28	7.3791E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO1CF-HE
29	7.3791E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO2CF-HE
30	6.0588E-011	IE-TX06B	06-CV-KFOCCF12	08-FPSISO3CF-HE
31	5.5859E-011	IE-TX06B	38-BY-BRA101-OP	08-FPSISO3CF-HE
32	4.6754E-011	IE-TX06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		08-FPSISO2CF-HE		
33	4.6754E-011	IE-TX06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO1CF-HE		
34	4.1595E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-PR	08-FPSISO1CF-HE	
35	4.1595E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-PR	08-FPSISO2CF-HE	
36	2.9083E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPSISO1CF-HE		
37	2.9083E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPSISO2CF-HE		
38	2.9083E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-FPSISO1CF-HE		
39	2.9083E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-FPSISO2CF-HE		
40	2.8050E-011	IE-TX06B	05BCVD-AFW1C-FO	08-FPSISO3CF-HE
41	2.6022E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-FPSISO2CF-HE		
42	2.6022E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-FPSISO1CF-HE		
43	2.6022E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPSISO1CF-HE		
44	2.6022E-011	XCOM-OCTX06BB	IE-TX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-FPSISO2CF-HE		
45	2.5724E-011	XCOM-OCTX06BB	IE-TX06B	38-BY-BRB101-OP
		STBY-CCWPB	08-FPSISO1CF-HE	
46	2.5724E-011	XCOM-OCTX06BB	IE-TX06B	38-BY-BRB101-OP
		STBY-CCWPB	08-FPSISO2CF-HE	
47	2.4235E-011	IE-TX06B	05BPMSKPSCCF23	08-FPSISO1CF-HE
48	2.4235E-011	IE-TX06B	05BPMSKPSCCF23	08-FPSISO3CF-HE
49	2.4235E-011	IE-TX06B	05BPMSKPSCCF23	08-FPSISO2CF-HE
50	2.1913E-011	IE-TX06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-FPSISO1CF-HE		
51	2.1913E-011	IE-TX06B	01-CMSKPRCCF23	86-INSTRFCRF-HE

		08-FPSISO2CF-HE		
52	2.1913E-011	IE-TX06B	01-CMSKPRCCF12	86-INSTRFCRF-HE
		08-FPSISO2CF-HE		

Table 8
Steamline Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (TX06B) (continued)

53	2.1913E-011	IE-TX06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-FPSISO1CF-HE		
54	2.1892E-011	IE-TX06B	01-AV-SW420B-FO	86-INSTRFCRF-HE
		08-FPSISO2CF-HE		
55	2.1892E-011	IE-TX06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-FPSISO1CF-HE		
56	2.0172E-011	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		33-PM-KPSCCF12	08-FPSISO3CF-HE	
57	1.8259E-011	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		38-BY-BRB101-OP	08-FPSISO3CF-HE	
58	1.6890E-011	05B-FRACTDP-OFF	05B-MDPTD2HF-HE	IE-TX06B
		05BPM--AFW1B-PR	08-FPSISO1CF-HE	
59	1.0377E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-CV---CC3A-FC	STBY-CCWPB	08-FPSISO2CF-HE
60	1.0377E-011	SL182	06--OC2----F-HE	IE-TX06B
		31-CV---CC3A-FC	STBY-CCWPB	08-FPSISO1CF-HE
61	1.0322E-011	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		02-PM-SW1B2--TM	16-BATCLG--F-HE	STBY-SWPA2
		STBY-SWPB2	08-FPSISO3CF-HE	
62	1.0322E-011	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		02-PM-SW1B2--TM	16-BATCLG--F-HE	STBY-SWPA1
		STBY-SWPB2	08-FPSISO3CF-HE	
63	1.0097E-011	IE-TX06B	27BCV-SWT242-FC	86-INSTRFCRF-HE
		08-FPSISO2CF-HE		
64	1.0097E-011	IE-TX06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		08-FPSISO1CF-HE		
65	9.7614E-012	IE-TX06B	05BPMRKPRCCF23	08-FPSISO1CF-HE
66	9.7614E-012	IE-TX06B	05BPMRKPRCCF23	08-FPSISO3CF-HE
67	9.7614E-012	IE-TX06B	05BPMRKPRCCF23	08-FPSISO2CF-HE
68	9.2355E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		02-PM-SW1B1--TM	16-BATCLG--F-HE	STBY-SWPA1
		STBY-SWPB1	08-FPSISO3CF-HE	
69	9.2355E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		02-PM-SW1B1--TM	16-BATCLG--F-HE	STBY-SWPA2
		STBY-SWPB1	08-FPSISO3CF-HE	
70	9.2140E-012	IE-TX06B	05BPM--AFW1B-PR	05BPT--AFW1C-PS
		08-FPSISO2CF-HE		
71	9.2140E-012	IE-TX06B	05BPM--AFW1B-PR	05BPT--AFW1C-PS
		08-FPSISO1CF-HE		
72	9.1841E-012	XCOM-OCTX06BB	27A-ORR----F-HE	IE-TX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO1CF-HE
73	9.1841E-012	XCOM-OCTX06BB	27A-ORR----F-HE	IE-TX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO2CF-HE
74	9.1690E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		33-CV---SI6B-FO	08-FPSISO3CF-HE	
75	9.0897E-012	IE-TX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		08-FPSISO1CF-HE		
76	9.0897E-012	IE-TX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		08-FPSISO2CF-HE		

77	8.5234E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-FPSISO2CF-HE	

Table 8
Steamline Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (TX06B) (continued)

78	8.5234E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-FPSISO2CF-HE	
79	8.5234E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-FPSISO1CF-HE	
80	8.5234E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-FPSISO1CF-HE	
81	8.4301E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-FPSISO3CF-HE	
82	8.4301E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-FPSISO3CF-HE	
83	8.2935E-012	SL182	06--OC2----F-HE	IE-TX06B
		31-XV---CC4B-AE	STBY-CCWPB	08-FPSISO1CF-HE
84	8.2935E-012	SL182	06--OC2----F-HE	IE-TX06B
		31-XV---CC4B-AE	STBY-CCWPB	08-FPSISO2CF-HE
85	8.2390E-012	86-INSTRFCRF-HE	IE-TX06B	05BPM--AFW1B-PR
		08-FPSISO1CF-HE		
86	8.2390E-012	86-INSTRFCRF-HE	IE-TX06B	05BPM--AFW1B-PR
		08-FPSISO2CF-HE		
87	8.1279E-012	86-INSTRFCRF-HE	IE-TX06B	05BPM--AFW1B-PS
		08-FPSISO2CF-HE		
88	8.1279E-012	86-INSTRFCRF-HE	IE-TX06B	05BPM--AFW1B-PS
		08-FPSISO1CF-HE		
89	8.0122E-012	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-FPSISO2CF-HE
90	8.0122E-012	SL182	06--OC2----F-HE	IE-TX06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-FPSISO1CF-HE
91	7.6262E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-FPSISO1CF-HE	
92	7.6262E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-FPSISO2CF-HE	
93	7.6262E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	08-FPSISO1CF-HE	
94	7.6262E-012	XCOM-OCTX06BB	IE-TX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	08-FPSISO2CF-HE	
95	7.5427E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	08-FPSISO3CF-HE	
96	7.5427E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-FPSISO3CF-HE	

97	7.4316E-012	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	05BPM--AFW1B-PR	08-FPSISO2CF-HE

Table 8
Steamline Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (TX06B) (continued)

98	6.1432E-012	XCOM-OCTX06B4	XCOM-AFX-2TX4	IE-TX06B
		33-PM-KPRCCF12	08-FPSISO3CF-HE	
99	5.6453E-012	IE-TX06B	05BSVAFW111B-FO	05BPT--AFW1C-PS
		08-FPSISO1CF-HE		
100	5.6453E-012	IE-TX06B	05BSVAFW111B-FO	05BPT--AFW1C-PS
		08-FPSISO2CF-HE		

Table 9
Feedwater Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (WI06B)

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==============================================================================
WinNUPRA 3.0 Production                          Licensed to: KNP
WI06B.EQP                                        File created: 10-28-2005
==============================================================================
   Equation File                                = WI06B.EQN
   Basic Event Data file referenced             = FLOOD.BED
   Number of cut sets in equation               = 5799
   Top event unavailability  (rare event)       = 8.720E-006
------------------------------------------------------------------------------
     1  4.7114E-006   XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                      08-ISO-FS40F-HE
     2  1.6835E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                      IE-WI06B          08-ISO-FS40F-HE
     3  8.7199E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
     4  2.4381E-007   XCOM-AFX-2WI4     XCOM-AFZ-BWI4     06--OC6----F-HE
                      IE-WI06B          08-ISO-FS40F-HE
     5  2.3773E-007   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS18F-HE
     6  1.9184E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                      08-ISO-FS33F-HE
     7  1.4819E-007   XCOM-AFZ-BWI4     IE-WI06B          05BPT--AFW1C-PS
                      08-ISO-FS40F-HE
     8  8.5293E-008   IE-WI06B          01-CMSIAC1B--TM   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
     9  5.2302E-008   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS33F-HE
    10  5.1847E-008   XCOM-AFZ-BWI4     IE-WI06B          05B-CST-SWS--HE
                      08-ISO-FS40F-HE
    11  4.6592E-008   05B-FRACTDP-OFF   05B-MDPTD49F-HE   IE-WI06B
                      05BPM--AFW1B-PR   08-ISO-FS18F-HE
    12  3.5867E-008   IE-WI06B          01-CMSIAC1B--PS   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
    13  1.9409E-008   XCOM-AFZ-BWI4     IE-WI06B          05BPT--AFW1C-PR
                      08-ISO-FS40F-HE
    14  1.8764E-008   IE-WI06B          01-CMSIAC1B--TM   86-INSTRFCRF-HE
                      08-ISO-FS33F-HE
    15  1.7757E-008   SL182             06--OC2----F-HE   IE-WI06B
                      31-PM--CCW1B-TM   STBY-CCWPB        08-ISO-FS18F-HE
    16  1.7484E-008   XCOM-AFZ-BWI4     IE-WI06B          05BMVI-MS102-FO
                      08-ISO-FS40F-HE
    17  1.2964E-008   XCOM-AFZ-BWI4     IE-WI06B          36--LHS-DIAG-HE
                      08-ISO-FS40F-HE
    18  1.1251E-008   IE-WI06B          01-CMSKPRCCF123   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
    19  1.0010E-008   SL182             06--OC2----F-HE   IE-WI06B
                      31-PM--CCW1B-PR   08-ISO-FS18F-HE
    20  7.8907E-009   IE-WI06B          01-CMSIAC1B--PS   86-INSTRFCRF-HE
                      08-ISO-FS33F-HE
    21  6.9986E-009   XCOM-OCWI06BB     02-PM-SW1B2--TM   16-BATCLG--F-HE
                      STBY-SWPA2        STBY-SWPB2        IE-WI06B
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08-ISO-FS18F-HE

Table 9
Feedwater Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (WI06B) (continued)

22	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
23	6.3722E-009	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-DIAG-HE
		08-ISO-FS40F-HE		
24	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
25	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
26	6.1902E-009	XCOM-OCWI06BB	38-BY-BRB101-OP	IE-WI06B
		STBY-CCWPB	08-ISO-FS18F-HE	
27	6.0159E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		SL480	IE-WI06B	08-ISO-FS40F-HE
28	6.0055E-009	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWB-CAL-AE
		08-ISO-FS40F-HE		
29	6.0055E-009	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWA-CAL-AE
		08-ISO-FS40F-HE		
30	5.8320E-009	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS18F-HE
31	5.2731E-009	IE-WI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
32	5.2731E-009	IE-WI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
33	5.2682E-009	IE-WI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
34	4.8127E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		IE-WI06B	33-PM---SI1B-TM	08-ISO-FS40F-HE
35	4.5101E-009	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD49F-HE
		IE-WI06B	05BPM--AFW1B-PR	08-ISO-FS33F-HE
36	3.9066E-009	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS33F-HE
37	3.6800E-009	XCOM-AFZ-BWI4	IE-WI06B	05BSVAFW111C-FO
		08-ISO-FS40F-HE		
38	2.5194E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		IE-WI06B	33-PM---SI1B-PS	08-ISO-FS40F-HE
39	2.4973E-009	SL182	06--OC2----F-HE	IE-WI06B
		31-CV---CC3A-FC	STBY-CCWPB	08-ISO-FS18F-HE
40	2.4752E-009	IE-WI06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
41	2.4298E-009	IE-WI06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
42	2.4061E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		IE-WI06B	33-CV---SI6A-FC	08-ISO-FS40F-HE
43	2.2101E-009	XCOM-OCWI06BB	27A-ORR----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
44	2.2021E-009	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS33F-HE	
45	2.1874E-009	05BPT--AFW1C-PS	IE-WI06B	05BPM--AFW1B-PS

08-ISO-FS18F-HE

Table 9
Feedwater Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (WI06B) (continued)

46	2.0511E-009	XCOM-OCWI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B2--TM	STBY-SWPA2	STBY-SWPB2
		IE-WI06B	08-ISO-FS18F-HE	
47	2.0511E-009	XCOM-OCWI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B2--TM	STBY-SWPA1	STBY-SWPB2
		IE-WI06B	08-ISO-FS18F-HE	
48	1.9958E-009	SL182	06--OC2----F-HE	IE-WI06B
		31-XV---CC4B-AE	STBY-CCWPB	08-ISO-FS18F-HE
49	1.9634E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		IE-WI06B	33-PM---SI1B-PR	08-ISO-FS40F-HE
50	1.9559E-009	86-INSTRFCRF-HE	IE-WI06B	05BPM--AFW1B-PS
		08-ISO-FS18F-HE		
51	1.9281E-009	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-ISO-FS18F-HE
52	1.9229E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		IE-WI06B	33-XV---SI7B-AE	08-ISO-FS40F-HE
53	1.8352E-009	XCOM-OCWI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B1--TM	STBY-SWPA1	STBY-SWPB1
		IE-WI06B	08-ISO-FS18F-HE	
54	1.8352E-009	XCOM-OCWI06BB	01-CMSIAC1B--PR	01-CV-IA503-2FC
		02-PM-SW1B1--TM	STBY-SWPA2	STBY-SWPB1
		IE-WI06B	08-ISO-FS18F-HE	
55	1.5397E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-WI06B
		08-ISO-FS33F-HE		
56	1.5397E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS33F-HE		
57	1.3776E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS33F-HE		
58	1.3776E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS33F-HE		
59	1.3618E-009	XCOM-OCWI06BB	38-BY-BRB101-OP	IE-WI06B
		STBY-CCWPB	08-ISO-FS33F-HE	
60	1.3585E-009	05BPT--AFW1C-PS	IE-WI06B	05BSVAFW111B-FO
		08-ISO-FS18F-HE		
61	1.3554E-009	XCOM-AFZ-AWIB	05BPMRKPRCCF23	IE-WI06B
		08-ISO-FS18F-HE		
62	1.2830E-009	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS33F-HE
63	1.2794E-009	XCOM-AFZ-AWIB	05BPT--AFW1C-PS	IE-WI06B
		05BPM--AFW1B-PR	08-ISO-FS18F-HE	
64	1.2458E-009	XCOM-OCWI06BB	27A-ORR----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
65	1.2148E-009	86-INSTRFCRF-HE	IE-WI06B	05BSVAFW111B-FO
		08-ISO-FS18F-HE		
66	1.2148E-009	IE-WI06B	01-SV-SW402B-FO	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		

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67  1.1601E-009    IE-WI06B          01-CMSKPRCCF23    86-INSTRFCRF-HE
                   08-ISO-FS33F-HE
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Table 9
Feedwater Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (WI06B) (continued)

68	1.1601E-009	IE-WI06B 08-ISO-FS33F-HE	01-CMSKPRCCF12	86-INSTRFCRF-HE
69	1.1590E-009	IE-WI06B 08-ISO-FS33F-HE	01-AV-SW420B-FO	86-INSTRFCRF-HE
70	1.1440E-009	XCOM-AFZ-AWIB 05BPM--AFW1B-PR	86-INSTRFCRF-HE 08-ISO-FS18F-HE	IE-WI06B
71	1.0670E-009	XCOM-OCWI06B4 IE-WI06B	XCOM-AFX-2WI4 33--MAN-HPI--HE	XCOM-AFZ-BWI4 08-ISO-FS40F-HE
72	9.9363E-010	05B-FRACTDP-OFF 05BPMRKPRCCF23	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
73	9.2826E-010	IE-WI06B 08-ISO-FS18F-HE	01-CMAKPSCCF123	86-INSTRRCRF-HE
74	9.0362E-010	XCOM-OCWI06BB STBY-SWPB1 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB2	02-PM-SW1B2--TM IE-WI06B
75	8.8956E-010	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B1--PS STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
76	8.8956E-010	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B2--PS STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
77	8.8956E-010	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B1--PS STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
78	8.8956E-010	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B2--PS STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
79	8.8404E-010	XCOM-OCWI06BB 31-PM--CCW1B-TM	33-PM---SI1B-TM STBY-CCWPB	IE-WI06B 08-ISO-FS18F-HE
80	8.1675E-010	05BSV-KFOCCF23	IE-WI06B	08-ISO-FS18F-HE
81	8.1499E-010	05BPT--AFW1C-PS 08-ISO-FS18F-HE	IE-WI06B	47-CN-AFP1XB-RC
82	8.1499E-010	05BPT--AFW1C-PS 08-ISO-FS18F-HE	IE-WI06B	47-CN-AFP2XB-RC
83	7.9505E-010	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	06-CV-KFOCCF12
84	7.7377E-010	XCOM-OCWI06BB STBY-SWPB1	38-BY-BRB101-OP STBY-SWPB2	IE-WI06B 08-ISO-FS18F-HE
85	7.6530E-010	05B-CST-SWS--HE 08-ISO-FS18F-HE	IE-WI06B	05BPM--AFW1B-PS
86	7.5975E-010	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	02-TURB-HDR--HE IE-WI06B
87	7.5975E-010	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	02-TURB-HDR--HE IE-WI06B
88	7.3300E-010	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	38-BY-BRA101-OP
89	7.2876E-010	86-INSTRFCRF-HE	IE-WI06B	47-CN-AFP1XB-RC

		08-ISO-FS18F-HE		
90	7.2876E-010	86-INSTRFCRF-HE	IE-WI06B	47-CN-AFP2XB-RC
		08-ISO-FS18F-HE		

Table 9
Feedwater Break (Large Fire Protection Discharge) in Turbine Building CDF Cutsets (WI06B) (continued)

91	6.7977E-010	XCOM-OCWI06BB	02-PM-SW1B1--TM	02-TURB-HDR--HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
92	6.7977E-010	XCOM-OCWI06BB	02-PM-SW1B1--TM	02-TURB-HDR--HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
93	6.1537E-010	XCOM-AFZ-AWIB	03-XV--MU2A--FC	16-BATCLG--F-HE
		IE-WI06B	08-ISO-FS18F-HE	
94	6.1385E-010	XCOM-OCWI06BB	02-CV--SW1B1-FC	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
95	6.1385E-010	XCOM-OCWI06BB	02-CV--SW1B2-FC	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
96	6.1385E-010	XCOM-OCWI06BB	02-CV--SW1B1-FC	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
97	6.1385E-010	XCOM-OCWI06BB	02-CV--SW1B2-FC	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
98	5.8932E-010	05B-FRACTDP-OFF	05B-MDPTD49F-HE	IE-WI06B
		05BAV--AFW2B-OC	08-ISO-FS18F-HE	
99	5.4940E-010	SL182	06--OC2----F-HE	IE-WI06B
		31-CV---CC3A-FC	STBY-CCWPB	08-ISO-FS33F-HE
100	5.3455E-010	IE-WI06B	27BCV-SWT242-FC	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		

Table 10
Feedwater Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (WX06B)

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================================================================================
WinNUPRA 3.0 Production                          Licensed to: KNP
WX06B.EQP                                        File created: 10-28-2005
================================================================================
   Equation File                               = WX06B.EQN
   Basic Event Data file referenced            = FLOOD.BED
   Number of cut sets in equation              = 2787
   Top event unavailability  (rare event)      = 6.133E-007
--------------------------------------------------------------------------------
    1  4.7794E-007    XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                      08-ISO-FS2HF-HE
    2  5.0517E-008    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD1CF-HE
                      IE-WX06B          08-ISO-FS2HF-HE
    3  2.4733E-008    XCOM-AFX-2WX4     XCOM-AFZ-BWX4     06--OC6----F-HE
                      IE-WX06B          08-ISO-FS2HF-HE
    4  1.5033E-008    XCOM-AFZ-BWX4     IE-WX06B          05BPT--AFW1C-PS
                      08-ISO-FS2HF-HE
    5  9.0880E-009    IE-WX06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                      08-ISO-FS97F-HE
    6  9.0880E-009    IE-WX06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-ISO-FS55F-HE
    7  5.2596E-009    XCOM-AFZ-BWX4     IE-WX06B          05B-CST-SWS--HE
                      08-ISO-FS2HF-HE
    8  2.4777E-009    IE-WX06B          36--LHS-DIAG-HE   08-ISO-FS55F-HE
    9  2.4777E-009    IE-WX06B          36--LHS-DIAG-HE   08-ISO-FS97F-HE
   10  1.9689E-009    XCOM-AFZ-BWX4     IE-WX06B          05BPT--AFW1C-PR
                      08-ISO-FS2HF-HE
   11  1.7736E-009    XCOM-AFZ-BWX4     IE-WX06B          05BMVI-MS102-FO
                      08-ISO-FS2HF-HE
   12  1.3151E-009    XCOM-AFZ-BWX4     IE-WX06B          36--LHS-DIAG-HE
                      08-ISO-FS2HF-HE
   13  8.8894E-010    IE-WX06B          01-CMSIAC1B--TM   86-INSTRFCRF-HE
                      08-ISO-FS97F-HE
   14  8.8894E-010    IE-WX06B          01-CMSIAC1B--TM   86-INSTRRCRF-HE
                      08-ISO-FS55F-HE
   15  6.4642E-010    XCOM-AFZ-BWX4     IE-WX06B          05B-CST-DIAG-HE
                      08-ISO-FS2HF-HE
   16  6.1027E-010    XCOM-OCWX06B4     XCOM-AFX-2WX4     XCOM-AFZ-BWX4
                      SL480             IE-WX06B          08-ISO-FS2HF-HE
   17  6.0923E-010    XCOM-AFZ-BWX4     IE-WX06B          05BFAFWB-CAL-AE
                      08-ISO-FS2HF-HE
   18  6.0923E-010    XCOM-AFZ-BWX4     IE-WX06B          05BFAFWA-CAL-AE
                      08-ISO-FS2HF-HE
   19  4.8822E-010    XCOM-OCWX06B4     XCOM-AFX-2WX4     XCOM-AFZ-BWX4
                      IE-WX06B          33-PM---SI1B-TM   08-ISO-FS2HF-HE
   20  3.7381E-010    IE-WX06B          01-CMSIAC1B--PS   86-INSTRFCRF-HE
                      08-ISO-FS97F-HE
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21	3.7381E-010	IE-WX06B 08-ISO-FS55F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
22	3.7332E-010	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	IE-WX06B	05BSVAFW111C-FO

Table 10
Feedwater Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (WX06B) (continued)

23	2.5558E-010	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33-PM---SI1B-PS	08-ISO-FS2HF-HE
24	2.4408E-010	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33-CV---SI6A-FC	08-ISO-FS2HF-HE
25	1.9917E-010	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33-PM---SI1B-PR	08-ISO-FS2HF-HE
26	1.9507E-010	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33-XV---SI7B-AE	08-ISO-FS2HF-HE
27	1.8507E-010	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS55F-HE
28	1.8507E-010	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS97F-HE
29	1.6531E-010	05B-FRACTDP-OFF	05B-MDPTD1CF-HE	IE-WX06B
		05BPM--AFW1B-PR	08-ISO-FS55F-HE	
30	1.1726E-010	IE-WX06B	01-CMSKPRCCF123	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
31	1.1726E-010	IE-WX06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
32	1.0824E-010	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33--MAN-HPI--HE	08-ISO-FS2HF-HE
33	1.0432E-010	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-PR	08-ISO-FS55F-HE	
34	1.0432E-010	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-PR	08-ISO-FS97F-HE	
35	8.0653E-011	XCOM-AFZ-BWX4	IE-WX06B	06-CV-KFOCCF12
		08-ISO-FS2HF-HE		
36	7.4358E-011	XCOM-AFZ-BWX4	IE-WX06B	38-BY-BRA101-OP
		08-ISO-FS2HF-HE		
37	7.2941E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-ISO-FS97F-HE		
38	7.2941E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-ISO-FS55F-HE		
39	7.2941E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB2
		08-ISO-FS55F-HE		
40	7.2941E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B2--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB2
		08-ISO-FS97F-HE		
41	7.2736E-011	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD1CF-HE
		IE-WX06B	05BPM--AFW1B-PR	08-ISO-FS97F-HE
42	6.5263E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-ISO-FS55F-HE		
43	6.5263E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA1	STBY-SWPB1
		08-ISO-FS97F-HE		
44	6.5263E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B1--TM

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16-BATCLG--F-HE  STBY-SWPA2        STBY-SWPB1
08-ISO-FS97F-HE
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Table 10
Feedwater Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (WX06B) (continued)

45	6.5263E-011	XCOM-OCWX06BB	IE-WX06B	02-PM-SW1B1--TM
		16-BATCLG--F-HE	STBY-SWPA2	STBY-SWPB1
		08-ISO-FS55F-HE		
46	6.4515E-011	XCOM-OCWX06BB	IE-WX06B	38-BY-BRB101-OP
		STBY-CCWPB	08-ISO-FS55F-HE	
47	6.4515E-011	XCOM-OCWX06BB	IE-WX06B	38-BY-BRB101-OP
		STBY-CCWPB	08-ISO-FS97F-HE	
48	6.0782E-011	IE-WX06B	05BPMSKPSCCF23	08-ISO-FS97F-HE
49	6.0782E-011	IE-WX06B	05BPMSKPSCCF23	08-ISO-FS55F-HE
50	5.4957E-011	IE-WX06B	01-CMSKPRCCF12	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
51	5.4957E-011	IE-WX06B	01-CMSKPRCCF23	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
52	5.4957E-011	IE-WX06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
53	5.4957E-011	IE-WX06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
54	5.4907E-011	IE-WX06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
55	5.4907E-011	IE-WX06B	01-AV-SW420B-FO	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
56	3.7339E-011	XCOM-AFZ-BWX4	IE-WX06B	05BCVD-AFW1C-FO
		08-ISO-FS2HF-HE		
57	3.2261E-011	XCOM-AFZ-BWX4	IE-WX06B	05BPMSKPSCCF23
		08-ISO-FS2HF-HE		
58	2.6852E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	33-PM-KPSCCF12	08-ISO-FS2HF-HE
59	2.6027E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-CV---CC3A-FC	STBY-CCWPB	08-ISO-FS97F-HE
60	2.6027E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-CV---CC3A-FC	STBY-CCWPB	08-ISO-FS55F-HE
61	2.5323E-011	IE-WX06B	27BCV-SWT242-FC	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
62	2.5323E-011	IE-WX06B	27BCV-SWT242-FC	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
63	2.4306E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	38-BY-BRB101-OP	08-ISO-FS2HF-HE
64	2.3034E-011	XCOM-OCWX06BB	27A-ORR----F-HE	IE-WX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS97F-HE
65	2.3034E-011	XCOM-OCWX06BB	27A-ORR----F-HE	IE-WX06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS55F-HE
66	2.2931E-011	XCOM-AFZ-BWXB	IE-WX06B	05BPMRKPRCCF23
		08-ISO-FS97F-HE		
67	2.2797E-011	IE-WX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		08-ISO-FS97F-HE		
68	2.2797E-011	IE-WX06B	05BPM--AFW1B-PS	05BPT--AFW1C-PS
		08-ISO-FS55F-HE		
69	2.1645E-011	XCOM-AFZ-BWXB	IE-WX06B	05BPM--AFW1B-PR
		05BPT--AFW1C-PS	08-ISO-FS97F-HE	

70	2.1377E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-ISO-FS97F-HE	

Table 10
Feedwater Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (WX06B) (continued)

71	2.1377E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-ISO-FS97F-HE	
72	2.1377E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA1
		STBY-SWPB2	08-ISO-FS55F-HE	
73	2.1377E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B2--TM	STBY-SWPA2
		STBY-SWPB2	08-ISO-FS55F-HE	
74	2.0956E-011	XCOM-AFZ-AWXB	IE-WX06B	05BPMRKPRCCF23
		08-ISO-FS55F-HE		
75	2.0800E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-XV---CC4B-AE	STBY-CCWPB	08-ISO-FS97F-HE
76	2.0800E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-XV---CC4B-AE	STBY-CCWPB	08-ISO-FS55F-HE
77	2.0385E-011	86-INSTRFCRF-HE	IE-WX06B	05BPM--AFW1B-PS
		08-ISO-FS97F-HE		
78	2.0385E-011	86-INSTRFCRF-HE	IE-WX06B	05BPM--AFW1B-PS
		08-ISO-FS55F-HE		
79	2.0095E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-ISO-FS97F-HE
80	2.0095E-011	SL182	06--OC2----F-HE	IE-WX06B
		31-PM--CCW1B-PS	STBY-CCWPB	08-ISO-FS55F-HE
81	1.9781E-011	XCOM-AFZ-AWXB	IE-WX06B	05BPM--AFW1B-PR
		05BPT--AFW1C-PS	08-ISO-FS55F-HE	
82	1.9354E-011	XCOM-AFZ-BWXB	86-INSTRFCRF-HE	IE-WX06B
		05BPM--AFW1B-PR	08-ISO-FS97F-HE	
83	1.9127E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	08-ISO-FS97F-HE	
84	1.9127E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA1
		STBY-SWPB1	08-ISO-FS55F-HE	
85	1.9127E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-ISO-FS97F-HE	
86	1.9127E-011	XCOM-OCWX06BB	IE-WX06B	01-CMSIAC1B--PR
		01-CV-IA503-2FC	02-PM-SW1B1--TM	STBY-SWPA2
		STBY-SWPB1	08-ISO-FS55F-HE	
87	1.7688E-011	XCOM-AFZ-AWXB	86-INSTRFCRF-HE	IE-WX06B
		05BPM--AFW1B-PR	08-ISO-FS55F-HE	
88	1.4159E-011	IE-WX06B	05BSVAFW111B-FO	05BPT--AFW1C-PS
		08-ISO-FS97F-HE		
89	1.4159E-011	IE-WX06B	05BSVAFW111B-FO	05BPT--AFW1C-PS
		08-ISO-FS55F-HE		
90	1.3740E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	08-ISO-FS2HF-HE
91	1.3740E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4

IE-WX06B	02-PM-SW1B2--TM	16-BATCLG--F-HE
STBY-SWPA1	STBY-SWPB2	08-ISO-FS2HF-HE

Table 10
Feedwater Break (Moderate Fire Protection Discharge) in Turbine Building CDF Cutsets (WX06B) (continued)

92	1.2994E-011	XCOM-AFZ-BWX4	IE-WX06B	05BPMRKPRCCF23
		08-ISO-FS2HF-HE		
93	1.2984E-011	XCOM-OCWX06BB	27A-ORR----F-HE	IE-WX06B
		31-PM--CCW1B-PR	08-ISO-FS55F-HE	
94	1.2984E-011	XCOM-OCWX06BB	27A-ORR----F-HE	IE-WX06B
		31-PM--CCW1B-PR	08-ISO-FS97F-HE	
95	1.2660E-011	IE-WX06B	01-SV-SW402B-FO	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
96	1.2660E-011	86-INSTRFCRF-HE	IE-WX06B	05BSVAFW111B-FO
		08-ISO-FS97F-HE		
97	1.2660E-011	86-INSTRFCRF-HE	IE-WX06B	05BSVAFW111B-FO
		08-ISO-FS55F-HE		
98	1.2660E-011	IE-WX06B	01-SV-SW402B-FO	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
99	1.2294E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	08-ISO-FS2HF-HE
100	1.2294E-011	XCOM-OCWX06B4	XCOM-AFX-2WX4	XCOM-AFZ-BWX4
		IE-WX06B	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	08-ISO-FS2HF-HE

Table 11
Basic Event Descriptions

```
==============================================================================
WinNUPRA 3.0 Production  Licensed to: KNP      Last saved: 10/28/2005
File: C:\Kewaunee\NEW SDI\Data\FLOOD.BED
==============================================================================
BASIC EVENT ID    POINT EST.  TYPE DESCRIPTION
==============================================================================
-GAFW300          1.000E+000  7   AFW SUCCESS
-GCHG1300         1.000E+000  7   CHARGING SUCCESFUL
-GEPS120          1.000E+000  7   BUS 5 SUCCESS (2)
-GEPS1210         1.000E+000  7   BUS 5 SUCCESS
-GEPS1211         1.000E+000  7   BUS 6 SUCCESS
-GEPS710          1.000E+000  7   BUS 6 SUCCESS (2)
01--IAS-STBY-HE   1.580E-002  3   OPERATOR FAILS TO START STANDBY AIR COMPRESSOR
01--IAS-STBYFHE   1.600E-001  3   OPERATOR FAILS TO START STANDBY AIR COMPRESSOR
(FIRE)
01-AC-ACC1516LK   2.399E-004  4   ACC-15, ACC-16 ACCUMULATOR LEAKS EXCESSIVELY
01-AC-PR2A---LK   2.399E-004  4   INDEPENDENT FAILUREPR-2A AIR ACCUMULATOR LEAKS
01-AC-PR2B---LK   2.399E-004  4   INDEPENDENT FAILUREPR-2B AIR ACCUMULATOR LEAKS
01-AC-SW4A---LK   2.399E-004  4   SW-4A AIR ACCUMULATOR LEAKS EXCESSIVELY
01-AC-SW4B---LK   2.399E-004  4   SW-4B AIR ACCUMULATOR LEAKS EXCESSIVELY
01-ACCKLKCCF12    5.640E-006  4   DOUBLE COMMON CAUSE FAILURE (CCF)01-ACCKLKCCF12
01-ACRKLKCCF12    5.640E-006  3   DOUBLE COMMON CAUSE FAILURE (CCF)PR-2A/B ACCUM
LEAK
01-ACSW1040A1LK   2.399E-004  4   INDEPENDENT FAILURESW-1040A-1 AIR ACCUMULATOR
LEAKS
01-ACSW1040B1LK   2.399E-004  4   INDEPENDENT FAILURESW-1040B-1 AIR ACCUMULATOR
LEAKS
01-AV-IA101--OC   1.032E-005  4   AOV IA-101 TRANSFERS CLOSED
01-AV-SW420A-FO   2.168E-003  3   INDEPENDENT FAILUREAOV SW-420A FAILS TO OPEN
01-AV-SW420B-FO   2.168E-003  3   INDEPENDENT FAILUREAOV SW-420B FAILS TO OPEN
01-AV-SW420C-FO   2.168E-003  3   INDEPENDENT FAILUREAOV SW-420C FAILS TO OPEN
01-AVSA121---FO   2.168E-003  3   AOV SA-121 FAILS TOOPEN
01-AVSA200---FC   4.758E-004  3   AOV SA-200 FAILS TOCLOSE
01-AVSA400---FC   4.758E-004  3   AOV SA-400 FAILS TOCLOSE
01-AVSA60----OC   1.032E-005  4   AOV SA-60 TRANSFERSCLOSED
01-AVSKFOCCF12    7.410E-005  3   DOUBLE COMMON CAUSE FAILURE (CCF)SW-420A/B FTO
01-AVSKFOCCF123   3.060E-005  3   TRIPLE COMMON CAUSE FAILURE (CCF)SW-420A/B/C FTO
01-AVSKFOCCF13    7.410E-005  3   DOUBLE COMMON CAUSE FAILURE (CCF)SW-420A/C FTO
01-AVSKFOCCF23    7.410E-005  3   DOUBLE COMMON CAUSE FAILURE (CCF)SW-420B/C FTO
01-CM-KPRCCF12    1.510E-004  3   DOUBLE COMMON CAUSE FAILURE (CCF)SIAC F/G FTR
01-CM-KPSCCF12    1.780E-004  3   DOUBLE COMMON CAUSE FAILURE (CCF)SIAC F/G FTS
01-CM-SIAC1F-PR   6.440E-003  4   INDEPENDENT FAILUREAIR COMPRESSOR F FAILS TO RUN
01-CM-SIAC1F-PS   3.788E-003  3   INDEPENDENT FAILUREAIR COMPRESSOR F FAILS TO START
01-CM-SIAC1F-TM   8.900E-002  3   AIR COMPRESSOR F UNAVAILABLE DUE TO TEST OR
MAINTENANCE
01-CM-SIAC1G-PR   6.440E-003  4   INDEPENDENT FAILUREAIR COMPRESSOR G FAILS TO RUN
01-CM-SIAC1G-PS   3.788E-003  3   INDEPENDENT FAILUREAIR COMPRESSOR G FAILS TO START
01-CM-SIAC1G-TM   2.960E-002  3   AIR COMPRESSOR G UNAVAILABLE DUE TO TEST OR
MAINTENANCE
01-CMAKPSCCF12    1.790E-004  3   DOUBLE COMMON CAUSE FAILURE (CCF)SIAC A/B FTS
01-CMAKPSCCF123   3.820E-004  3   TRIPLE COMMON CAUSE FAILURE (CCF)SIAC A/B/C FTS
01-CMAKPSCCF13    1.790E-004  3   DOUBLE COMMON CAUSE FAILURE (CCF)SIAC A/C FTS
01-CMAKPSCCF23    1.790E-004  3   DOUBLE COMMON CAUSE FAILURE (CCF)SIAC B/C FTS
01-CMSIAC1A--PR   3.588E-001  4   INDEPENDENT FAILUREAIR COMPRESSOR A FAILS TO RUN
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Table 11
Basic Event Descriptions (continued)

01-CMSIAC1A--PS	1.476E-002	3	INDEPENDENT FAILUREAIR COMPRESSOR A FAILS TO START
01-CMSIAC1A--TM	3.100E-002	3	AIR COMPRESSOR A UNAVAILABLE DUE TO TEST OR MAINTENANCE
01-CMSIAC1B--PR	3.588E-001	4	INDEPENDENT FAILUREAIR COMPRESSOR B FAILS TO RUN
01-CMSIAC1B--PS	1.476E-002	3	INDEPENDENT FAILUREAIR COMPRESSOR B FAILS TO START
01-CMSIAC1B--TM	3.510E-002	3	AIR COMPRESSOR B UNAVAILABLE DUE TO TEST OR MAINTENANCE
01-CMSIAC1C--PR	3.588E-001	4	INDEPENDENT FAILUREAIR COMPRESSOR C FAILS TO RUN
01-CMSIAC1C--PS	1.476E-002	3	INDEPENDENT FAILUREAIR COMPRESSOR C FAILS TO START
01-CMSIAC1C--TM	2.860E-002	3	AIR COMPRESSOR C UNAVAILABLE DUE TO TEST OR MAINTENANCE
01-CMSKPRCCF12	2.170E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)SIAC A/B FTR
01-CMSKPRCCF123	4.630E-003	3	TRIPLE COMMON CAUSE FAILURE (CCF)SIAC A/B/C FTR
01-CMSKPRCCF13	2.170E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)SIAC A/C FTR
01-CMSKPRCCF23	2.170E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)SIAC B/C FTR
01-CV-IA102--FO	5.000E-005	3	CHECK VALVE IA-102 FAILS TO OPEN
01-CV-IA102--OC	1.200E-007	4	CHECK VALVE IA-102 TRANSFERS CLOSED
01-CV-IA103--FO	5.000E-005	3	CHECK VALVE IA-103 FAILS TO OPEN
01-CV-IA103--OC	1.200E-007	4	CHECK VALVE IA-103 TRANSFERS CLOSED
01-CV-IA150-2FC	6.452E-002	3	INDEPENDENT FAILURECHECK VALVE IA-150-2 FTC
01-CV-IA150-2FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE IA-150-2 FTO
01-CV-IA151-2FC	6.452E-002	3	INDEPENDENT FAILURECHECK VALVE IA-151-2 FTC
01-CV-IA151-2FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE IA-151-2 FTO
01-CV-IA311--FO	5.000E-005	3	CHECK VALVE IA-311 FAILS TO OPEN
01-CV-IA422--FC	9.999E-004	3	CHECK VALVE IA-422 FAILS TO TO CLOSE
01-CV-IA482--FO	5.000E-005	3	CHECK VALVE IA-482 FAILS TO OPEN
01-CV-IA501-2FC	6.452E-002	3	CHECK VALVE IA-501-2 FAILS TO CLOSE
01-CV-IA503-2FC	6.452E-002	3	CHECK VALVE IA-503-2 FAILS TO CLOSE
01-CV-SA63---FC	9.999E-004	3	CHECK VALVE SA-63 FAILS TO CLOSE
01-CV5KFCCCF12	5.050E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)IA-150-2/151-2 FTC
01-CVAKFCCCF12	5.050E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)01-CVAKFCCCF12
01-CVCKFCCCF12	7.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)IA-330-2/471-1 FTC
01-CVIA1403-2FC	6.452E-002	3	INDEPENDENT FAILURECHECK VALVE IA-1403-2 FTC
01-CVIA1403-4FC	6.452E-002	3	INDEPENDENT FAILURECHECK VALVE IA-1403-4 FTC
01-CVIA1430-2FC	9.999E-004	3	CHECK VALVE IA-1430-2 FAILS TO CLOSE
01-CVIA1493-2FC	6.452E-002	3	CHECK VALVE IA-1493-2 FAILS TO CLOSE
01-CVIA330-2-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE IA-330-2 FTC
01-CVIA471-1-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE IA-471-1 FTC
01-CVOKFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)IA-150-2/151-2 FTO
01-FL-A-B-C--PL	2.399E-004	4	AIR DRYER/FILTER FAILURE
01-IAS-MAN---HE	4.036E-001	3	OPERATOR FAILS TO LOCALLY ESTABLISH IA DURING FIRE
01-PP-SAS----RP	1.673E-006	4	STATION AIR SYSTEM PIPING FAILURE
01-PSAKOPCC1234	4.380E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)SIACS EXCEPT 16121
01-PSAKOPCC1235	4.380E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)SIACS EXCEPT 16107
01-PSAKOPCC1245	4.380E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)SIACS EXCEPT 16105
01-PSAKOPCC1345	4.380E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)SIACS EXCEPT 15517J
01-PSAKOPCC2345	4.380E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)SIACS EXCEPT 15516J
01-PSAKOPCCF1-5	4.374E-009	3	GLOBAL FAILURE OF SIAC PRESS SWTCHS

Table 11
Basic Event Descriptions (continued)

01-PSAKOPCCF12	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15516J/17J FTOP
01-PSAKOPCCF123	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/17J/16105
01-PSAKOPCCF124	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/17J/16107
01-PSAKOPCCF125	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/17J/16121
01-PSAKOPCCF13	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15516J/16105
01-PSAKOPCCF134	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/16105/07
01-PSAKOPCCF135	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/16105/21
01-PSAKOPCCF14	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15516J/16107
01-PSAKOPCCF145	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15516J/16107/21
01-PSAKOPCCF15	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15516J/16121
01-PSAKOPCCF23	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15517J/16105
01-PSAKOPCCF234	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15517J/16105/07
01-PSAKOPCCF235	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15517J/16105/21
01-PSAKOPCCF24	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15517J/16107
01-PSAKOPCCF245	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 15517J/16107/21
01-PSAKOPCCF25	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 15517J/16121
01-PSAKOPCCF34	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 16105/16107 FTOP
01-PSAKOPCCF345	5.144E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)PS 16105/07/21
01-PSAKOPCCF35	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 16105/16121 FTOP
01-PSAKOPCCF45	1.364E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS 16107/16121 FTOP
01-PSPS15516JOP	2.999E-007	3	INDEPENDENT FAILUREPRESSURE SWITCH PS-15516J
01-PSPS15517JOP	2.999E-007	3	INDEPENDENT FAILUREPRESSURE SWITCH PS-15517J
01-PSPS16105-OP	2.999E-007	3	INDEPENDENT FAILUREPRESSURE SWITCH PS-16105
01-PSPS16107-OP	2.999E-007	3	INDEPENDENT FAILUREPRESSURE SWITCH PS-16107
01-PSPS16121-OP	2.999E-007	3	INDEPENDENT FAILUREPRESSURE SWITCH PS-16121
01-SV-SW402A-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-402A FAILS TO OPEN
01-SV-SW402B-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-402B FAILS TO OPEN
01-SV-SW403C-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-403C FAILS TO OPEN
01-SVSKFOCCF12	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-402A/B FTO
01-SVSKFOCCF123	1.290E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-402A/B/403C FTO
01-SVSKFOCCF13	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-402A/403C FTO
01-SVSKFOCCF23	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-402B/403C FTO
01-VC-SA121--OP	7.197E-005	4	CONTROLLER FOR AOV SA-121 FAILURE
01-XV-IA104--OC	8.834E-008	4	MANUAL VALVE IA-104TRANSFERS CLOSED
01-XV-IA1400-OC	8.834E-008	4	MANUAL VALVE IA-1400 TRANSFERS CLOSED
01-XV-IA1440-OC	8.834E-008	4	MANUAL VALVE IA-1440 TRANSFERS CLOSED
01-XV-IA160--OC	8.834E-008	4	MANUAL VALVE IA-160TRANSFERS CLOSED
01-XV-IA1A---FC	1.000E-004	3	MANUAL VALVE IA-1A FAILS TO CLOSE
01-XV-IA200--FC	1.000E-004	3	MANUAL VALVE IA-200FAILS TO CLOSE
01-XV-IA310--FO	1.000E-004	3	MANUAL VALVE IA-310FAILS TO OPEN
01-XV-IA400--FC	1.000E-004	3	MANUAL VALVE IA-400FAILS TO CLOSE
01-XV-IA500--OC	8.834E-008	4	MANUAL VALVE IA-500TRANSFERS CLOSED

Table 11
Basic Event Descriptions (continued)

01-XV-IA520--OC	8.834E-008	4	MANUAL VALVE IA-520TRANSFERS CLOSED
01-XV-IA5A---FC	1.000E-004	3	MANUAL VALVE IA-5A FAILS TO CLOSE
01-XV-SA100A-FC	1.000E-004	3	MANUAL VALVE SA-100A FAILS TO CLOSE
01-XV-SA101B-FC	1.000E-004	3	MANUAL VALVE SA-101B FAILS TO CLOSE
01-XV-SA110--FC	1.000E-004	3	MANUAL VALVE SA-110FAILS TO CLOSE
01-XV-SA62---FC	1.000E-004	3	MANUAL VALVE SA-62 FAILS TO CLOSE
01-XVIA101-1-FO	1.000E-004	3	MANUAL VALVE IA-101-1 FAILS TO OPEN
01-XVSA107A1-FC	1.000E-004	3	MANUAL VALVE SA-107A1 FAILS TO CLOSE
01-XVSA107A2-FC	1.000E-004	3	MANUAL VALVE SA-107A2 FAILS TO CLOSE
02-AV-KFCCCF12	9.420E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-3A/3B FTC
02-AV-SW1601-OC	1.032E-005	4	AOV SW-1601 TRANSFERS CLOSED
02-AV-SW3A---FC	4.758E-004	3	INDEPENDENT FAILUREAOV SW-3A FAILS TO CLOSE
02-AV-SW3A---OC	1.032E-005	4	AOV SW-3A TRANSFERS CLOSED
02-AV-SW3B---FC	4.758E-004	3	INDEPENDENT FAILUREAOV SW-3B FAILS TO CLOSE
02-AV-SW3B---OC	1.032E-005	4	AOV SW-3B TRANSFERS CLOSED
02-AV-SW4A---FC	4.758E-004	3	AOV SW-4A FAILS TO CLOSE
02-AV-SW4A---FO	2.168E-003	3	AOV SW-4A FAILS TO OPEN
02-AV-SW4A---OC	1.032E-005	4	AOV SW-4A TRANSFERS CLOSED
02-AV-SW4B---FC	4.758E-004	3	AOV SW-4B FAILS TO CLOSE
02-AV-SW4B---FO	2.168E-003	3	AOV SW-4B FAILS TO OPEN
02-AV-SW4B---OC	1.032E-005	4	AOV SW-4B TRANSFERS CLOSED
02-AVSKFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-301A/B FTO
02-AVSKOCCCF12	2.420E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1306A/B TRN CLS
02-AVSW1306A-OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1306A TRANSFERS CLOSED
02-AVSW1306B-OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1306B TRANSFERS CLOSED
02-AVSW301A--FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-301A FAILS TO OPEN
02-AVSW301B--FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-301B FAILS TO OPEN
02-CN-KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)21005AX, 6AX CNT FL
02-CN21005AX-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 21005AX CONTACTS FAIL
02-CN21006AX-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 21006AX CONTACTS FAIL
02-CV--SW1A1-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW1A1 FAILS TO CLOSE
02-CV--SW1A1-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-1A1 FAILS TO OPEN
02-CV--SW1A2-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW-1A2 FAILS TO CLOSE
02-CV--SW1A2-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-1A2 FAILS TO OPEN
02-CV--SW1B1-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW-1B1 FAILS TO CLOSE
02-CV--SW1B1-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-1B1 FAILS TO OPEN
02-CV--SW1B2-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW-1B2 FAILS TO CLOSE
02-CV--SW1B2-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-1B2 FAILS TO OPEN
02-CV-KFCCCF1-4	5.100E-005	3	GLOBAL FAILURE OF 02-CV-KFCCCF1-4
02-CV-KFCCCF12	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF12
02-CV-KFCCCF123	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF123
02-CV-KFCCCF124	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF124
02-CV-KFCCCF13	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1B1 FTC
02-CV-KFCCCF134	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF134
02-CV-KFCCCF14	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1B2 FTC
02-CV-KFCCCF23	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A2/1B1 FTC

Table 11
Basic Event Descriptions (continued)

02-CV-KFCCCF234	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF234
02-CV-KFCCCF24	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A2/1B2 FTC
02-CV-KFCCCF34	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)02-CV-KFCCCF34
02-CV-KFOCCF12	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-400A/B2 FTO
02-CV-KFOCCF123	8.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-400A/B2/01C2 FTO
02-CV-KFOCCF13	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-400A/401C2 FTO
02-CV-KFOCCF23	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-400B2/401C2 FTO
02-CV-SW400A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-400AFAILS TO OPEN
02-CV-SW400B2FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-400B2 FTO
02-CV-SW401C2FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-401C2 FTO
02-CV-SW501A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-501AFAILS TO OPEN
02-CV-SW501B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SW-501BFAILS TO OPEN
02-CVSKFOCCF1-4	8.530E-006	3	GLOBAL FAILURE OF SW-1A1/1A2/1B1/1B2
02-CVSKFOCCF12	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1A2 FTO
02-CVSKFOCCF123	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1A1/1A2/1B1 FTO
02-CVSKFOCCF124	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1A1/1A2/1B2 FTO
02-CVSKFOCCF13	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1B1 FTO
02-CVSKFOCCF134	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1A1/1B1/1B2 FTO
02-CVSKFOCCF14	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1B2 FTO
02-CVSKFOCCF23	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A2/1B1 FTO
02-CVSKFOCCF234	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1A2/1B1/1B2 FTO
02-CVSKFOCCF24	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A2/1B2 FTO
02-CVSKFOCCF34	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1B1/1B2 FTO
02-CVWKFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1A1/1A2 FTO
02-FL-KPSCCF1-4	2.600E-005	3	GLOBAL FAILURE OF TWS A1/A2/B1/B2 FTS
02-FL-KPSCCF12	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/A2 FTS
02-FL-KPSCCF123	4.710E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/A2/B1 FTS
02-FL-KPSCCF124	4.710E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/A2/B2 FTS
02-FL-KPSCCF13	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/B1 FTS
02-FL-KPSCCF134	4.710E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/B1/B2 FTS
02-FL-KPSCCF14	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/B2 FTS
02-FL-KPSCCF23	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A2/B1 FTS
02-FL-KPSCCF234	4.710E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A2/B1/B2 FTS
02-FL-KPSCCF24	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A2/B2 FTS
02-FL-KPSCCF34	9.940E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS B1/B2 FTS
02-FL-TWS----PL	1.200E-004	4	TRAVELING WATER SCREENS PLUGGED
02-FLT-TW1A1-PR	8.159E-004	4	INDEPENDENT FAILURETRAVELING WATER SCREEN A1 FTR
02-FLT-TW1A1-PS	1.400E-003	3	INDEPENDENT FAILURETRAVELING WATER SCREEN A1 FTS
02-FLT-TW1A2-PR	8.159E-004	4	INDEPENDENT FAILURETRAVELING WATER SCREEN A2 FTR
02-FLT-TW1A2-PS	1.400E-003	3	INDEPENDENT FAILURETRAVELING WATER SCREEN A2 FTS
02-FLT-TW1B1-PR	8.159E-004	4	INDEPENDENT FAILURETRAVELING WATER SCREEN B1 FTR
02-FLT-TW1B1-PS	1.400E-003	3	INDEPENDENT FAILURETRAVELING WATER SCREEN B1 FTS
02-FLT-TW1B2-PR	8.159E-004	4	INDEPENDENT FAILURETRAVELING WATER SCREEN B2 FTR
02-FLT-TW1B2-PS	1.400E-003	3	INDEPENDENT FAILURETRAVELING WATER SCREEN B2 FTS
02-FLTKPRCCF1-4	7.590E-006	3	GLOBAL FAILURE OF TWS TO RUN
02-FLTKPRCCF12	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/A2 FTR
02-FLTKPRCCF123	1.370E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/A2/B1 FTR

Table 11
Basic Event Descriptions (continued)

02-FLTKPRCCF124	1.370E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/A2/B2 FTR
02-FLTKPRCCF13	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/B1 FTR
02-FLTKPRCCF134	1.370E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A1/B1/B2 FTR
02-FLTKPRCCF14	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A1/B2 FTR
02-FLTKPRCCF23	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A2/B1 FTR
02-FLTKPRCCF234	1.370E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)TWS A2/B1/B2 FTR
02-FLTKPRCCF24	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS A2/B2 FTR
02-FLTKPRCCF34	2.900E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TWS B1/B2 FTR
02-ISO-03AB50-HE	1.000E-002	3	FAIL TO CLOSE SW10AOR SW10B IN 50 MINUTES
02-ISO-04AB80-HE	1.000E-002	3	FAILURE TO ISOLATE LARGE SERVICE WTR BRK IN TURB BLDG
02-ISO-10A-30-HE	1.000E-002	3	FAILURE TO CLOSE SW10A WITHIN 30 MINOF SW PIPE BREAK
02-ISO-10A-50-HE	1.000E-002	3	FAILURE TO CLOSE SW10A WITHIN 50 MINOF SW PIPE BREAK
02-ISO-10AB30-HE	1.000E-002	3	FAIL TO CLOSE SW10AOR SW10B IN 30 MINUTES
02-ISO-10B-30-HE	1.000E-002	3	FAILURE TO CLOSE SW10B WITHIN 30 MINOF SW PIPE BREAK
02-ISO-10B-50-HE	1.000E-002	3	FAILURE TO CLOSE SW10B WITHIN 50 MINOF SW PIPE BREAK
02-MISC-61-F-HE-	6.722E-002	3	FAILURE TO ISOLATE FIRE PROT LINE BRK IN TURB BLDG
02-MISCL61-F-HE-	8.000E-001	3	FAILURE TO ISOLATE FIRE PROT WTR BEFORE FAIL TDAFP
02-MV-KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1300A/B FTO
02-MV-KOCCCF12	2.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-10A/B TRANS CLSD
02-MV-SW10A--FC	1.905E-003	3	MOV SW-10A FAILS TOCLOSE
02-MV-SW10A--OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-10A TRANSFERS CLOSED
02-MV-SW10B--FC	1.905E-003	3	MOV SW-10A FAILS TOCLOSE
02-MV-SW10B--OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-10B TRANSFERS CLOSED
02-MV-SW502--FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-502 FAILS TO OPEN
02-MV-SW601A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-601A FAILS TO OPEN
02-MV-SW601B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-601B FAILS TO OPEN
02-MV-SW903A-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-903A TRANSFERS CLOSED
02-MV-SW903ABAE	5.327E-004	3	OPERATOR FAILS TO OPEN MOVS SW-903A/BAFTER TEST
02-MV-SW903B-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-903B TRANSFERS CLOSED
02-MV-SW903C-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-903C TRANSFERS CLOSED
02-MV-SW903CDAE	5.327E-004	3	OPERATOR FAILS TO OPEN MOVS SW-903C/DAFTER TEST
02-MV-SW903D-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SW-903D TRANSFERS CLOSED
02-MV9KOCCCF1-4	1.120E-008	3	GLOBAL FAILURE OF SW-903A/B/C/D TR CL
02-MV9KOCCCF12	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903A/B TRAN CLS
02-MV9KOCCCF123	2.020E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-903A/B/C TRN CLS
02-MV9KOCCCF124	2.020E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-903A/B/D TRN CLS
02-MV9KOCCCF13	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903A/C TRAN CLS
02-MV9KOCCCF134	2.020E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-903A/C/D TRN CLS
02-MV9KOCCCF14	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903A/D TRAN CLS
02-MV9KOCCCF23	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903B/C TRAN CLS
02-MV9KOCCCF234	2.020E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-903B/C/D TRN CLS

Table 11
Basic Event Descriptions (continued)

02-MV9KOCCCF24	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903B/D TRAN CLS
02-MV9KOCCCF34	4.260E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-903C/D TRAN CLS
02-MVSKFOCCF12	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-502/601A FTO
02-MVSKFOCCF123	3.720E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-502/601A/B FTO
02-MVSKFOCCF13	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-502/601B FTO
02-MVSKFOCCF23	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-601A/B FTO
02-MVSW1300A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-1300A FAILS TO OPEN
02-MVSW1300B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-1300B FAILS TO OPEN
02-PM-STOP-F-HE	1.547E-002	3	OPERATOR FAILS TO STOP SW PUMPS DURING FLOOD
02-PM-STOP-F-HE-	1.547E-002	3	FAIL TO CLOSE SW10AOR SW10B IN 50 MINUTES
02-PM-SW1A1--AE	7.991E-004	3	OPERATOR FAILS TO RESTORE SW PUMP A1 AFTER TEST
02-PM-SW1A1--PR	1.397E-004	4	INDEPENDENT FAILURESERVICE WATER PUMP A1 FAILS TO RUN
02-PM-SW1A1--PS	1.449E-003	3	INDEPENDENT FAILURESERVICE WATER PUMP A1 FAILS TO START
02-PM-SW1A1--TM	6.560E-003	3	SW PUMP A1 UNAVAILABLE DUE TO TEST OR MAINTENANCE
02-PM-SW1A2--AE	7.991E-004	3	OPERATOR FAILS TO RESTORE SW PUMP A2 AFTER TEST
02-PM-SW1A2--PR	1.397E-004	4	INDEPENDENT FAILURESERVICE WATER PUMP A2 FAILS TO RUN
02-PM-SW1A2--PS	1.449E-003	3	INDEPENDENT FAILURESERVICE WATER PUMP A2 FAILS TO START
02-PM-SW1A2--TM	1.190E-002	3	SW PUMP A2 UNAVAILABLE DUE TO TEST OR MAINTENANCE
02-PM-SW1B1--AE	7.991E-004	3	OPERATOR FAILS TO RESTORE SW PUMP B1 AFTER TEST
02-PM-SW1B1--PR	1.397E-004	4	INDEPENDENT FAILURESERVICE WATER PUMP B1 FAILS TO RUN
02-PM-SW1B1--PS	1.449E-003	3	INDEPENDENT FAILURESERVICE WATER PUMP B1 FAILS TO START
02-PM-SW1B1--TM	1.020E-002	3	SW PUMP B1 UNAVAILABLE DUE TO TEST OR MAINTENANCE
02-PM-SW1B2--AE	7.991E-004	3	OPERATOR FAILS TO RESTORE SW PUMP B2 AFTER TEST
02-PM-SW1B2--PR	1.397E-004	4	INDEPENDENT FAILURESERVICE WATER PUMP B2 FAILS TO RUN
02-PM-SW1B2--PS	1.449E-003	3	INDEPENDENT FAILURESERVICE WATER PUMP B2 FAILS TO START
02-PM-SW1B2--TM	1.140E-002	3	SW PUMP B2 UNAVAILABLE DUE TO TEST OR MAINTENANCE
02-PMRKPRCCF1-4	3.220E-007	4	GLOBAL FAILURE OF SW PUMPS TO RUN
02-PMRKPRCCF12	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/A2 FTR
02-PMRKPRCCF123	2.260E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/A2/B1 FTR
02-PMRKPRCCF124	2.260E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/A2/B2 FTR
02-PMRKPRCCF13	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/B1 FTR
02-PMRKPRCCF134	2.260E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/B1/B2 FTR
02-PMRKPRCCF14	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/B2 FTR
02-PMRKPRCCF23	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A2/B1 FTR
02-PMRKPRCCF234	2.260E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A2/B1/B2 FTR
02-PMRKPRCCF24	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A2/B2 FTR
02-PMRKPRCCF34	7.210E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)SWP B1/B2 FTR
02-PMSKPSCCF1-4	9.770E-006	3	GLOBAL FAILURE OF SWPS FAIL TO START
02-PMSKPSCCF12	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/A2 FTS
02-PMSKPSCCF123	4.090E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/A2/B1 FTS
02-PMSKPSCCF124	4.090E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/A2/B2 FTS
02-PMSKPSCCF13	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/B1 FTS
02-PMSKPSCCF134	4.090E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A1/B1/B2 FTS
02-PMSKPSCCF14	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A1/B2 FTS
02-PMSKPSCCF23	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A2/B1 FTS
02-PMSKPSCCF234	4.090E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SWP A2/B1/B2 FTS

Table 11
Basic Event Descriptions (continued)

02-PMSKPSCCF24	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP A2/B2 FTS
02-PMSKPSCCF34	3.000E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SWP B1/B2 FTS
02-PP-KRPCCF12	1.920E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW PIPING
02-PP-SWTA---RP	8.160E-008	4	INDEPENDENT FAILURESERVICE WATER TRAINA PIPING FAILURE
02-PP-SWTB---RP	8.160E-008	4	INDEPENDENT FAILURESERVICE WATER TRAINB PIPING FAILURE
02-PS2KOPCCF12	1.410E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)PS-16004/16005 FTOP
02-PSPS16003-OP	2.999E-007	3	FAILURE OF PRESSURESWITCH PS-16003
02-PSPS16004-OP	2.999E-007	3	INDEPENDENT FAILUREFAILURE OF PRESSURESWITCH PS-16004
02-PSPS16005-OP	2.999E-007	3	INDEPENDENT FAILUREFAILURE OF PRESSURESWITCH PS-16005
02-RE-KRBCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)21005AX,6AX MECH BN
02-RE21005AX-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 21005AX MECHANICALLY BOUND
02-RE21006AX-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 21006AX MECHANICALLY BOUND
02-SSW-52--F-HE-BREAK	1.753E-001	3	FAILURE TO CLOSE SW10B WITHIN 50 MINOF SW PIPE
02-SSW-TD--F-HE-BRK	1.552E-001	3	FAILURE TO CLOSE LOCAL VLV WITHIN 30MINUTES OF SW
02-SV-33040--CO	1.200E-005	4	INDEPENDENT FAILURESOV 33040 TRANSFERSOPEN
02-SV-33040--OC	1.200E-005	4	SOV 33040 TRANSFERSCLOSED
02-SV-33041--CO	1.200E-005	4	INDEPENDENT FAILURESOV 33041 TRANSFERSOPEN
02-SV-33041--OC	1.200E-005	4	SOV 33041 TRANSFERSCLOSED
02-SV-KCOCCF12	2.820E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)SOVS 33040/41 TR OP
02-SV33043---FO	4.999E-004	3	SOV 33043 FAILS TO OPEN
02-SV33044---FO	4.999E-004	3	SOV 33044 FAILS TO OPEN
02-SVSKFOCCF1-4	9.300E-006	3	GLOBAL FAILURE OF SW-202A1 FTO
02-SVSKFOCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202A1/A2 FTO
02-SVSKFOCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-202A1/A2/B1 FTO
02-SVSKFOCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-202A1/A2/B2 FTO
02-SVSKFOCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202A1/B1 FTO
02-SVSKFOCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-202A1/B1/B2 FTO
02-SVSKFOCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202A1/B2 FTO
02-SVSKFOCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202A2/B1 FTO
02-SVSKFOCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)SW-202A2/B1/B2 FTO
02-SVSKFOCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202A2/B2 FTO
02-SVSKFOCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-202B1/B2 FTO
02-SVSW202A1-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-202A1 FAILS TO OPEN
02-SVSW202A2-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-202A2 FAILS TO OPEN
02-SVSW202B1-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-202B1 FAILS TO OPEN
02-SVSW202B2-FO	4.999E-004	3	INDEPENDENT FAILURESOV SW-202B2 FAILS TO OPEN
02-SW-RCVR-BMHE	2.125E-002	3	OPERATOR FAILS TO RECOVER SERVICE WATER BEFORE BOIL
02-SW-RCVR-DMHE	1.602E-002	3	OPERATOR FAILS TO RECOVER SERVICE WATER BEFORE CD
02-SW10A-B-F-HE	3.999E-001	3	OPERATOR FAILS TO CLOSE SW-10A/B DURING FLOOD
02-SW4A-B29F-HE	2.000E-002	3	CLOSE SW-4A SW-4B DURING FLOOD - 29 MIN.

Table 11
Basic Event Descriptions (continued)

02-SW4A-B45F-HE	2.000E-002	3	CLOSE SW-4A SW-4B DURING FLOOD - 45 MIN.
02-SW4A-B51F-HE	2.000E-002	3	CLOSE SW-4A SW-4B DURING FLOOD - 51 MIN.
02-SW4A-B66F-HE	2.000E-002	3	CLOSE SW-4A SW-4B DURING FLOOD - 66 MIN.
02-SW4AB-D-F-HE	6.300E-002	3	FAILURE TO ISOLATE SW HDR BEFORE FAILURE OF TDAFP
02-SW4AB-D2F-HE	1.600E-001	3	FAILURE TO ISOLATE SW HDR BEFORE FAILURE OF 4 KV BUS
02-SWS-DSP---HE	3.833E-003	3	OPERATOR FAILS TO ESTABLISH SERVICE WATER USING DSP
02-SWS-MAN---HE	2.985E-002	3	OPERATOR FAILS TO ESTABLISH SW MANUALLY -- FIRE
02-TP--21005-FA	7.197E-005	4	INDEPENDENT FAILUREPRESSURE TRANS. 21005 FAILS
02-TP--21006-FA	7.197E-005	4	INDEPENDENT FAILUREPRESSURE TRANS. 21006 FAILS
02-TP-KFACCF12	1.690E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)TRNS 21005, 6 FAIL
02-TURB-HDR--HE	8.576E-003	3	OPERATOR FAILS TO SWITCH TURBINE BUILDING SW HEADER
02-TURB-HDR-SHE	1.000E+000	3	OPERATOR FAILS TO SWITCH TURBINE BLDGSW HEADER (SEISMIC)
02-XV-SW500ABAE	5.327E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVES SW-500A/B AFTER TST
02-XV-SW600A-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE SW-600A AFTER TEST
02-XV-SW600B-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE SW-600B AFTER TEST
02-XV-SW700B-OC	8.834E-008	4	MANUAL VALVE SW-700B TRANSFERS CLOSED
02-XV-SW722--OC	8.834E-008	4	MANUAL VALVE SW-722 TRANSFERS CLOSED
03-AS-HTLVLC-OP	7.197E-005	4	CONTROL SIGNAL TO AOV MU-3A FAILS
03-AV--C701--FO	2.168E-003	3	AOV C-701 FAILS TO OPEN
03-AV--MU3A--CO	1.032E-005	4	AOV MU-3A TRANSFERSOPEN
03-AV--MU3A--FO	2.168E-003	3	INDEPENDENT FAILUREAOV MU-3A FAILS TO OPEN
03-AV--MU3B--CO	1.032E-005	4	AOV MU-3B TRANSFERSOPEN
03-AV--MU3B--FO	2.168E-003	3	INDEPENDENT FAILUREAOV MU-3B FAILS TO OPEN
03-AV-KFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-3A/B FTO
03-CV--C2A---FC	9.999E-004	3	CHECK VALVE C-2A FAILS TO CLOSE
03-CV--C2B---FC	9.999E-004	3	CHECK VALVE C-2B FAILS TO CLOSE
03-CV-KOCCCF12	7.260E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/B TRN CLS
03-CV-KOCCCF123	1.550E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)MU-311A/B/C TRN CL
03-CV-KOCCCF13	7.260E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/C TRN CLS
03-CV-KOCCCF23	7.260E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311B/C TRN CLS
03-CV-MU311A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE MU-311AFAILS TO CLOSE
03-CV-MU311A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MU-311AFAILS TO OPEN
03-CV-MU311A-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE MU-311ATRANSFERS CLOSED
03-CV-MU311B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE MU-311BFAILS TO CLOSE
03-CV-MU311B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MU-311BFAILS TO OPEN
03-CV-MU311B-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE MU-311BTRANSFERS CLOSED
03-CV-MU311C-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE MU-311CFAILS TO CLOSE
03-CV-MU311C-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MU-311CFAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

03-CV-MU311C-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE MU-311CTRANSFERS CLOSED
03-CVCKFCCCF12	2.310E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/B FTC
03-CVCKFCCCF123	5.580E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)MU-311A/B/C FTC
03-CVCKFCCCF13	2.310E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/C FTC
03-CVCKFCCCF23	2.310E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311B/C FTC
03-CVOKFCCCF12	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/B FTO
03-CVOKFCCCF123	8.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)MU-311A/B/C FTO
03-CVOKFCCCF13	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311A/C FTO
03-CVOKFCCCF23	2.140E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-311B/C FTO
03-CVS-MU301-FC	9.999E-004	3	CHECK VALVE MU-301 FAILS TO CLOSE
03-CVS-MU301-FO	5.000E-005	3	CHECK VALVE MU-301 FAILS TO OPEN
03-CVS-MU301-OC	1.200E-007	4	CHECK VALVE MU-301 TRANSFERS CLOSED
03-ISO-VLV100-HE	1.000E-002	3	FAILURE TO CLOSE LOCAL VLV IN 100 MINUTES OF SW BRK
03-ISO-VLV30-HE	1.000E-002	3	FAILURE TO CLOSE LOCAL VLV WITHIN 30MINUTES OF SW BRK
03-ISO-VLV70-HE	1.000E-002	3	FAILURE TO CLOSE LOCAL VLV WITHIN 70MINUTES OF SW BRK
03-PM--CDP1A-PR	2.496E-004	4	INDEPENDENT FAILURECONDENSATE PUMP A FAILS TO RUN
03-PM--CDP1B-PR	2.496E-004	4	INDEPENDENT FAILURECONDENSATE PUMP B FAILS TO RUN
03-PM-KPRCCF12	1.730E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)CD PUMPS FTR
03-SV-33188--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33188 FAILS TO CLOSE
03-SV-33873--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33873 FAILS TO CLOSE
03-SV-KFCCCF12	2.350E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SV-33188/33873 FTC
03-TK----CST-RP	6.482E-007	4	CONDENSATE STORAGE TANK RUPTURE
03-XV---MU1A-OC	8.834E-008	4	MANUAL VALVE MU-1A TRANSFERS CLOSED
03-XV---MU1B-OC	8.834E-008	4	MANUAL VALVE MU-1B TRANSFERS CLOSED
03-XV--MU2A--FC	1.000E-004	3	MANUAL VALVE MU-2A FAILS TO CLOSE
03-XV--MU2B--FC	1.000E-004	3	MANUAL VALVE MU-2B FAILS TO CLOSE
03-XV--MU300-OC	8.834E-008	4	MANUAL VALVE MU-300TRANSFERS CLOSED
03-XV-KOCCCF12	5.340E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-310A/B TRN CLS
03-XV-KOCCCF123	1.140E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)MU-310A/B/C TRN CL
03-XV-KOCCCF13	5.340E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-310A/C TRN CLS
03-XV-KOCCCF23	5.340E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-310B/C TRN CLS
03-XV-MU310A-OC	8.834E-008	4	INDEPENDENT FAILUREMANUAL VALVE MU-310A TRN CLOSED
03-XV-MU310B-OC	8.834E-008	4	INDEPENDENT FAILUREMANUAL VALVE MU-310B TRN CLOSED
03-XV-MU310C-OC	8.834E-008	4	INDEPENDENT FAILUREMANUAL VALVE MU-310A TRN CLOSED
04--LO-LEVEL-FB	5.140E-004	3	LOW FOREBAY LEVEL
04--MAN-CPT--HE	2.984E-003	3	OPERATOR FAILS TO TRIP CIRCULATING WATER PUMP
04-CN-26829A-RC	2.999E-004	3	RELAY 26829A CONTACTS FAIL
04-CN-26829B-RC	2.999E-004	3	RELAY 26829B CONTACTS FAIL
04-CN-26830A-RC	2.999E-004	3	RELAY 26830A CONTACTS FAIL
04-CN-26830B-RC	2.999E-004	3	RELAY 26830B CONTACTS FAIL
04-CN-26831A-RC	2.999E-004	3	RELAY 26831A CONTACTS FAIL
04-CN-26831B-RC	2.999E-004	3	RELAY 26831B CONTACTS FAIL
04-CN-26832A-RC	2.999E-004	3	RELAY 26832A CONTACTS FAIL
04-CN-26832B-RC	2.999E-004	3	RELAY 26832B CONTACTS FAIL
04-CW-MDAFP1LHE	1.000E-001	3	Operator Fails to Control MDAFP LargeCW Break AC Avail
04-CW-MDAFPAMHE	1.000E-001	3	Operator Fails to Control MDAFP Med CW Brk AC Avail
04-CW-TDAFP2LHE	1.000E-001	3	Operator Fails to Control TDAFP CW Large No MDAFP Run

Table 11
Basic Event Descriptions (continued)

04-CW-TDAFP2MHE	1.000E-001	3	Operator Fails to Control TDAFP Med CW No MDAFP Run
04-CW-TDAFP3LHE	1.000E-001	3	Oper Fails to Control TDAFP LargeCW No MDAFP Start
04-CW-TDAFP3MHE	1.000E-001	3	Oper Fails to Control TDAFP Med CW No MDAFP Start
04-CW-TDAFP4LHE	1.000E-001	3	Operator Fails to Control TDAFP LargeCW Break No AC
04-CW-TDAFP4MHE	1.000E-001	3	Operator Fails to Control TDAFP Med CW No AC
04-CW-TDAFPALHE	1.000E-001	3	Operator fails to Start TDAFP Large CW Break AC Avail
04-CW-TDAFPM-HE	1.000E-001	3	Operator fails to Start TDAFP Medium CW Break AC Avail
04-CW-TDAFPNLHE	1.000E-001	3	Operator fails to Start TDAFP Large CW Break AC Avail
04-CW-TDAFPNMHE	1.000E-001	3	Operator fails to Start TDAFP Medium CW Break No AC
04-CW-TRIP-F-HE	1.000E+000	3	FAIL TO ISOL LRG CIRC WTR BRK BEFOREFAILURE OF 480V BUS
04-CW-TRIP-FLHE	1.100E-001	3	FAIL TO ISOL MOD CIRC WTR BRK BEFOREFAILURE OF 480V BUS
04-CW-TRIP4F-HE	1.000E+000	3	FAIL TO ISOL LRG CIRC WTR BRK BEFOREFAILURE OF 4 KV BUS
04-CW-TRIP4FLHE	5.600E-001	3	FAIL TO ISOL MOD CIRC WTR BRK BEFOREFAILURE OF 4 KV BUS
04-CW-TRIPDF-HE	1.000E+000	3	FAIL TO ISOL LRG CIRC WTR BRK BEFOREFAILURE OF TDAFP
04-CW-TRIPDFLHE	1.600E-001	3	FAIL TO ISOL MOD CIRC WTR BRK BEFOREFAILURE OF TDAFP
04-CWSTP13-F-HE	2.600E-001	3	TRIP CW PUMP DURINGFLOOD EVENT - 13 MINUTES
04-CWSTP19-F-HE	1.200E-001	3	TRIP CW PUMP DURINGFLOOD EVENT - 19 M INUTES
04-CWSTP22-F-HE	1.200E-001	3	TRIP CW PUMP DURINGFLOOD EVENT - 22 M INUTES
04-CWSTP25-F-HE	1.200E-001	3	TRIP CW PUMP DURINGFLOOD EVENT - 25 M INUTES
04-FP-MDAFPALHE	1.000E-001	3	Operator Fails to Control MDAFP LargeFP Brk AC Avail
04-FP-TDAFP2LHE	1.000E-001	3	Operator Fails to Control TDAFP LargeFP No MDAFP Run
04-FP-TDAFP3LHE	1.000E-001	3	Oper Fails to Control TDAFP LargeFP No MDAFP Start
04-FP-TDAFP4-HE	1.000E-001	3	Operator Fails to Control TDAFP LargeFP No AC
04-FP-TDAFPL-HE	1.000E-001	3	Operator fails to Start TDAFP Large FP Brk AC Avail
04-FP-TDAFPLIHE	1.000E-001	3	Fail to Bypass Interlock
04-FP-TDAFPLLHE	1.000E-001	3	Fail to Take Pump Control Switch out of Pull to Lock
04-FP-TDAFPLNHE	1.000E-001	3	Operator fails to Start TDAFP Large FP Break No AC
04-FW-MDAFPALHE	1.000E-001	3	Operator Fails to Control MDAFP LargeFW Brk AC Avail
04-FW-MDAFPAMHE	1.000E-001	3	Operator Fails to Control MDAFP Med FW Brk AC Avail
04-FW-TDAFP2LHE	1.000E-001	3	Operator Fails to Control TDAFP LargeFW No MDAFP Run
04-FW-TDAFP2MHE	1.000E-001	3	Operator Fails to Control TDAFP Med FW No MDAFP Run
04-FW-TDAFP3LHE	1.000E-001	3	Oper Fails to Control TDAFP LargeFW No MDAFP Start
04-FW-TDAFP3MHE	1.000E-001	3	Oper Fails to Control TDAFP Med FW No MDAFP Start
04-FW-TDAFP4-HE	1.000E-001	3	Operator Fails to Control TDAFP LargeFW No AC
04-FW-TDAFP4MHE	1.000E-001	3	Operator Fails to Control TDAFP Med FW No AC

Table 11
Basic Event Descriptions (continued)

04-FW-TDAFPL-HE	1.000E-001	3	Operator fails to Start TDAFP Large FW Brk AC Avail
04-FW-TDAFPLNHE	1.000E-001	3	Operator fails to Start TDAFP Large FW Break No AC
04-FW-TDAFPM-HE	1.000E-001	3	Operator fails to Start TDAFP Medium FW Brk AC Avail
04-FW-TDAFPMNHE	1.000E-001	3	Operator fails to Start TDAFP Medium FW Break No AC
04-LC--26829-OP	2.400E-005	4	INDEPENDENT FAILUREFOREBAY LEVEL CHANNEL A1 FAILS
04-LC--26830-OP	2.400E-005	4	INDEPENDENT FAILUREFOREBAY LEVEL CHANNEL A2 FAILS
04-LC--26831-OP	2.400E-005	4	INDEPENDENT FAILUREFOREBAY LEVEL CHANNEL B1 FAILS
04-LC--26832-OP	2.400E-005	4	INDEPENDENT FAILUREFOREBAY LEVEL CHANNEL B2 FAILS
04-LC-KOPCCF1-4	4.460E-007	3	GLOBAL FAILURE OF FOREBAY LEVEL CHANS
04-LC-KOPCCF12	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/A2
04-LC-KOPCCF123	8.080E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/A2/B1
04-LC-KOPCCF124	8.080E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/A2/B2
04-LC-KOPCCF13	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/B1
04-LC-KOPCCF134	8.080E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/B1/B2
04-LC-KOPCCF14	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A1/B2
04-LC-KOPCCF23	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A2/B1
04-LC-KOPCCF234	8.080E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A2/B1/B2
04-LC-KOPCCF24	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN A2/B2
04-LC-KOPCCF34	1.700E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FB LEV CHN B1/B2
04-LS-FCCCF1-6	1.230E-006	3	SEXTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1-6
04-LS-FCCCF12	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF12
04-LS-FCCCF123	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF123
04-LS-FCCCF1234	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1234
04-LS-FCCCF12345	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF12345
04-LS-FCCCF12346	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF12346
04-LS-FCCCF1235	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1235
04-LS-FCCCF12356	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF12356
04-LS-FCCCF1236	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1236
04-LS-FCCCF124	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF124
04-LS-FCCCF1245	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1245
04-LS-FCCCF12456	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF12456
04-LS-FCCCF1246	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1246
04-LS-FCCCF125	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF125
04-LS-FCCCF1256	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1256
04-LS-FCCCF126	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF126
04-LS-FCCCF13	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF13
04-LS-FCCCF134	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF134
04-LS-FCCCF1345	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1345

Table 11
Basic Event Descriptions (continued)

04-LS-FCCCF13456	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF13456
04-LS-FCCCF1346	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1346
04-LS-FCCCF135	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF135
04-LS-FCCCF1356	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1356
04-LS-FCCCF136	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF136
04-LS-FCCCF14	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF14
04-LS-FCCCF145	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF145
04-LS-FCCCF1456	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF1456
04-LS-FCCCF146	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF146
04-LS-FCCCF15	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF15
04-LS-FCCCF156	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF156
04-LS-FCCCF16	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF16
04-LS-FCCCF23	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF23
04-LS-FCCCF234	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF234
04-LS-FCCCF2345	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF2345
04-LS-FCCCF23456	9.190E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF23456
04-LS-FCCCF2346	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF2346
04-LS-FCCCF235	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF235
04-LS-FCCCF2356	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF2356
04-LS-FCCCF236	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF236
04-LS-FCCCF24	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF24
04-LS-FCCCF245	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF245
04-LS-FCCCF2456	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF2456
04-LS-FCCCF246	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF246
04-LS-FCCCF25	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF25
04-LS-FCCCF256	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF256
04-LS-FCCCF26	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF26
04-LS-FCCCF34	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF34
04-LS-FCCCF345	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF345
04-LS-FCCCF3456	5.910E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF3456
04-LS-FCCCF346	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF346
04-LS-FCCCF35	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF35
04-LS-FCCCF356	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF356
04-LS-FCCCF36	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF36
04-LS-FCCCF45	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF45
04-LS-FCCCF456	1.020E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF456
04-LS-FCCCF46	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF46
04-LS-FCCCF56	2.940E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)04-LS-FCCCF56
04-LS-KFOCCF1-4	5.600E-009	3	GLOBAL FAILURE OF FB LEVEL SWTS FTO
04-LS-KFOCCF12	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26829/30-71 FTO
04-LS-KFOCCF123	1.010E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LS 26829/30/31-71
04-LS-KFOCCF124	1.010E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LS 26829/30/32-71
04-LS-KFOCCF13	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26829/31-71 FTO
04-LS-KFOCCF134	1.010E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LS 26829/31/32-71

Table 11
Basic Event Descriptions (continued)

04-LS-KFOCCF14 FTO	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26829/32-71
04-LS-KFOCCF23 FTO	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26830/31-71
04-LS-KFOCCF234	1.010E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LS 26830/31/32-71
04-LS-KFOCCF24 FTO	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26830/32-71
04-LS-KFOCCF34 FTO	2.140E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)LS 26831/32-71
04-LSLS16761-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16761 FAILS TO
04-LSLS16762-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16762 FAILS TO
04-LSLS16763-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16763 FAILS TO
04-LSLS16764-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16764 FAILS TO
04-LSLS16765-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16765 FAILS TO
04-LSLS16766-FC CLOSE	1.000E-004	3	INDEPENDENT FAILURELEVEL SWITCH 16766 FAILS TO
04-LSLS26829-FO	3.010E-007	3	INDEPENDENT FAILURELEVEL SWITCH 26829-71 FTO
04-LSLS26830-FO	3.010E-007	3	INDEPENDENT FAILURELEVEL SWITCH 26830-71 FTO
04-LSLS26831-FO	3.010E-007	3	INDEPENDENT FAILURELEVEL SWITCH 26831-71 FTO
04-LSLS26832-FO	3.010E-007	3	INDEPENDENT FAILURELEVEL SWITCH 26832-71 FTO
04-RE-26829A-RF	3.279E-003	4	RELAY 26830A FAILS TO OPERATE
04-RE-26829B-RF	3.279E-003	4	RELAY 26829B FAILS TO OPERATE
04-RE-26830A-RF	3.279E-003	4	RELAY 26830A FAILS TO OPERATE
04-RE-26830B-RF	3.279E-003	4	RELAY 26830B FAILS TO OPERATE
04-RE-26831A-RF	3.279E-003	4	RELAY 26831A FAILS TO OPERATE
04-RE-26831B-RF	3.279E-003	4	RELAY 26831B FAILS TO OPERATE
04-RE-26832A-RF	3.279E-003	4	RELAY 26832A FAILS TO OPERATE
04-RE-26832B-RF	3.279E-003	4	RELAY 26832B FAILS TO OPERATE
04-STMMDAFPALHE Avail	1.000E-001	3	Operator Fails to Control MDAFP Med STM Brk AC
04-STMMDAFPAMHE Avail	1.000E-001	3	Operator Fails to Control MDAFP Med STM Brk AC
04-STMTDAFP2LHE Run	1.000E-001	3	Operator Fails to Control TDAFP LargeSTM No MDAFP
04-STMTDAFP2MHE Run	1.000E-001	3	Operator Fails to Control TDAFP Med STM No MDAFP
04-STMTDAFP3LHE Start	1.000E-001	3	Oper Fails to Control TDAFP LargeSTM No MDAFP
04-STMTDAFP3MHE	1.000E-001	3	Oper Fails to Control TDAFP Med STM No MDAFP Start
04-STMTDAFP4-HE	1.000E-001	3	Operator Fails to Control TDAFP LargeSTM No AC
04-STMTDAFP4MHE	1.000E-001	3	Operator Fails to Control TDAFP Med STM No AC
04-STMTDAFPL-HE Avail	1.000E-001	3	Operator fails to Start TDAFP Large STM Brk AC
04-STMTDAFPLNHE AC	1.000E-001	3	Operator fails to Start TDAFP Large STM Break No
04-STMTDAFPM-HE Avail	1.000E-001	3	Operator fails to Start TDAFP Medium STM Brk AC
04-STMTDAFPMNHE AC	1.000E-001	3	Operator fails to Start TDAFP Medium STM Break No
04-SW-MDAFPALHE Avail	1.000E-001	3	Operator Fails to Control MDAFP LargeFW Brk AC

Table 11
Basic Event Descriptions (continued)

04-SW-TDAFP2LHE	1.000E-001	3	Operator Fails to Control TDAFP LargeSW No MDAFP Run
04-SW-TDAFP3LHE	1.000E-001	3	Oper Fails to Control TDAFP LargeSW No MDAFP Start
04-SW-TDAFP4-HE	1.000E-001	3	Operator Fails to Control TDAFP LargeSW No AC
04-SW-TDAFP4SHE	1.000E-001	3	Operator Fails to Control TDAFP LargeSW Break
04-SW-TDAFPL-HE	1.000E-001	3	Operator fails to Start TDAFP Large SW Brk AC Avail
04-SW-TDAFPLNHE	1.000E-001	3	Operator fails to Start TDAFP Large SW Break No AC
04-SW4A-B66F-HE	2.000E-002	3	FAILURE TO ISOLATE SW HDR BEFORE FAILURE OF TDAFP
04FPMDAFPNSFIHE	1.000E-001	3	MDAFP not Secured (Event True if PumpNot Secured) LrgFP
04FPMDAFPNSTIHE	1.000E-001	3	MDAFP not Secured (Event True if PumpNot Secured)LrgSTM
04FPMDAFPNSTXHE	1.000E-001	3	MDAFP not Secured (Event True if PumpNot Secured) LrgFW
04FPMDAFPNSWIHE	1.000E-001	3	MDAFP not Secured (Event True if PumpNot Secured) LrgFW
04FPMDAFPNSWXHE	1.000E-001	3	MDAFP not Secured (Event True if PumpNot Secured) ModFW
04FPMDAFPSEFIHE	9.000E-001	3	MDAFP Secured (Event True if PumpSecured) Large FP
04FPMDAFPSETIHE	9.000E-001	3	MDAFP Secured (Event True if PumpSecured) Large STM
04FPMDAFPSETXHE	9.000E-001	3	MDAFP Secured (Event True if PumpSecured) Mod STM
04FPMDAFPSEWIHE	9.000E-001	3	MDAFP Secured (Event True if PumpSecured) Large FW
04FPMDAFPSEWXHE	9.000E-001	3	MDAFP Secured (Event True if PumpSecured) Mod FW
04FPTDAFPDNFIHE	1.000E-001	3	Did not Initially Secure TDAFP Large FP Break
04FPTDAFPDNTIHE	1.000E-001	3	Did not Initially Secure TDAFP Large STM Break
04FPTDAFPDNTXHE	1.000E-001	3	Did not Initially Secure TDAFP Mod STM Break
04FPTDAFPDNWIHE	1.000E-001	3	Did not Initially Secure TDAFP Mod FW Break
04FPTDAFPDNWXHE	1.000E-001	3	Did not Initially Secure TDAFP Mod FW Break
04FPTDAFPMCFIHE	1.000E-001	3	Fail to Take ManualControl of AFW-2A/BLarge FP Break
04FPTDAFPMCTIHE	1.000E-001	3	Fail to Take ManualControl of AFW-2A/BMod STM Break
04FPTDAFPMCTXHE	1.000E-001	3	Fail to Take ManualControl of AFW-2A/BLarge FW Break
04FPTDAFPMCWIHE	1.000E-001	3	Fail to Take ManualControl of AFW-2A/BLarge FW Break
04FPTDAFPMCWXHE	1.000E-001	3	Fail to Take ManualControl of AFW-2A/BMod FW Break
04FPTDAFPRNFIHE	1.000E-001	3	Fail to Maintain TDAFP Running Large FP Break
04FPTDAFPRNTIHE	1.000E-001	3	Fail to Maintain TDAFP Running Large STM Break
04FPTDAFPRNTXHE	1.000E-001	3	Fail to Maintain TDAFP Running Moderate STM Break
04FPTDAFPRNWIHE	1.000E-001	3	Fail to Maintain TDAFP Running Large FW Break
04FPTDAFPRNWXHE	1.000E-001	3	Fail to Maintain TDAFP Running Moderate FW Break
04FPTDAFPRSFIHE	1.000E-001	3	Fail to Restart TDAFP after Stopped per Proc
04FPTDAFPRSTIHE	1.000E-001	3	Fail to Restart TDAFP after Stopped per Proc
04FPTDAFPRSTXHE	1.000E-001	3	Fail to Restart TDAFP after Stopped per Proc
04FPTDAFPRSWIHE	1.000E-001	3	Fail to Restart TDAFP after Stopped per Proc
04FPTDAFPRSWXHE	1.000E-001	3	Fail to Restart TDAFP after Stopped per Proc
04FPTDAFPSRFIHE	1.000E-001	3	Short Term Restart
04FPTDAFPSRTIHE	1.000E-001	3	Short Term Restart Large STM Break
04FPTDAFPSRTXHE	1.000E-001	3	Short Term Restart Moderate STM Break
04FPTDAFPSRWIHE	1.000E-001	3	Short Term Restart Large FW Break
04FPTDAFPSRWXHE	1.000E-001	3	Short Term Restart Moderate FW Break
05-BYALOP-F-HE	1.000E-001	3	Fail to Bypass Interlock Large FW Break
05-BYALOP-FIHE	1.000E+000	3	Fail to Bypass Interlock Large FP Break

Table 11
Basic Event Descriptions (continued)

05-BYALOP-TIHE	1.000E-001	3	Fail to Bypass Interlock Large STM Break
05-BYALOP-TXHE	1.000E-001	3	Fail to Bypass Interlock Moderate STM Break
05-BYALOP-WXHE	1.000E-001	3	Fail to Bypass Interlock Moderate FW Break
05A-FW-BRK-F-HE	5.006E-002	3	OPERATOR FAILS TO ISOLATE FEEDWATER BREAK
05A-MF1------HE	1.447E-002	3	OPERATOR FAILS TO START FW PUMPS AND ESTABLISH FLOW
05A-MF2------HE	4.307E-003	3	OPERATOR FAILS TO ESTABLISH MAIN FEEDWATER
05AAM--LM462-FA	3.358E-004	4	INDEPENDENT FAILUREISOLATION AMPLIFIERLM-462 FAILS
05AAM--LM472-FA	3.358E-004	4	INDEPENDENT FAILUREISOLATION AMPLIFIERLM-472 FAILS
05AAM-KFACCF1-4	3.120E-006	3	GLOBAL FAILURE OF LM-462/63B/72/73B
05AAM-KFACCF12	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-462/472
05AAM-KFACCF123	5.660E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)LM-462/463B/472
05AAM-KFACCF124	5.660E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)LM-462/472/473B
05AAM-KFACCF13	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-462/463B
05AAM-KFACCF134	5.660E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)LM-462/463B/473B
05AAM-KFACCF14	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-462/473B
05AAM-KFACCF23	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-463B/472
05AAM-KFACCF234	5.660E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)LM-463B/472/473B
05AAM-KFACCF24	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-472/473B
05AAM-KFACCF34	1.190E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)LM-463B/473B
05AAM-LM463B-FA	3.358E-004	4	INDEPENDENT FAILUREISOLATION AMPLIFIERLM-463B FAILS
05AAM-LM473B-FA	3.358E-004	4	INDEPENDENT FAILUREISOLATION AMPLIFIERLM-473B FAILS
05AAV---FW7A-FC	4.758E-004	3	INDEPENDENT FAILUREAOV FW-7A FAILS TO CLOSE
05AAV---FW7A-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-7A FAILS TO OPEN
05AAV---FW7A-OC	1.032E-005	4	INDEPENDENT FAILUREAOV FW-7A TRANSFERSCLOSED
05AAV---FW7B-FC	4.758E-004	3	INDEPENDENT FAILUREAOV FW-7B FAILS TO CLOSE
05AAV---FW7B-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-7B FAILS TO OPEN
05AAV---FW7B-OC	1.032E-005	4	INDEPENDENT FAILUREAOV FW-7B TRANSFERSCLOSED
05AAV--FW10A-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-10A FAILS TOOPEN
05AAV--FW10B-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-10B FAILS TOOPEN
05AAV-FW101A-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-101A FAILS TO OPEN
05AAV-FW101B-FO	2.168E-003	3	INDEPENDENT FAILUREAOV FW-101B FAILS TO OPEN
05AAV-KFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-101A/B FTO
05AAVCKFCCCF12	9.420E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7A/B FTC
05AAVOKFOCCF1-4	1.620E-005	3	GLOBAL FAILURE OF FW-7A/B/10A/B T OP
05AAVOKFOCCF12	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7A/B FTO
05AAVOKFOCCF123	3.080E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)FW-7A/B/10A FTO
05AAVOKFOCCF124	3.080E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)FW-7A/B/10B FTO
05AAVOKFOCCF13	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7A/10A FTO
05AAVOKFOCCF134	3.080E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)FW-7A/10A/B FTO
05AAVOKFOCCF14	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7A/10B FTO
05AAVOKFOCCF23	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7B/10A FTO
05AAVOKFOCCF234	3.080E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)FW-7B/10A/B FTO
05AAVOKFOCCF24	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7B/10B FTO
05AAVOKFOCCF34	3.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-10A/B FTO
05AAVTKOCCCF12	2.420E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-7A/B TRAN CLOSED
05ACV-FW13A--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE FW-13A FAILS TO CLOSE
05ACV-FW13A--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FW-13A FAILS TO OPEN
05ACV-FW13B--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE FW-13B FAILS TO CLOSE

Table 11
Basic Event Descriptions (continued)

05ACV-FW13B--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FW-13B FAILS TO OPEN
05ACV-KFCCCF12	7.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-13A/B FTC
05ACV-KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-13A/B FTO
05ACV1KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FW-1A/B FTO
05ACVD-FW1A--FC	9.999E-004	3	CHECK VALVE FW-1A FAILS TO CLOSE
05ACVD-FW1A--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FW-1A FAILS TO OPEN
05ACVD-FW1B--FC	9.999E-004	3	CHECK VALVE FW-1B FAILS TO CLOSE
05ACVD-FW1B--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FW-1B FAILS TO OPEN
05ADC--LQ461-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-461 FAILS
05ADC--LQ462-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-462 FAILS
05ADC--LQ463-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-463 FAILS
05ADC--LQ471-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-471 FAILS
05ADC--LQ472-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-472 FAILS
05ADC--LQ473-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY LQ-473 FAILS
05ADCAKFACC12345	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-461/62/63/71/72
05ADCAKFACC12346	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-461/62/63/71/73
05ADCAKFACC12356	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-461/62/63/72/73
05ADCAKFACC12456	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-461/62/71/72/73
05ADCAKFACC13456	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-461/63/71/72/73
05ADCAKFACC23456	4.606E-009	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)LQ-462/63/71/72/73
05ADCAKFACCF1-6	6.164E-008	3	GLOBAL FAILURE OF LQ-461/2/3/71/2/3
05ADCAKFACCF12	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-461/462
05ADCAKFACCF123	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/463
05ADCAKFACCF1234	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/463/471
05ADCAKFACCF1235	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/463/472
05ADCAKFACCF1236	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/463/473
05ADCAKFACCF124	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/471
05ADCAKFACCF1245	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/471/472
05ADCAKFACCF1246	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/471/473
05ADCAKFACCF125	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/472
05ADCAKFACCF1256	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/472/473
05ADCAKFACCF126	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/462/473
05ADCAKFACCF13	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-461/463
05ADCAKFACCF134	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/471
05ADCAKFACCF1345	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/471/472
05ADCAKFACCF1346	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/471/473
05ADCAKFACCF135	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/472
05ADCAKFACCF1356	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/472/473
05ADCAKFACCF136	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/463/473
05ADCAKFACCF14	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-461/471

Table 11
Basic Event Descriptions (continued)

05ADCAKFACCF145	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/471/472
05ADCAKFACCF1456	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-461/471/472/473
05ADCAKFACCF146	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/471/473
05ADCAKFACCF15	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-461/472
05ADCAKFACCF156	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-461/472/473
05ADCAKFACCF16	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-461/473
05ADCAKFACCF23	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-462/463
05ADCAKFACCF234	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/471
05ADCAKFACCF2345	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/471/472
05ADCAKFACCF2346	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/471/473
05ADCAKFACCF235	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/472
05ADCAKFACCF2356	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/472/473
05ADCAKFACCF236	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/463/473
05ADCAKFACCF24	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-462/471
05ADCAKFACCF245	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/471/472
05ADCAKFACCF2456	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-462/471/472/473
05ADCAKFACCF246	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/471/473
05ADCAKFACCF25	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-462/472
05ADCAKFACCF256	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-462/472/473
05ADCAKFACCF26	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-462/473
05ADCAKFACCF34	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-463/471
05ADCAKFACCF345	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-463/471/472
05ADCAKFACCF3456	2.960E-009	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)LQ-463/471/472/473
05ADCAKFACCF346	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-463/471/473
05ADCAKFACCF35	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-463/472
05ADCAKFACCF356	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-463/472/473
05ADCAKFACCF36	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-463/473
05ADCAKFACCF45	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-471/472
05ADCAKFACCF456	5.110E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)LQ-471/472/473
05ADCAKFACCF46	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-471/473
05ADCAKFACCF56	1.472E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)LQ-472/473
05AMV--FW12A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV FW-12A FAILS TOCLOSE
05AMV--FW12A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV FW-12A FAILS TOOPEN
05AMV--FW12A-OC	1.200E-006	4	INDEPENDENT FAILUREMOV FW-12A TRANSFERS CLOSED
05AMV--FW12B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV FW-12B FAILS TOCLOSE
05AMV--FW12B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV FW-12B FAILS TOOPEN
05AMV--FW12B-OC	1.200E-006	4	INDEPENDENT FAILUREMOV FW-12B TRANSFERS CLOSED
05AMV1KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AMV1KFOCCF12
05AMV1KOCCCF12	2.820E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AMV1KOCCCF12
05AMV2KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AMV2KFOCCF12
05AMV2KOCCCF12	2.820E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AMV2KOCCCF12
05AMVCKFCCCF12	8.570E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AMVCKFCCCF12
05AMVD-FW2A--FO	6.968E-004	3	INDEPENDENT FAILUREMOV FW-2A FAILS TO OPEN
05AMVD-FW2A--OC	1.200E-006	4	INDEPENDENT FAILUREMOV FW-2A TRANSFERSCLOSED
05AMVD-FW2B--FO	6.968E-004	3	INDEPENDENT FAILUREMOV FW-2B FAILS TO OPEN
05AMVD-FW2B--OC	1.200E-006	4	INDEPENDENT FAILUREMOV FW-2B TRANSFERSCLOSED
05APM--FWP1A-PR	2.496E-004	4	INDEPENDENT FAILUREFEEDWATER PUMP A FAILS TO RUN
05APM--FWP1A-PS	1.400E-003	3	INDEPENDENT FAILUREFEEDWATER PUMP A FAILS TO START
05APM--FWP1B-PR	2.496E-004	4	INDEPENDENT FAILUREFEEDWATER PUMP B FAILS TO RUN
05APM--FWP1B-PS	1.400E-003	3	INDEPENDENT FAILUREFEEDWATER PUMP B FAILS TO START

Table 11
Basic Event Descriptions (continued)

05APMALOP1A--PR	3.401E-005	4	INDEPENDENT FAILUREFEEDWATER PUMP A ALOP FTR
05APMALOP1A--PS	1.400E-003	3	INDEPENDENT FAILUREFEEDWATER PUMP A ALOP FTS
05APMALOP1B--PR	3.401E-005	4	INDEPENDENT FAILUREFEEDWATER PUMP B ALOP FTR
05APMALOP1B--PS	1.400E-003	3	INDEPENDENT FAILUREFEEDWATER PUMP B ALOP FTS
05APMOKPRCCF12	2.350E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)FWP ALOPS A, B
05APMOKPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)05APMOKPSCCF12
05APMRKPRCCF12	1.730E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)05APMRKPRCCF12
05APMSKPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)05APMSKPSCCF12
05ASV-33074--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33074 FAILS TO CLOSE
05ASV-33074--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33074 FAILS TO OPEN
05ASV-33075--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33075 FAILS TO CLOSE
05ASV-33075--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33075 FAILS TO OPEN
05ASV-33077--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33077 FAILS TO CLOSE
05ASV-33077--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33077 FAILS TO OPEN
05ASV-33078--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33078 FAILS TO CLOSE
05ASV-33078--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33078 FAILS TO OPEN
05ASV-33080--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33080 FAILS TO CLOSE
05ASV-33081--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33081 FAILS TO CLOSE
05ASV-33082--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33082 FAILS TO CLOSE
05ASV-33083--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33083 FAILS TO CLOSE
05ASV-KFCCCF1-4	9.300E-006	3	GLOBAL FAILURE OF 05ASV-KFCCCF1-4
05ASV-KFCCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF12
05ASV-KFCCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF123
05ASV-KFCCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF124
05ASV-KFCCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF13
05ASV-KFCCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF134
05ASV-KFCCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF14
05ASV-KFCCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF23
05ASV-KFCCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF234
05ASV-KFCCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF24
05ASV-KFCCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASV-KFCCCF34
05ASVCKFCCCF1-4	9.300E-006	3	GLOBAL FAILURE OF 05ASVCKFCCCF1-4
05ASVCKFCCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF12
05ASVCKFCCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF123
05ASVCKFCCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF124
05ASVCKFCCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF13
05ASVCKFCCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF134
05ASVCKFCCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF14
05ASVCKFCCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF23
05ASVCKFCCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF234
05ASVCKFCCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF24
05ASVCKFCCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVCKFCCCF34
05ASVOKFOCCF1-4	9.300E-006	3	GLOBAL FAILURE OF 05ASVOKFOCCF1-4
05ASVOKFOCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF12
05ASVOKFOCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF123
05ASVOKFOCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF124
05ASVOKFOCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF13
05ASVOKFOCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF134
05ASVOKFOCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF14
05ASVOKFOCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF23
05ASVOKFOCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF234
05ASVOKFOCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF24
05ASVOKFOCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASVOKFOCCF34
05ASW--TS462-CO	3.719E-004	4	INDEPENDENT FAILURESWITCH TS/LM462 CONTACTS XFER OPEN

Table 11
Basic Event Descriptions (continued)

05ASW--TS472-CO	3.719E-004	4	INDEPENDENT FAILURESWITCH TS/LM472 CONTACTS XFER OPEN
05ASW-KCOCCF12	8.740E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASW-KCOCCF12
05ASW-TS463B-CO	1.119E-003	4	INDEPENDENT FAILURESWITCH TS/LM463B CONTACTS XFER OPEN
05ASW-TS473B-CO	1.119E-003	4	INDEPENDENT FAILURESWITCH TS/LM473B CONTACTS XFER OPEN
05ASW1KCOCCF12	2.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ASW1KCOCCF12
05ATL--LT461-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-461 FAILS
05ATL--LT462-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-462 FAILS
05ATL--LT463-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-463 FAILS
05ATL--LT471-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-471 FAILS
05ATL--LT472-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-472 FAILS
05ATL--LT473-FA	9.999E-007	4	INDEPENDENT FAILURELEVEL TRANSMITTER LT-473 FAILS
05ATLAKFACC12345	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC12345
05ATLAKFACC12346	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC12346
05ATLAKFACC12356	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC12356
05ATLAKFACC12456	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC12456
05ATLAKFACC13456	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC13456
05ATLAKFACC23456	4.606E-010	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACC23456
05ATLAKFACCF1-6	6.164E-009	3	GLOBAL FAILURE OF 05ATLAKFACCF1-6
05ATLAKFACCF12	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF12
05ATLAKFACCF123	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF123
05ATLAKFACCF1234	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1234
05ATLAKFACCF1235	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1235
05ATLAKFACCF1236	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1236
05ATLAKFACCF124	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF124
05ATLAKFACCF1245	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1245
05ATLAKFACCF1246	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1246
05ATLAKFACCF125	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF125
05ATLAKFACCF1256	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1256
05ATLAKFACCF126	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF126
05ATLAKFACCF13	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF13
05ATLAKFACCF134	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF134
05ATLAKFACCF1345	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1345
05ATLAKFACCF1346	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1346
05ATLAKFACCF135	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF135
05ATLAKFACCF1356	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1356
05ATLAKFACCF136	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF136
05ATLAKFACCF14	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF14
05ATLAKFACCF145	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF145

Table 11
Basic Event Descriptions (continued)

05ATLAKFACCF1456	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF1456
05ATLAKFACCF146	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF146
05ATLAKFACCF15	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF15
05ATLAKFACCF156	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF156
05ATLAKFACCF16	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF16
05ATLAKFACCF23	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF23
05ATLAKFACCF234	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF234
05ATLAKFACCF2345	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF2345
05ATLAKFACCF2346	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF2346
05ATLAKFACCF235	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF235
05ATLAKFACCF2356	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF2356
05ATLAKFACCF236	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF236
05ATLAKFACCF24	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF24
05ATLAKFACCF245	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF245
05ATLAKFACCF2456	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF2456
05ATLAKFACCF246	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF246
05ATLAKFACCF25	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF25
05ATLAKFACCF256	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF256
05ATLAKFACCF26	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF26
05ATLAKFACCF34	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF34
05ATLAKFACCF345	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF345
05ATLAKFACCF3456	2.960E-010	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF3456
05ATLAKFACCF346	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF346
05ATLAKFACCF35	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF35
05ATLAKFACCF356	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF356
05ATLAKFACCF36	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF36
05ATLAKFACCF45	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF45
05ATLAKFACCF456	5.110E-010	3	TRIPLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF456
05ATLAKFACCF46	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF46
05ATLAKFACCF56	1.472E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05ATLAKFACCF56
05AVC-FW10A--OP	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV FW-10A FAILURE
05AVC-FW10B--OP	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV FW-10B FAILURE
05AVC-FW7A---OP	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV FW-7A FAILURE
05AVC-FW7B---OP	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV FW-7B FAILURE
05AVC-KOPCCF1-4	1.340E-006	3	GLOBAL FAILURE OF 05AVC-KOPCCF1-4
05AVC-KOPCCF12	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF12
05AVC-KOPCCF123	2.420E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF123
05AVC-KOPCCF124	2.420E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF124
05AVC-KOPCCF13	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF13
05AVC-KOPCCF134	2.420E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF134
05AVC-KOPCCF14	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF14
05AVC-KOPCCF23	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF23
05AVC-KOPCCF234	2.420E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF234
05AVC-KOPCCF24	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF24
05AVC-KOPCCF34	5.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05AVC-KOPCCF34
05B-AF4------HE	2.860E-002	3	OPERATOR FAILS TO ESTABLISH AUXILIARYFEEDWATER

Table 11
Basic Event Descriptions (continued)

05B-AFW-ISO--HE	1.968E-002	3	OPERATOR FAILS TO ISOLATE STEAM FROM BROKEN SG TO TDAFWP
05B-AFW-LTC--HE	1.000E-006	3	OPERATOR FAILS TO PROVIDE LONG-TERM COOLING VIA AFW,RHR
05B-AFW-SLB--HE	1.925E-002	3	OPERATOR FAILS TO RESTART AFW PUMPS IN STEAM LINE BREAK
05B-AFW-SLB-SHE	1.000E+000	3	OPERATOR FAILS TO RESTART AFW PUMPS IN SLB (SEISMIC)
05B-AFWVLV2B-HE	7.040E-003	3	OP FAILS TO MAN. THROTTLE AFW 2B
05B-BYALOP-F-HE	4.400E-001	3	FAIL TO BYPASS AFW ALOP PERMISSIVE LARGE FW BREAK
05B-BYALOPCX-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Mod CW Break
05B-BYALOPFI-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Large FP Break
05B-BYALOPSI-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Large SW Break
05B-BYALOPTI-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Large STM Break
05B-BYALOPTX-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Mod STM Break
05B-BYALOPWX-HE	1.000E+000	3	Fail to Bypass AFW ALOP Permissive Mod FW Break
05B-CST-DIAG-HE	8.656E-004	3	OPERATOR FAILS TO DIAGNOSE NEED FOR ALTERNATE AFW SRC
05B-CST-DIAGSHE	1.000E+000	3	OPERATOR FAILS TO DIAGNOSE NEED FOR ALTERNATE AFW - SEI
05B-CST-SWS--HE	7.043E-003	3	OPERATOR FAILS TO SWITCH AFW FROM CSTTO SWS
05B-CST-SWS-SHE	1.000E+000	3	OPERATOR FAILS TO SWITCH AFW FROM CSTTO SWS (SEISMIC)
05B-FRACTDP-OFF	9.000E-001	3	PROB OF CONDITIONS WHERE TDAFP IS SECURED
05B-MDPTD1CF-HE	1.600E-001	3	Start TD AFW Pump before loss of MD AFW Pump - 108 min.
05B-MDPTD2HF-HE	4.100E-002	3	Start TD AFW Pump before loss of MD AFW Pump - 2 Hr.
05B-MDPTD36F-HE	4.700E-001	3	Start DT AFW Pump before loss of MD AFW Pump - 36 min.
05B-MDPTD49F-HE	4.700E-001	3	Start TD AFW Pump before loss of MD AFW Pump - 49 min.
05B-MDPTD61F-HE	3.100E-001	3	Start TD AFW Pump before loss of MD AFW Pump - 61 min.
05B-MU3A-CHW-HE	2.470E-002	3	OPERATOR FAILS TO ISOLATE AOV MU-3A ON HIGH CNDSR LEVEL
05B-MU3A-SBO-HE	3.781E-003	3	OPERATOR FAILS TO ISOLATE AOV MU-3A DURING BLACKOUT
05B-MU3A-TIA-HE	9.800E-003	3	OPERATOR FAILS TO ISOLATE AOV MU-3A DURING LOSS OF AIR
05B-SG-RFLX-MHE	8.069E-002	3	OPERATOR FAILS TO ESTABLISH SG REFLUX COOLING
05B-TDAFW-PS-HE	7.040E-003	3	OP FAILS TO START TDAFW PMP BEFORE LOSS OF MD PMP
05B-TDAFWOPF-HE	9.000E-001	3	Fail to Maintain TDAFP Running
05B-TDAFWSG-MHE	7.319E-002	3	OPERATOR FAILS TO ALIGN TD AFW PUMP TO S/G
05BAFW-DSP---HE	4.649E-003	3	OPERATOR FAILS TO ESTABLISH AUXILIARYFEEDWATER FROM DSP
05BAFW-MAN---HE	8.051E-002	3	OPERATOR FAILS TO ESTABLISH AUXILIARYFEEDWATER MANUALLY
05BAV--AFW2A-OC	1.032E-005	4	INDEPENDENT FAILUREAOV AFW-2A TRANSFERS CLOSED
05BAV--AFW2B-OC	1.032E-005	4	INDEPENDENT FAILUREAOV AFW-2B TRANSFERS CLOSED
05BAV-KOCCCF12	2.420E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BAV-KOCCCF12
05BCN-33X165-CO	3.284E-003	4	TURBINE DRIVEN AUX FEED PUMP DISCHPRESSURE TRIP FAILS
05BCN-33X165-RC	2.999E-004	3	RELAY 33X/1-165 CONTACTS FAIL
05BCN-62T165-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 62T/1-165 CONTACTS FAIL
05BCN-62T504-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 62T/1-504 CONTACTS FAIL

Table 11
Basic Event Descriptions (continued)

05BCN-62T604-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 62T/1-604 CONTACTS FAIL
05BCN0KRCCCF12	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCN0KRCCCF12
05BCN0KRCCCF123	7.740E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BCN0KRCCCF123
05BCN0KRCCCF13	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCN0KRCCCF13
05BCN0KRCCCF23	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCN0KRCCCF23
05BCN62T1165-CO	3.284E-003	4	TURBINE DRIVEN AUX FEED PUMP DISCHPRESSURE TRIP FAILS
05BCN62T1165-RC	2.999E-004	3	RELAY 62T1/1-165 CONTACTS FAIL
05BCNCKRCCCF12	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCNCKRCCCF12
05BCNCKRCCCF123	7.740E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BCNCKRCCCF123
05BCNCKRCCCF13	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCNCKRCCCF13
05BCNCKRCCCF23	3.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCNCKRCCCF23
05BCNPS15502JRC	2.999E-004	3	INDEPENDENT FAILUREPS PS-15502J CONTACTS FAIL
05BCNPS15503JRC	2.999E-004	3	INDEPENDENT FAILUREPS PS-15503J CONTACTS FAIL
05BCNPS15504JRC	2.999E-004	3	INDEPENDENT FAILUREPS PS-15504J CONTACTS FAIL
05BCV-KFOCCF12	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-101A/B FTO
05BCV-KFOCCF123	1.360E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)AFW-101A/B/C FTO
05BCV-KFOCCF13	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-101A/C FTO
05BCV-KFOCCF23	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-101B/C FTO
05BCV-KOCCCF12	2.700E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW4A/B TRN CLOSED
05BCVAFW101A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-101A FTO
05BCVAFW101B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-101B FTO
05BCVAFW101C-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-101C FTO
05BCVD-AFW1A-FC	9.999E-004	3	CHECK VALVE AFW-1A FAILS TO CLOSE
05BCVD-AFW1A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-1A FAILS TO OPEN
05BCVD-AFW1B-FC	9.999E-004	3	CHECK VALVE AFW-1B FAILS TO CLOSE
05BCVD-AFW1B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-1B FAILS TO OPEN
05BCVD-AFW1C-FC	9.999E-004	3	CHECK VALVE AFW-1C FAILS TO CLOSE
05BCVD-AFW1C-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-1C FAILS TO OPEN
05BCVD-MU311C-FC	1.000E-003	3	CHECK VALVE MU-311CFAILS TO CLOSE
05BCVDKFOCCF12	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-1A/B FTO
05BCVDKFOCCF123	1.360E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)AFW-1A/B/C FTO
05BCVDKFOCCF13	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-1A/C FTO
05BCVDKFOCCF23	1.310E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-1B/C FTO
05BCVI-AFW4A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-4A FAILS TO OPEN
05BCVI-AFW4A-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE AFW-4A TRANSFERS CLOSED
05BCVI-AFW4B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE AFW-4B FAILS TO OPEN
05BCVI-AFW4B-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE AFW-4B TRANSFERS CLOSED
05BCVIKFOCCF12	1.490E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BCVIKFOCCF12
05BFAFWA-CAL-AE	8.158E-004	3	TECHNICIAN MISCALIBRATES AFW TRAIN A FLOW
05BFAFWB-CAL-AE	8.158E-004	3	TECHNICIAN MISCALIBRATES AFW TRAIN B FLOW
05BMDPTD49F-HE	4.700E-001	3	Start TD AFW Pump before loss of MD AF Pump - 49 min.
05BMV-AFW10A-FC	1.905E-003	3	MOV AFW-10A FAILS TO CLOSE
05BMV-AFW10A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV AFW-10A FAILS TO OPEN
05BMV-AFW10A-OC	1.200E-006	4	INDEPENDENT FAILUREMOV AFW-10A TRANSFERS CLOSED
05BMV-AFW10B-FC	1.905E-003	3	MOV AFW-10B FAILS TO CLOSE
05BMV-AFW10B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV AFW-10B FAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

05BMV-AFW10B-OC	1.200E-006	4	INDEPENDENT FAILUREMOV AFW-10B TRANSFERS CLOSED
05BMV-KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-10A/B FTO
05BMV-KOCCCF12	2.820E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)AFW-10A/B TRN CLS
05BMVI-MS102-FO	2.375E-003	3	MOV MS-102 FAILS TOOPEN
05BPM--AFW1A-PR	8.159E-004	4	INDEPENDENT FAILUREAUXILIARY FEEDWATERPUMP A FAILS TO RUN
05BPM--AFW1A-PS	8.049E-004	3	INDEPENDENT FAILUREAUXILIARY FEEDWATERPUMP A FTS
05BPM--AFW1A-TM	1.680E-003	3	AFW PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE
05BPM--AFW1B-PR	8.159E-004	4	INDEPENDENT FAILUREAUXILIARY FEEDWATERPUMP B FAILS TO RUN
05BPM--AFW1B-PS	8.049E-004	3	INDEPENDENT FAILUREAUXILIARY FEEDWATERPUMP B FTS
05BPM--AFW1B-TM	2.050E-003	3	AFW PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
05BPMALOP1A--PR	3.401E-005	4	INDEPENDENT FAILUREAFW PUMP A AUX LUBEOIL PUMP FTR
05BPMALOP1A--PS	1.110E-003	3	INDEPENDENT FAILUREAFW PUMP A AUX LUBEOIL PUMP FTS
05BPMALOP1B--PR	3.401E-005	4	INDEPENDENT FAILUREAFW PUMP B AUX LUBEOIL PUMP FTR
05BPMALOP1B--PS	1.110E-003	3	INDEPENDENT FAILUREAFW PUMP B AUX LUBEOIL PUMP FTS
05BPMALOP1C--PR	3.401E-005	4	INDEPENDENT FAILURETD AFW PUMP AUX LUBE OIL PUMP FTR
05BPMALOP1C--PS	1.110E-003	3	INDEPENDENT FAILURETD AFW PUMP AUX LUBE OIL PUMP FTS
05BPMLKPRCCF12	4.220E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)AFW ALOP A,B FTR
05BPMLKPRCCF123	2.030E-006	4	TRIPLE COMMON CAUSE FAILURE (CCF)AFW ALOP A,B,TD FTR
05BPMLKPRCCF13	4.220E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)AFW ALOP A,TD FTR
05BPMLKPRCCF23	4.220E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)AFW ALOP B,TD FTR
05BPMOKPSCCF12	2.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMOKPSCCF12
05BPMOKPSCCF123	1.050E-004	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BPMOKPSCCF123
05BPMOKPSCCF13	2.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMOKPSCCF13
05BPMOKPSCCF23	2.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMOKPSCCF23
05BPMRKPRCCF12	1.230E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMRKPRCCF12
05BPMRKPRCCF123	1.450E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BPMRKPRCCF123
05BPMRKPRCCF13	1.740E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMRKPRCCF13
05BPMRKPRCCF23	1.740E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMRKPRCCF23
05BPMSKPSCCF12	2.290E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMSKPSCCF12
05BPMSKPSCCF123	1.380E-004	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BPMSKPSCCF123
05BPMSKPSCCF13	4.320E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMSKPSCCF13
05BPMSKPSCCF23	4.320E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPMSKPSCCF23
05BPS-KOPCCF12	3.630E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPS-KOPCCF12
05BPS-KOPCCF123	7.740E-009	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BPS-KOPCCF123
05BPS-KOPCCF13	3.630E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPS-KOPCCF13
05BPS-KOPCCF23	3.630E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BPS-KOPCCF23
05BPSPS15502JOP	2.999E-007	3	INDEPENDENT FAILUREFAILURE OF PRESSURESWITCH PS-15505J
05BPSPS15503JOP	2.999E-007	3	INDEPENDENT FAILUREFAILURE OF PRESSURESWITCH PS-15503J
05BPSPS15504JOP	2.999E-007	3	INDEPENDENT FAILUREFAILURE OF PRESSURESWITCH PS-15504J
05BPT--AFW1C-PR	2.637E-003	4	INDEPENDENT FAILURETD AFW PUMP FAILS TO RUN
05BPT--AFW1C-PS	2.013E-002	3	INDEPENDENT FAILURETD AFW PUMP FAILS TO START
05BPT--AFW1C-TM	3.930E-003	3	TD AFW PUMP UNAVAILABLE DUE TO TEST OR MAINTENANCE
05BRE-62T165-RB	3.279E-003	4	INDEPENDENT FAILURERELAY 62T/1-165 MECH BOUND
05BRE-62T504-RB	3.279E-003	4	INDEPENDENT FAILURERELAY 62T/1-504 MECH BOUND
05BRE-62T604-RB	3.279E-003	4	INDEPENDENT FAILURERELAY 62T/1-604 MECH BOUND
05BRE-KRBCCF12	1.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BRE-KRBCCF12
05BRE-KRBCCF123	4.230E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BRE-KRBCCF123
05BRE-KRBCCF13	1.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BRE-KRBCCF13

Table 11
Basic Event Descriptions (continued)

05BRE-KRBCCF23	1.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BRE-KRBCCF23
05BRE62T1165-RB	3.279E-003	4	RELAY 62T1/1-165 MECHANICALLY BOUND
05BSB-ADPTBY-FA SWITCH FAILS	6.548E-003	4	INDEPENDENT FAILUREAFWP A DISCH P TRIPBYPASS
05BSB-BDPTBY-FA SWITCH FAILS	6.548E-003	4	INDEPENDENT FAILUREAFWP B DISCH P TRIPBYPASS
05BSB-CDPTBY-FA SWITCH FAILS	6.548E-003	4	INDEPENDENT FAILURETD AFWP DISCH PTRIPBYPASS
05BSB-KFACCF12	3.960E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSB-KFACCF12
05BSB-KFACCF123	8.450E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BSB-KFACCF123
05BSB-KFACCF13	3.960E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSB-KFACCF13
05BSB-KFACCF23	3.960E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSB-KFACCF23
05BSV-KFOCCF12	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSV-KFOCCF12
05BSV-KFOCCF123	1.290E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)05BSV-KFOCCF123
05BSV-KFOCCF13	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSV-KFOCCF13
05BSV-KFOCCF23	6.050E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)05BSV-KFOCCF23
05BSVAFW111A-FO	4.999E-004	3	INDEPENDENT FAILURESOV AFW-111A FAILS TO OPEN
05BSVAFW111B-FO	4.999E-004	3	INDEPENDENT FAILURESOV AFW-111B FAILS TO OPEN
05BSVAFW111C-FO	4.999E-004	3	INDEPENDENT FAILURESOV AFW-111C FAILS TO OPEN
06--IS2------HE	4.280E-003	3	OPERATOR FAILS TO ISOLATE 1 OF 2 STEAM GENERATORS
06--OC1------HE INJECT	3.655E-002	3	OPERATOR FAILS TO CD AND DEPRES RCS FOR LOW PRES
06--OC1-----SHE (SEISMIC)	1.000E+000	3	OPERATOR FAILS TO CD AND DEPRES RCS FOR LPI
06--OC1-FLD--HE FLOOD	1.000E-001	3	OPERATOR FAILS TO CD AND DEPRES RCS FOR TURB BLG
06--OC2------HE	4.722E-002	3	OPERATOR FAILS TO CD AND DEPRES RCS FOR CHARGING
06--OC2----F-HE	7.400E-002	3	LOCAL OPERATION OF S/G PORV
06--OC3------HE LEAK	2.330E-002	3	OPERATOR FAILS TO CD AND DEPRES RCS TO STOP TUBE
06--OC4------HE	1.850E-001	3	OPERATOR FAILS TO CD AND DEPRES RCS IN ECA-3.1/3.2
06--OC6----F-HE	9.200E-002	3	FAIL TO COOLDOWN PER ES-1.2
06--OCD-SLB--HE BREAK	7.737E-002	3	OPERATOR FAILS TO DEPRESSURIZE AFTER A STEAM LINE
06--OCD-SLB-SHE SEISMIC	1.000E+000	3	OPERATOR FAILS TO DEPRESSURIZE AFTER AN SLB -
06-AV---MS1A-FC	2.000E-003	3	INDEPENDENT FAILUREAOV MS-1A FAILS TO CLOSE
06-AV---MS1B-FC	2.000E-003	3	INDEPENDENT FAILUREAOV MS-1B FAILS TO CLOSE
06-AV-KFCCCF12	4.900E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFCCCF12
06-AV-KFOCCF1-4	1.300E-005	3	GLOBAL FAILURE OF 06-AV-KFOCCF1-4
06-AV-KFOCCF12	2.600E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF12
06-AV-KFOCCF123	2.470E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF123
06-AV-KFOCCF124	2.470E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF124
06-AV-KFOCCF13	2.600E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF13
06-AV-KFOCCF134	2.470E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF134
06-AV-KFOCCF14	2.600E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF14
06-AV-KFOCCF23	2.600E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF23
06-AV-KFOCCF234	2.470E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF234
06-AV-KFOCCF24	2.600E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF24
06-AV-KFOCCF34	4.480E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-AV-KFOCCF34
06-AV-SD11A1-FO	1.740E-003	3	INDEPENDENT FAILUREAOV SD-11A1 FAILS TO OPEN
06-AV-SD11B1-FO	1.740E-003	3	INDEPENDENT FAILUREAOV SD-11B1 FAILS TO OPEN
06-AV-SD3A---FO	3.000E-003	3	INDEPENDENT FAILUREAOV SD-3A FAILS TO OPEN
06-AV-SD3B---FO	3.000E-003	3	INDEPENDENT FAILUREAOV SD-3B FAILS TO OPEN
06-BLINDAFWF-HE indication	6.400E-001	3	Operator fails to feed S/G without Level

Table 11
Basic Event Descriptions (continued)

06-CN---MSA1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSA1 CONATCTSFAIL
06-CN---MSA2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSA2 CONATCTSFAIL
06-CN---MSB1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSB1 CONATCTSFAIL
06-CN---MSB2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSB2 CONATCTSFAIL
06-CN--MSA1X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSA1X CONTACTS FAIL
06-CN--MSA2X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSA2X CONTACTS FAIL
06-CN--MSB1X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSB1X CONTACTS FAIL
06-CN--MSB2X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY MSB2X CONTACTS FAIL
06-CN1KRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 06-CN1KRCCCF1-4
06-CN1KRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF12
06-CN1KRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF123
06-CN1KRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF124
06-CN1KRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF13
06-CN1KRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF134
06-CN1KRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF14
06-CN1KRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF23
06-CN1KRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF234
06-CN1KRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF24
06-CN1KRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN1KRCCCF34
06-CN2KRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 06-CN2KRCCCF1-4
06-CN2KRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF12
06-CN2KRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF123
06-CN2KRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF124
06-CN2KRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF13
06-CN2KRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF134
06-CN2KRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF14
06-CN2KRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF23
06-CN2KRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF234
06-CN2KRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF24
06-CN2KRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CN2KRCCCF34
06-CV---MS1A-FC	9.999E-004	3	NON-RETURN CHECK VALVE IN MS-1A FAILS TO CLOSE
06-CV---MS1B-FC	9.999E-004	3	NON-RETURN CHECK VALVE IN MS-1B FAILS TO CLOSE
06-CV-KFOCCF12	1.080E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-CV-KFOCCF12
06-CV-KOCCCF12	2.700E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)MS-101A/B TRN CLSD
06-CV-MS101A-FC	9.999E-004	3	CHECK VALVE MS-101AFAILS TO CLOSE
06-CV-MS101A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MS-101AFAILS TO OPEN
06-CV-MS101A-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE MS-101ATRANSFERS CLOSED
06-CV-MS101B-FC	9.999E-004	3	CHECK VALVE MS-101BFAILS TO CLOSE
06-CV-MS101B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MS-101BFAILS TO OPEN
06-CV-MS101B-OC	1.200E-007	4	INDEPENDENT FAILURECHECK VALVE MS-101BTRANSFERS CLOSED
06-MV-KOCCCF12	2.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)MS-100A/B TRANS CLS
06-MV-MS100A-FC	1.905E-003	3	MOV MS-100A FAILS TO CLOSE
06-MV-MS100A-OC	1.200E-006	4	INDEPENDENT FAILUREMOV MS-100A TRANSFERS CLOSED
06-MV-MS100B-FC	1.905E-003	3	MOV MS-100B FAILS TO CLOSE
06-MV-MS100B-OC	1.200E-006	4	INDEPENDENT FAILUREMOV MS-100B TRANSFERS CLOSED
06-RE---MSA1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSA1 FAILS TOOPERATE
06-RE---MSA2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSA2 FAILS TOOPERATE
06-RE---MSB1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSB1 FAILS TOOPERATE
06-RE---MSB2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSB2 FAILS TOOPERATE
06-RE--MSA1X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSA1X FAILS TO OPERATE

Table 11
Basic Event Descriptions (continued)

06-RE--MSA2X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSA2X FAILS TO OPERATE
06-RE--MSB1X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSB1X FAILS TO OPERATE
06-RE--MSB2X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY MSB2X FAILS TO OPERATE
06-RE1KRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 06-RE1KRFCCF1-4
06-RE1KRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF12
06-RE1KRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF123
06-RE1KRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF124
06-RE1KRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF13
06-RE1KRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF134
06-RE1KRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF14
06-RE1KRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF23
06-RE1KRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF234
06-RE1KRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF24
06-RE1KRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE1KRFCCF34
06-RE2KRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 06-RE2KRFCCF1-4
06-RE2KRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF12
06-RE2KRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF123
06-RE2KRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF124
06-RE2KRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF13
06-RE2KRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF134
06-RE2KRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF14
06-RE2KRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF23
06-RE2KRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF234
06-RE2KRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF24
06-RE2KRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-RE2KRFCCF34
06-SV-33177--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33177 FAILS TO OPEN
06-SV-33178--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33178 FAILS TO OPEN
06-SV-33185--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33185 FAILS TO OPEN
06-SV-33186--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33186 FAILS TO OPEN
06-SV-KFOCCF1-4	9.300E-006	3	GLOBAL FAILURE OF 06-SV-KFOCCF1-4
06-SV-KFOCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF12
06-SV-KFOCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF123
06-SV-KFOCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF124
06-SV-KFOCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF13
06-SV-KFOCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF134
06-SV-KFOCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF14
06-SV-KFOCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF23
06-SV-KFOCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF234
06-SV-KFOCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF24
06-SV-KFOCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-SV-KFOCCF34
06-SY--MSIAB-FA	1.415E-004	3	MAIN STEAM ISOLATION SIGNAL FAILS
06-VC-KOPCCF12	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-VC-KOPCCF12
06-VC-KOPCCF123	9.290E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)06-VC-KOPCCF123
06-VC-KOPCCF13	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-VC-KOPCCF13
06-VC-KOPCCF23	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)06-VC-KOPCCF23
06-VC-SD3A---OP FAILURE	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV SD-3A
06-VC-SD3B---OP FAILURE	7.197E-005	4	INDEPENDENT FAILURECONTROLLER FOR AOV SD-3B
06-VC-STMDMP-OP	7.197E-005	4	INDEPENDENT FAILURESTEAM DUMP CONTROL FAILURE
07-MV---BT2A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV BT-2A FAILS TO CLOSE
07-MV---BT2B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV BT-2B FAILS TO CLOSE
07-MV---BT3A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV BT-3A FAILS TO CLOSE
07-MV---BT3B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV BT-3B FAILS TO CLOSE
07-MV-KFCCCF1-4	4.930E-005	3	GLOBAL FAILURE OF 07-MV-KFCCCF1-4
07-MV-KFCCCF12	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF12

Table 11
Basic Event Descriptions (continued)

07-MV-KFCCCF123	1.090E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF123
07-MV-KFCCCF124	1.090E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF124
07-MV-KFCCCF13	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF13
07-MV-KFCCCF134	1.090E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF134
07-MV-KFCCCF14	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF14
07-MV-KFCCCF23	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF23
07-MV-KFCCCF234	1.090E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF234
07-MV-KFCCCF24	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF24
07-MV-KFCCCF34	2.460E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)07-MV-KFCCCF34
08-FP-ISOL--F-HE	1.000E+000	3	FAIL TO ISO LRG FP DISCH GIVEN FW BRK PRIOR FAIL 480V BUS
08-FP-ISOLL-F-HE	5.100E-002	3	FAIL TO ISO LRG FP DISCH GIVEN FW BRK PRIOR FAIL TDAFP
08-FP-ISOLLFD-HE	5.600E-001	3	FAIL TO ISOL FP WTRGIVEN FW BRK BEFOREFAILURE OF 4 KV BUS
08-FP-SMLD2F-HE	9.900E-002	3	FAIL TO ISO MOD FP DISCH GIVEN FW BRK PRIOR FAIL TDAFP
08-FP-SMLK-F-HE	5.200E-002	3	FAIL TO ISO MOD FP DISCH GIVEN FW BRK PRIOR FAIL 480V BUS
08-FP-SMLKDF-HE	9.900E-002	3	FAIL TO ISO MOD FP DISCH GIVEN FW BRK PRIOR FAIL 4 KV BUS
08-FP-TRIP-F-HE	6.300E-002	3	FAIL TO ISOL FIRE PROT WTR BEFORE FAILURE 480V BUS
08-FP-TRIPDF-HE	2.000E-001	3	FAILURE TO ISOLATE FIRE PROT WTR BEFORE FAIL TDAFP
08-FP-TRIPDF4HE	1.100E-001	3	FAILURE TO ISOLATE FIRE PROT WTR BEFORE FAIL 4KV BUS
08-FPISO29-F-HE	1.000E+000	3	ISOL FIRE PUMP DURING FLOOD EVENT - 29MINUTES
08-FPISO45-F-HE	6.600E-002	3	ISOL FIRE PUMP DURING FLOOD EVENT - 45MINUTES
08-FPISO56-F-HE	2.400E-002	3	ISOL FIRE PUMP DURING FLOOD EVENT - 56MINUTES
08-FPMS-ID-F-HE	1.100E-001	3	FAIL TO ISO LRG FP DISCH GIVEN SLB PRIOR FAIL 4 KV BUS
08-FPMS-ID2F-HE	2.000E-001	3	FAIL TO ISO LRG FP DISCH GIVEN SLB PRIOR FAIL TDAFP
08-FPMS-ISOF-HE	6.200E-002	3	FAIL TO ISO LRG FP DISCH GIVEN SLB PRIOR FAIL 480V BUS
08-FPMS-SMD2-HE	9.900E-002	3	FAIL TO ISO MOD FP DISCH GIVEN SLB PRIOR FAIL TDAFP
08-FPMS-SMDF-HE	9.900E-002	3	FAIL TO ISO MOD FP DISCH GIVEN SLB PRIOR FAIL 4 KV BUS
08-FPMS-SMLK-HE	5.200E-002	3	FAIL TO ISO MOD FP DISCH GIVEN SLB PRIOR FAIL 480V BUS
08-FPSISO100FHE	3.000E-002	3	Fail to Isolate Before Failure of any Buses STM Mod
08-FPSISO150FHE	3.000E-002	3	Fail to Isolate Before Failure of AFWP STM Mod
08-FPSISO170FHE	3.000E-002	3	Fail to Start MDAFPSTM Moderate
08-FPSISO1CF-HE	3.000E-002	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT(SM)-100 MIN
08-FPSISO29F-HE	4.500E-001	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 29 MIN.
08-FPSISO2CF-HE	3.000E-002	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT(SM)-150 MIN
08-FPSISO3CF-HE	3.000E-002	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT(SM)-170 MIN
08-FPSISO3HF-HE	1.700E-002	3	Fail to Start MDAFPSTM Moderate
08-FPSISO45F-HE	3.900E-002	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 45 MIN.

Table 11
Basic Event Descriptions (continued)

08-FPSISO56F-HE	3.000E-002	3	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 56 MIN.
08-ISO-FS120FHE	1.700E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 2 HR
08-ISO-FS18C-HE	1.000E+000	3	ISOLATE SPRINKLERS MOD FLOOD/CW EVENT IN 18 MIN
08-ISO-FS18F-HE	1.000E+000	3	ISOLATE SPRINKLERS LARGE FLOOD/FW EVENT IN 18 MIN
08-ISO-FS18FMHE	1.000E+000	3	ISOLATE SPRINKLERS MOD FLOOD/FW EVENT IN 18 MIN
08-ISO-FS18P-HE	1.000E+000	3	ISOLATE SPRINKLERS LARGE FLOOD/FP EVENT IN 18 MIN
08-ISO-FS18S-HE	1.000E+000	3	ISOLATE SPRINKLERS LARGE FLOOD/SW EVENT IN 18 MIN
08-ISO-FS18T-HE	1.000E+000	3	ISOLATE SPRINKLERS LARGE FLOOD/STM EVENT IN 18 MIN
08-ISO-FS18TMHE	1.000E+000	3	ISOLATE SPRINKLERS MOD FLOOD/STM EVENT IN 18 MIN
08-ISO-FS2HF-HE	1.700E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 2 HR.
08-ISO-FS33C-HE	2.200E-001	3	ISOLATE SPRINKLERS MOD FLOOD/CW EVENT IN 33 MIN
08-ISO-FS33F-HE	2.200E-001	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 33 MIN
08-ISO-FS33FMHE	2.200E-001	3	ISOLATE SPRINKLERS MOD FLOOD/FW EVENT IN 33 MIN
08-ISO-FS33P-HE	2.200E-001	3	ISOLATE SPRINKLERS LARGE FLOOD/FP EVENT IN 33 MIN
08-ISO-FS33S-HE	2.200E-001	3	ISOLATE SPRINKLERS LARGE FLOOD/SW EVENT IN 33 MIN
08-ISO-FS33T-HE	2.200E-001	3	ISOLATE SPRINKLERS LARGE FLOOD/STM EVENT IN 33 MIN
08-ISO-FS33TMHE	2.200E-001	3	ISOLATE SPRINKLERS MOD FLOOD/STM EVENT IN 33 MIN
08-ISO-FS40C-HE	6.700E-002	3	ISOLATE SPRINKLERS MOD FLOOD/CW EVENT IN 40 MIN
08-ISO-FS40F-HE	6.700E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 40 MIN
08-ISO-FS40FMHE	6.700E-002	3	ISOLATE SPRINKLERS MOD FLOOD/FW EVENT IN 40 MIN
08-ISO-FS40P-HE	6.700E-002	3	ISOLATE SPRINKLERS LARGE FLOOD/FP EVENT IN 40 MIN
08-ISO-FS40S-HE	6.700E-002	3	ISOLATE SPRINKLERS LARGE FLOOD/SW EVENT IN 40 MIN
08-ISO-FS40T-HE	6.700E-002	3	ISOLATE SPRINKLERS LARGE FLOOD/STM EVENT IN 40 MIN
08-ISO-FS40TMHE	6.700E-002	3	ISOLATE SPRINKLERS MOD FLOOD/STM EVENT IN 40 MIN
08-ISO-FS54C-HE	3.000E-002	3	ISOLATE SPRINKLERS MOD FLOOD/CW EVENT IN 54 MIN
08-ISO-FS54F-HE	3.000E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 54 MIN.
08-ISO-FS54S-HE	3.000E-002	3	ISOLATE SPRINKLERS LARGE FLOOD/SW EVENT IN 54 MIN
08-ISO-FS55F-HE	3.000E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT (SM) - 55 MIN.
08-ISO-FS97F-HE	3.000E-002	3	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT (SM) - 97 MIN.
08-ISO-VLV50-HE	1.000E-002	3	FAILURE TO ISOLATE FIRE PROT LINE BRK IN DG ROOM
08-LFP-CO2-F-HE-	1.990E-002	3	
08-LFP-DGA-F-HE-	1.990E-002	3	FAILURE TO ISOLATE FIRE PROT LINE BRK IN DG ROOM
09-ISO-FS18P-HE	0.000E+000	2	ISOLATE SPRINKLERS LARGE FLOOD/FP EVENT IN 18 MIN
10--MAN-EDG--HE	8.400E-004	3	OPERATOR FAILS TO START AND LOAD DIESEL MANUALLY
10-BY-TDGB---OP	1.782E-005	4	TSC DIESEL STARTUP BATTERY FAILURE
10-DGA-DSP---HE	1.115E-002	3	OPERATOR FAILS TO START AND LOAD DIESEL FROM DSP
10-DGB-MAN---HE	5.010E-002	3	OPERATOR FAILS TO START AND LOAD DIESEL MANUALLY
10-GE-DG1A---AE	1.629E-003	3	OPERATOR FAILS TO RESTORE DG A AFTER TEST
10-GE-DG1A---PR	3.904E-002	4	INDEPENDENT FAILUREDIESEL GENERATOR A FAILS TO RUN
10-GE-DG1A---PS	5.627E-003	3	INDEPENDENT FAILUREDIESEL GENERATOR A FAILS TO START
10-GE-DG1A---TM	1.330E-002	3	DIESEL GENERATOR A UNAVAILABLE DUE TO TEST OR MAINTENANCE
10-GE-DG1B---AE	1.629E-003	3	OPERATOR FAILS TO RESTORE DG B AFTER TEST
10-GE-DG1B---PR	3.904E-002	4	INDEPENDENT FAILUREDIESEL GENERATOR B FAILS TO RUN
10-GE-DG1B---PS	5.627E-003	3	INDEPENDENT FAILUREDIESEL GENERATOR B FAILS TO START
10-GE-DG1B---TM	1.180E-002	3	DIESEL GENERATOR B UNAVAILABLE DUE TO TEST OR MAINTENANCE
10-GE-TSC-DG-AE	8.558E-003	3	OPERATOR FAILS TO RESTORE TSC DIESEL AFTER TEST
10-GE-TSC-DG-PR	3.587E-002	4	TSC DIESEL GENERATOR FAILS TO RUN
10-GE-TSC-DG-PS	7.610E-003	3	TSC DIESEL GENERATOR FAILS TO START

Table 11
Basic Event Descriptions (continued)

10-GE-TSC-DG-TM	1.470E-002	3	TSC DG UNAVAILABLE DUE TO TEST OR MAINTENANCE
10-GERKPRCCF12	3.010E-003	4	DOUBLE COMMON CAUSE FAILURE (CCF)10-GERKPRCCF12
10-GESKPSCCF12	3.410E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)10-GESKPSCCF12
10-SS-28265--OP	2.999E-007	3	INDEPENDENT FAILUREDIESEL GENERATOR A SPEED SENSITIVE SW
10-SS-28266--OP	2.999E-007	3	INDEPENDENT FAILUREDIESEL GENERATOR B SPEED SENSITIVE SW
10-SS-KOPCCF12	7.050E-009	3	DOUBLE COMMON CAUSE FAILURE (CCF)10-SS-KOPCCF12
14-AD-CHAN-1-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 1 COMPARATOR FAILS
14-AD-CHAN-2-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 2 COMPARATOR FAILS
14-AD-CHAN-3-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 3 COMPARATOR FAILS
14-AD-KFACCF12	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AD-KFACCF12
14-AD-KFACCF123	1.440E-006	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-AD-KFACCF123
14-AD-KFACCF13	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AD-KFACCF13
14-AD-KFACCF23	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AD-KFACCF23
14-AM-CHAN-1-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 1 R/I CONVERTER FAILS
14-AM-CHAN-2-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 2 R/I CONVERTER FAILS
14-AM-CHAN-3-FA	1.116E-004	4	INDEPENDENT FAILURECHANNEL 3 R/I CONVERTER FAILS
14-AM-KFACCF12	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AM-KFACCF12
14-AM-KFACCF123	1.440E-006	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-AM-KFACCF123
14-AM-KFACCF13	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AM-KFACCF13
14-AM-KFACCF23	6.780E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-AM-KFACCF23
14-CN-ABZXA--RC	2.999E-004	3	INDEPENDENT FAILURETRAIN A BOUNDARY DAMPER RELAY ABZXA
14-CN-ABZXB--RC	2.999E-004	3	INDEPENDENT FAILURETRAIN B BOUNDARY DAMPER RELAY ABZXB
14-CN-KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CN-KRCCCF12
14-CN-SE-A/A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SE-A/A CONTACTS FAIL
14-CN-SE-A/B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SE-A/B CONTACTS FAIL
14-CN-SE10X--RC	2.999E-004	3	INDEPENDENT FAILURERELAY SE10X CONTACTS FAIL
14-CN-SE20X--RC	2.999E-004	3	INDEPENDENT FAILURERELAY SE20X CONTACTS FAIL
14-CN26XA/T1-RC	2.999E-004	3	INDEPENDANT FAILURERELAY 26XA/T1 CONTACTS FAIL
14-CN26XA/T2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 26XA/T2 CONTACTS FAIL
14-CN26XA/T3-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 26XA/T3 CONTACTS FAIL
14-CN26XB/T1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 26XB/T1 CONTACTS FAIL
14-CN26XB/T2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 26XB/T2 CONTACTS FAIL
14-CN26XB/T3-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 26XB/T3 CONTACTS FAIL
14-CNAKRCCC12345	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T12 CNF
14-CNAKRCCC12346	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T13 CNF
14-CNAKRCCC12356	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T23 CNF
14-CNAKRCCC12456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T123 CNF
14-CNAKRCCC13456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T123 CNF
14-CNAKRCCC23456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T123 CNF
14-CNAKRCCCF1-6	3.691E-006	3	GLOBAL FAILURE OF CONTACTS26XA/T123,B/T123
14-CNAKRCCCF12	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XA/T2 CNF
14-CNAKRCCCF123	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T123 CNF
14-CNAKRCCCF1234	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T1 CNF

Table 11
Basic Event Descriptions (continued)

14-CNAKRCCCF1235	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T2 CNF
14-CNAKRCCCF1236	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T3 CNF
14-CNAKRCCCF124	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T1 CNF
14-CNAKRCCCF1245	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T12 CNF
14-CNAKRCCCF1246	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T13 CNF
14-CNAKRCCCF125	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T2 CNF
14-CNAKRCCCF1256	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T23 CNF
14-CNAKRCCCF126	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T3 CNF
14-CNAKRCCCF13	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XA/T3 CNF
14-CNAKRCCCF134	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T1 CNF
14-CNAKRCCCF1345	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T12 CNF
14-CNAKRCCCF1346	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T13 CNF
14-CNAKRCCCF135	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,A/T2 CNF
14-CNAKRCCCF1356	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T23 CNF
14-CNAKRCCCF136	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,A/T3 CNF
14-CNAKRCCCF14	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T1 CNF
14-CNAKRCCCF145	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T12 CNF
14-CNAKRCCCF1456	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T123 CNF
14-CNAKRCCCF146	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T13 CNF
14-CNAKRCCCF15	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T2 CNF
14-CNAKRCCCF156	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T23 CNF
14-CNAKRCCCF16	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T3 CNF
14-CNAKRCCCF23	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XA/T3 CNF
14-CNAKRCCCF234	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T1 CNF
14-CNAKRCCCF2345	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T12 CNF
14-CNAKRCCCF2346	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T13 CNF
14-CNAKRCCCF235	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T2 CNF
14-CNAKRCCCF2356	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T23 CNF
14-CNAKRCCCF236	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T3 CNF
14-CNAKRCCCF24	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T1 CNF
14-CNAKRCCCF245	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T12 CNF
14-CNAKRCCCF2456	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T123 CNF
14-CNAKRCCCF246	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T13 CNF
14-CNAKRCCCF25	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XB/T2 CNF
14-CNAKRCCCF256	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T23 CNF

Table 11
Basic Event Descriptions (continued)

14-CNAKRCCCF26 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XB/T3
14-CNAKRCCCF34 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T1
14-CNAKRCCCF345	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T12 CNF
14-CNAKRCCCF3456 CNF	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T123
14-CNAKRCCCF346	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T13 CNF
14-CNAKRCCCF35 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T2
14-CNAKRCCCF356	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T23 CNF
14-CNAKRCCCF36 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T3
14-CNAKRCCCF45 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T1,26XB/T2
14-CNAKRCCCF456	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XB/T123 CNF
14-CNAKRCCCF46 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T1,26XB/T3
14-CNAKRCCCF56 CNF	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T2,26XB/T3
14-CNMKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 14-CNMKRCCCF1-4
14-CNMKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF12
14-CNMKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF123
14-CNMKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF124
14-CNMKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF13
14-CNMKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF134
14-CNMKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF14
14-CNMKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF23
14-CNMKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF234
14-CNMKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF24
14-CNMKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-CNMKRCCCF34
14-DM-ACC10--FC	3.000E-003	3	INDEPENDENT FAILUREDAMPER ACC-10 FAIL TO CLOSE
14-DM-ACC11--FC	3.000E-003	3	INDEPENDENT FAILUREDAMPER ACC-11 FAIL TO CLOSE
14-DM-KFCCCF12 FTC	1.410E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)ACC-10, ACC-11
14-DM-TAV21--OC	7.198E-006	4	DAMPER TAV-21 TRANSFERS CLOSED
14-DM-TAV22--OC	7.198E-006	4	DAMPER TAV-22 TRANSFERS CLOSED
14-RE-ABZXA2-RF ABZXA2	1.859E-004	4	INDEPENDENT FAILURETRAIN A BOUNDARY DAMPER RELAY
14-RE-ABZXB3-RF ABZXB3	1.859E-004	4	INDEPENDENT FAILURETRAIN B BOUNDARY DAMPER RELAY
14-RE-KRFCCF12 ABZXA2,ABZXB3	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)RELAY
14-RE-SE-A/A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SE-A/A FAILS TO OPERATE
14-RE-SE-A/B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SE-A/B FAILS TO OPERATE
14-RE-SE10X--RF	1.859E-004	4	INDEPENDENT FAILURERELAY SE10X FAILS TO OPERATE
14-RE-SE20X--RF	1.859E-004	4	INDEPENDENT FAILURERELAY SE20X FAILS TO OPERATE
14-RE26XA/T1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XA/T1 FAILSTO OPERATE
14-RE26XA/T2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XA/T2 FAILSTO OPERATE
14-RE26XA/T3-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XA/T3 FAILSTO OPERATE
14-RE26XB/T1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XB/T1 FAILSTO OPERATE
14-RE26XB/T2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XB/T2 FAILSTO OPERATE
14-RE26XB/T3-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 26XB/T3 FAILSTO OPERATE
14-REAKRFCC12345 (CCF)26XA/T123,B/T12 FLR	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE

Table 11
Basic Event Descriptions (continued)

14-REAKRFCC12346	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T13 FLR
14-REAKRFCC12356	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T23 FLR
14-REAKRFCC12456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T123 FLR
14-REAKRFCC13456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T123 FLR
14-REAKRFCC23456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T123 FLR
14-REAKRFCCF1-6	1.147E-006	3	GLOBAL FAILURE OF RELAYS 26XA/T123,B/T123
14-REAKRFCCF12	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XA/T2 FLR
14-REAKRFCCF123	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T123 FLR
14-REAKRFCCF1234	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T1 FLR
14-REAKRFCCF1235	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T2 FLR
14-REAKRFCCF1236	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T123,B/T3 FLR
14-REAKRFCCF124	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T1 FLR
14-REAKRFCCF1245	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T12 FLR
14-REAKRFCCF1246	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T13 FLR
14-REAKRFCCF125	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T2 FLR
14-REAKRFCCF1256	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T23 FLR
14-REAKRFCCF126	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T12,B/T3 FLR
14-REAKRFCCF13	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XA/T3 FLR
14-REAKRFCCF134	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T1 FLR
14-REAKRFCCF1345	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T12 FLR
14-REAKRFCCF1346	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T13 FLR
14-REAKRFCCF135	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T2 FLR
14-REAKRFCCF1356	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T23 FLR
14-REAKRFCCF136	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T13,B/T3 FLR
14-REAKRFCCF14	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T1 FLR
14-REAKRFCCF145	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T12 FLR
14-REAKRFCCF1456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T123 FLR
14-REAKRFCCF146	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T13 FLR
14-REAKRFCCF15	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T2 FLR
14-REAKRFCCF156	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T1,B/T23 FLR
14-REAKRFCCF16	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T1,26XB/T3 FLR
14-REAKRFCCF23	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XA/T3 FLR
14-REAKRFCCF234	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T1 FLR
14-REAKRFCCF2345	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T12 FLR

Table 11
Basic Event Descriptions (continued)

14-REAKRFCCF2346	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T13 FLR
14-REAKRFCCF235	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T2 FLR
14-REAKRFCCF2356	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T23 FLR
14-REAKRFCCF236	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T23,B/T3 FLR
14-REAKRFCCF24	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XB/T1 FLR
14-REAKRFCCF245	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T12 FLR
14-REAKRFCCF2456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T123 FLR
14-REAKRFCCF246	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T13 FLR
14-REAKRFCCF25	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XB/T2 FLR
14-REAKRFCCF256	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T2,B/T23 FLR
14-REAKRFCCF26	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T2,26XB/T3 FLR
14-REAKRFCCF34	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T1 FLR
14-REAKRFCCF345	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T12 FLR
14-REAKRFCCF3456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T123 FLR
14-REAKRFCCF346	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T16 FLR
14-REAKRFCCF35	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T2 FLR
14-REAKRFCCF356	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XA/T3,B/T23 FLR
14-REAKRFCCF36	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XA/T3,26XB/T3 FLR
14-REAKRFCCF45	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T1,26XB/T2 FLR
14-REAKRFCCF456	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)26XB/T123 FLR
14-REAKRFCCF46	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T1,26XB/T3 FLR
14-REAKRFCCF56	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)26XB/T2,26XB/T3 FLR
14-REMKRFCCF1-4	1.730E-006	4	GLOBAL FAILURE OF 14-REMKRFCCF1-4
14-REMKRFCCF12	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF12
14-REMKRFCCF123	3.130E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF123
14-REMKRFCCF124	3.130E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF124
14-REMKRFCCF13	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF13
14-REMKRFCCF134	3.130E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF134
14-REMKRFCCF14	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF14
14-REMKRFCCF23	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF23
14-REMKRFCCF234	3.130E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF234
14-REMKRFCCF24	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF24
14-REMKRFCCF34	6.600E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-REMKRFCCF34
14-SV-33439--OC	1.200E-005	4	SOV 33439 TRANSFER CLOSED
14-SV-33440--OC	1.200E-005	4	SOV 33440 TRANSFER CLOSED
14-SV-33443--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33443 FAILS TO OPEN
14-SV-33444--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33444 FAILS TO OPEN
14-SV-KFOCCF12	2.350E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)14-SV-KFOCCF12
14-TT-CHAN-1-FA	1.115E-003	4	INDEPENDENT FAILURECHANNEL 1 RTD FAILS
14-TT-CHAN-2-FA	1.115E-003	4	INDEPENDENT FAILURECHANNEL 2 RTD FAILS
14-TT-CHAN-3-FA	1.115E-003	4	INDEPENDENT FAILURECHANNEL 3 RTD FAILS
14-TT-KFACCF12	6.780E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-TT-KFACCF12
14-TT-KFACCF123	1.440E-005	4	TRIPLE COMMON CAUSE FAILURE (CCF)14-TT-KFACCF123

Table 11
Basic Event Descriptions (continued)

14-TT-KFACCF13	6.780E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-TT-KFACCF13
14-TT-KFACCF23	6.780E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)14-TT-KFACCF23
16-BATCLG--F-HE	7.900E-002	3	Establish Battery Room Cooling - Flood
16-DM-KFOCCF12	1.410E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-DM-KFOCCF12
16-DM-KOCCCF12	1.690E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)TAV-FD-18/20 TRN CL
16-DM-TAV20--OC	7.198E-006	4	DAMPER TAV-20 TRANSFERS CLOSED
16-DM-TAV2A--OC	7.198E-006	4	INDEPENDENT FAILUREDAMPER TAV-2A TRANSFERS CLOSED
16-DM-TAV2B--OC	7.198E-006	4	INDEPENDENT FAILUREDAMPER TAV-2B TRANSFERS CLOSED
16-DM-TAV2C--OC	7.198E-006	4	INDEPENDENT FAILUREDAMPER TAV-2C TRANSFERS CLOSED
16-DM-TAV60A-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER TAV-60A FAILS TO OPEN
16-DM-TAV60B-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER TAV-60B FAILS TO OPEN
16-DM-TAV62A-OC	1.288E-006	4	DAMPER TAV-62A TRANSFERS CLOSED
16-DM-TAV62B-OC	1.288E-006	4	DAMPER TAV-62B TRANSFERS CLOSED
16-DM-TAV63A-FO	3.000E-003	3	DAMPER TAV-63A FAILS TO OPEN
16-DMSKOCCCF12	4.360E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)TAV-2A/B TRN CLSD
16-DMSKOCCCF123	9.290E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)TAV-2A/B/C TRN CLS
16-DMSKOCCCF13	4.360E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)TAV-2A/C TRN CLSD
16-DMSKOCCCF23	4.360E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)TAV-2B/C TRN CLSD
16-DMTAVFD16-OC	7.198E-006	4	DAMPER TAV-FD-16 TRANSFERS CLOSED
16-DMTAVFD17-OC	7.198E-006	4	DAMPER TAV-FD-17 TRANSFERS CLOSED
16-DMTAVFD18-OC	7.198E-006	4	INDEPENDENT FAILUREDAMPER TAV-FD-18 TRANSFERS CLOSED
16-DMTAVFD20-OC	7.198E-006	4	INDEPENDENT FAILUREDAMPER TAV-FD-20 TRANSFERS CLOSED
16-DMTAVFD21-OC	7.198E-006	4	DAMPER TAV-FD-21 TRANSFERS CLOSED
16-FN-AFP1A--PL	7.198E-006	4	INDEPENDENT FAILUREAFW PUMP A FAN COILUNIT PLUGGED
16-FN-AFP1A--PR	5.506E-004	4	INDEPENDENT FAILUREAFW PUMP A FAN COILUNIT FAILS TO RUN
16-FN-AFP1A--PS	9.886E-004	3	INDEPENDENT FAILUREAFW PUMP A FAN COILUNIT FAILS TO START
16-FN-BRFC1A-PL	7.198E-006	4	INDEPENDENT FAILUREBATTERY ROOM FCU A PLUGGED
16-FN-BRFC1A-PR	5.506E-004	4	INDEPENDENT FAILUREBATTERY ROOM FAN COIL UNIT A FTR
16-FN-BRFC1A-PS	9.886E-004	3	INDEPENDENT FAILUREBATTERY ROOM FAN COIL UNIT A FTS
16-FN-BRFC1B-PL	7.198E-006	4	INDEPENDENT FAILUREBATTERY ROOM FCU B PLUGGED
16-FN-BRFC1B-PR	5.506E-004	4	INDEPENDENT FAILUREBATTERY ROOM FAN COIL UNIT B FTR
16-FN-BRFC1B-PS	9.886E-004	3	INDEPENDENT FAILUREBATTERY ROOM FAN COIL UNIT B FTS
16-FN-DGAF---PR	5.283E-005	4	INDEPENDENT FAILUREDIESEL ROOM A SUPPLY FAN FTR
16-FN-DGAF---PS	3.940E-003	3	INDEPENDENT FAILUREDIESEL ROOM A SUPPLY FAN FTS
16-FN-DGBF---PR	5.283E-005	4	INDEPENDENT FAILUREDIESEL ROOM B SUPPLY FAN FTR
16-FN-DGBF---PS	3.940E-003	3	INDEPENDENT FAILUREDIESEL ROOM B SUPPLY FAN FTS
16-FN-TBB1B--PL	7.198E-006	4	INDEPENDENT FAILURETURB BLDG BSMT FCU B PLUGGED
16-FN-TBB1B--PR	5.506E-004	4	INDEPENDENT FAILURETURB BLDG BSMT FAN COIL UNIT B FTR
16-FN-TBB1B--PS	9.886E-004	3	INDEPENDENT FAILURETURB BLDG BSMT FAN COIL UNIT B FTS
16-FNAKPLCCF12	3.620E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNAKPLCCF12
16-FNAKPRCCF12	7.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNAKPRCCF12
16-FNAKPSCCF12	1.290E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNAKPSCCF12
16-FNBKPLCCF12	3.620E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNBKPLCCF12
16-FNBKPRCCF12	7.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNBKPRCCF12

Table 11
Basic Event Descriptions (continued)

16-FNBKPSCCF12	1.290E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNBKPSCCF12
16-FNBREXF1A-PR	2.952E-004	4	INDEPENDENT FAILUREBATTERY ROOM EXHAUST FAN A FTR
16-FNBREXF1A-PS	3.940E-003	3	INDEPENDENT FAILUREBATTERY ROOM EXHAUST FAN A FTS
16-FNBREXF1B-PR	2.952E-004	4	INDEPENDENT FAILUREBATTERY ROOM EXHAUST FAN B FTR
16-FNBREXF1B-PS	3.940E-003	3	INDEPENDENT FAILUREBATTERY ROOM EXHAUST FAN B FTS
16-FNDKPRCCF12	6.860E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNDKPRCCF12
16-FNDKPSCCF12	5.120E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNDKPSCCF12
16-FNEKPRCCF12	3.840E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNEKPRCCF12
16-FNEKPSCCF12	5.120E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNEKPSCCF12
16-FNTBSF1A--PR FTR	2.952E-004	4	INDEPENDENT FAILURETURBINE BUILDING SUPPLY FAN A
16-FNTBSF1B--PR FTR	2.952E-004	4	INDEPENDENT FAILURETURBINE BUILDING SUPPLY FAN B
16-FNTBSF1C--PR FTR	2.952E-004	4	INDEPENDENT FAILURETURBINE BUILDING SUPPLY FAN C
16-FNTKPRCCF12	9.280E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNTKPRCCF12
16-FNTKPRCCF123	1.980E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)16-FNTKPRCCF123
16-FNTKPRCCF13	9.280E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNTKPRCCF13
16-FNTKPRCCF23	9.280E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-FNTKPRCCF23
16-MV-KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-MV-KFOCCF12
16-MV-SW720A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-720A FAILS TO OPEN
16-MV-SW720B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SW-720B FAILS TO OPEN
16-SV-33278--OC	1.200E-005	4	SOV 33278 TRANSFERSCLOSED
16-TS-KOPCCF12	1.410E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)16-TS-KOPCCF12
16-TSTS16233-OP FAILS	2.999E-007	3	INDEPENDENT FAILURETEMPERATURE SWITCH TS-16233
16-TSTS16234-OP FAILS	2.999E-007	3	INDEPENDENT FAILURETEMPERATURE SWITCH TS-16234
17-DMACAFD-5-OC	7.198E-006	4	DAMPER ACA-FD-5 TRANSFERS CLOSED
17-DMACAFD15-OC	7.198E-006	4	DAMPER ACA-FD-15 TRANSFERS CLOSED
17-FN-ABB1A--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG BSMT FCU A PLUGGED
17-FN-ABB1A--PR FTR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT A
17-FN-ABB1A--PS FTS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT A
17-FN-ABB1B--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG BSMT FCU B PLUGGED
17-FN-ABB1B--PR FTR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT B
17-FN-ABB1B--PS FTS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT B
17-FN-ABB1C--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG BSMT FCU C PLUGGED
17-FN-ABB1C--PR FTR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT C
17-FN-ABB1C--PS FTS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT C
17-FN-ABB1D--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG BSMT FCU D PLUGGED
17-FN-ABB1D--PR FTR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT D
17-FN-ABB1D--PS FTS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG BSMT FAN COIL UNIT D
17-FN-ABM1A--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG MEZZ FCU A PLUGGED
17-FN-ABM1A--PR FTR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG MEZZ FAN COIL UNIT A
17-FN-ABM1A--PS FTS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG MEZZ FAN COIL UNIT A
17-FN-ABM1B--PL	7.198E-006	4	INDEPENDENT FAILUREAUX BLDG MEZZ FCU B PLUGGED

Table 11
Basic Event Descriptions (continued)

17-FN-ABM1B--PR	5.506E-004	4	INDEPENDENT FAILUREAUX BLDG MEZZ FAN COIL UNIT B FTR
17-FN-ABM1B--PS	9.886E-004	3	INDEPENDENT FAILUREAUX BLDG MEZZ FAN COIL UNIT B FTS
17-FN-CCWP1B-PL	7.198E-006	4	COMPONENT COOLING PUMP B FAN COIL UNIT PLUGGED
17-FN-CCWP1B-PR	5.506E-004	4	COMPONENT COOLING PUMP B FAN COIL UNIT FAILS TO RUN
17-FN-CCWP1B-PS	9.886E-004	3	COMPONENT COOLING PUMP B FAN COIL UNIT FAILS TO START
17-FN1KPLCCF12	3.620E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN1KPLCCF12
17-FN2KPRCCF12	7.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN2KPRCCF12
17-FN3KPSCCF12	1.290E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN3KPSCCF12
17-FN4KPLCCF12	3.620E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN4KPLCCF12
17-FN5KPRCCF12	7.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN5KPRCCF12
17-FN6KPSCCF12	1.280E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FN6KPSCCF12
17-FNPKPLCCF1-4	3.320E-006	3	GLOBAL FAILURE OF 17-FNPKPLCCF1-4
17-FNPKPLCCF12	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF12
17-FNPKPLCCF123	2.950E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF123
17-FNPKPLCCF124	2.950E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF124
17-FNPKPLCCF13	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF13
17-FNPKPLCCF134	2.950E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF134
17-FNPKPLCCF14	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF14
17-FNPKPLCCF23	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF23
17-FNPKPLCCF234	2.950E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF234
17-FNPKPLCCF24	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF24
17-FNPKPLCCF34	2.470E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNPKPLCCF34
17-FNPMPPITA-PL	7.198E-006	4	INDEPENDENT FAILURERHR PUMP PIT FCU A PLUGGED
17-FNPMPPITA-PR	5.506E-004	4	INDEPENDENT FAILURERHR PUMP PIT FAN COIL UNIT A FTR
17-FNPMPPITA-PS	9.886E-004	3	INDEPENDENT FAILURERHR PUMP PIT FAN COIL UNIT A FTS
17-FNPMPPITB-PL	7.198E-006	4	INDEPENDENT FAILURERHR PUMP PIT FCU B PLUGGED
17-FNPMPPITB-PR	5.506E-004	4	INDEPENDENT FAILURERHR PUMP PIT FAN COIL UNIT B FTR
17-FNPMPPITB-PS	9.886E-004	3	INDEPENDENT FAILURERHR PUMP PIT FAN COIL UNIT B FTS
17-FNRKPRCCF1-4	2.660E-005	3	GLOBAL FAILURE OF 17-FNRKPRCCF1-4
17-FNRKPRCCF12	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF12
17-FNRKPRCCF123	4.820E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF123
17-FNRKPRCCF124	4.820E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF124
17-FNRKPRCCF13	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF13
17-FNRKPRCCF134	4.820E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF134
17-FNRKPRCCF14	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF14
17-FNRKPRCCF23	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF23
17-FNRKPRCCF234	4.820E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF234
17-FNRKPRCCF24	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF24
17-FNRKPRCCF34	1.020E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNRKPRCCF34
17-FNSKPSCCF1-4	4.780E-005	3	GLOBAL FAILURE OF 17-FNSKPSCCF1-4
17-FNSKPSCCF12	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF12
17-FNSKPSCCF123	8.660E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF123
17-FNSKPSCCF124	8.660E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF124
17-FNSKPSCCF13	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF13
17-FNSKPSCCF134	8.660E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF134
17-FNSKPSCCF14	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF14
17-FNSKPSCCF23	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF23
17-FNSKPSCCF234	8.660E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF234

Table 11
Basic Event Descriptions (continued)

17-FNSKPSCCF24	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF24
17-FNSKPSCCF34	1.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-FNSKPSCCF34
17-SV-SW1261-FO	4.999E-004	3	SOV SW-1261 FAILS TO OPEN
17-TS-KOPCCF12	1.410E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)17-TS-KOPCCF12
17-TSTS16391-OP	2.999E-007	3	FAILURE OF TEMPERATURE SWITCH TS-16391
18-AVLOCA100BFC	4.758E-004	3	AOV LOCA-100B FAILSTO CLOSE
18-AVLOCA201BFC	4.758E-004	3	AOV LOCA-201B FAILSTO CLOSE
18-CVSA7004B-FC	9.999E-004	3	CHECK VALVE SA-7004B FAILS TO CLOSE
18-DC--PQ945-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-945 FAILS
18-DC--PQ946-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-946 FAILS
18-DC--PQ947-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-947 FAILS
18-DC--PQ948-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-948 FAILS
18-DC--PQ949-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-949 FAILS
18-DC--PQ950-FA	1.900E-004	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-950 FAILS
18-DC1KFACCF12	4.470E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-945/PQ-946 FAIL
18-DC2KFACCF12	4.470E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-947/PQ-948 FAIL
18-DC3KFACCF12	4.470E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-949/PQ-950 FAIL
18-DM-KFOCCF1-4	5.580E-005	3	GLOBAL FAILURE OF 18-DM-KFOCCF1-4
18-DM-KFOCCF12	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF12
18-DM-KFOCCF123	1.010E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF123
18-DM-KFOCCF124	1.010E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF124
18-DM-KFOCCF13	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF13
18-DM-KFOCCF134	1.010E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF134
18-DM-KFOCCF14	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF14
18-DM-KFOCCF23	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF23
18-DM-KFOCCF234	1.010E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF234
18-DM-KFOCCF24	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF24
18-DM-KFOCCF34	2.130E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-DM-KFOCCF34
18-DMRBV150A-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER RBV-150A FAILS TO OPEN
18-DMRBV150B-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER RBV-150B FAILS TO OPEN
18-DMRBV150C-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER RBV-150C FAILS TO OPEN
18-DMRBV150D-FO	3.000E-003	3	INDEPENDENT FAILUREDAMPER RBV-150D FAILS TO OPEN
18-FCU-DSP---HE	1.890E-002	3	OPERATOR FAILS TO START CNTMNT FAN COIL UNITS FROM DSP
18-FCU-MAN---HE	2.400E-002	3	OPERATOR FAILS TO START CNTMNT FAN COIL UNITS MANUALLY
18-FN-FCU1A--PR	6.283E-005	4	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT A FAILS
18-FN-FCU1A--PS	2.037E-003	3	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT A FAILS
18-FN-FCU1A--TM	4.980E-004	3	CFCU A UNAVAILABLE DUE TO TEST OR MAINTENANCE
18-FN-FCU1B--PR	6.283E-005	4	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT B FAILS
18-FN-FCU1B--PS	2.037E-003	3	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT B FAILS
18-FN-FCU1B--TM	2.880E-004	3	CFCU B UNAVAILABLE DUE TO TEST OR MAINTENANCE
18-FN-FCU1C--PR	6.283E-005	4	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT C FAILS
18-FN-FCU1C--PS	2.037E-003	3	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT C FAILS
18-FN-FCU1C--TM	1.480E-003	3	CFCU C UNAVAILABLE DUE TO TEST OR MAINTENANCE
18-FN-FCU1D--PR	6.283E-005	4	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT D FAILS

Table 11
Basic Event Descriptions (continued)

18-FN-FCU1D--PS	2.037E-003	3	INDEPENDENT FAILURECONTAINMENT FAN COIL UNIT D FAILS
18-FN-FCU1D--TM	1.070E-003	3	CFCU D UNAVAILABLE DUE TO TEST OR MAINTENANCE
18-FNRKPRCCF1-4	3.040E-006	4	GLOBAL FAILURE OF 18-FNRKPRCCF1-4
18-FNRKPRCCF12	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF12
18-FNRKPRCCF123	5.500E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF123
18-FNRKPRCCF124	5.500E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF124
18-FNRKPRCCF13	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF13
18-FNRKPRCCF134	5.500E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF134
18-FNRKPRCCF14	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF14
18-FNRKPRCCF23	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF23
18-FNRKPRCCF234	5.500E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF234
18-FNRKPRCCF24	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF24
18-FNRKPRCCF34	1.160E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNRKPRCCF34
18-FNSKPSCCF1-4	9.860E-005	3	GLOBAL FAILURE OF 18-FNSKPSCCF1-4
18-FNSKPSCCF12	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF12
18-FNSKPSCCF123	1.790E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF123
18-FNSKPSCCF124	1.790E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF124
18-FNSKPSCCF13	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF13
18-FNSKPSCCF134	1.790E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF134
18-FNSKPSCCF14	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF14
18-FNSKPSCCF23	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF23
18-FNSKPSCCF234	1.790E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF234
18-FNSKPSCCF24	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF24
18-FNSKPSCCF34	3.770E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-FNSKPSCCF34
18-MV-LOCA2B-FC	1.905E-003	3	MOV LOCA-2B FAILS TO CLOSE
18-MVSA7003B-FC	1.905E-003	3	MOV SA-7003B FAILS TO CLOSE
18-SV-33809--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33809 FAILS TO CLOSE
18-SV-33810--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33810 FAILS TO CLOSE
18-SV-33811--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33811 FAILS TO CLOSE
18-SV-33812--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33812 FAILS TO CLOSE
18-SV-KFCCCF1-4	9.300E-006	3	GLOBAL FAILURE OF 18-SV-KFCCCF1-4
18-SV-KFCCCF12	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF12
18-SV-KFCCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF123
18-SV-KFCCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF124
18-SV-KFCCCF13	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF13
18-SV-KFCCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF134
18-SV-KFCCCF14	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF14
18-SV-KFCCCF23	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF23
18-SV-KFCCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF234
18-SV-KFCCCF24	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF24
18-SV-KFCCCF34	3.550E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)18-SV-KFCCCF34
18-TP--PT945-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-945
18-TP--PT946-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-946
18-TP--PT947-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-947
18-TP--PT948-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-948
18-TP--PT949-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-949
18-TP--PT950-FA	5.698E-005	4	INDEPENDENT FAILUREPRESSURE TRANSMITTER PT-950
18-TP1KFACCF12	1.340E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-945/PQ-946 FAIL
18-TP2KFACCF12	1.340E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-947/PQ-948 FAIL
18-TP3KFACCF12	1.340E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-949/PQ-950 FAIL
21-CV-FPC3A--FC	9.999E-004	3	CHECK VALVE FPC-3A FAILS TO CLOSE

Table 11
Basic Event Descriptions (continued)

21-CV-FPC3A--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FPC-3A FAILS TO OPEN
21-CV-FPC3B--FC	9.999E-004	3	CHECK VALVE FPC-3B FAILS TO CLOSE
21-CV-FPC3B--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE FPC-3B FAILS TO OPEN
21-CV-KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)FPC-3A, 3B FTO
21-CV-SW1501-FO	5.000E-005	3	CHECK VALVE SW-1501FAILS TO OPEN
21-DIASFPCL-MHE	2.800E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF SFP COOLING
21-DIASFPLK-MHE	4.499E-003	3	OPERATOR FAILS TO DIAGNOSE A LOSS OF SFP LEVEL
21-DIASFPSW-MHE	8.999E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF SFP COOLING (TSW)
21-FL-KPLCCF12	8.280E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SFPC FLTRS PLUGGED
21-FL-SFPCA--PL	1.200E-004	4	INDEPENDENT FAILURESPENT FUEL POOL FILTER A PLUGGED
21-FL-SFPCB--PL	1.200E-004	4	INDEPENDENT FAILURESPENT FUEL POOL FILTER B PLUGGED
21-FPCRCVR-BMHE	1.369E-001	3	OPERATOR FAILS TO RECOVER SPENT FUEL COOLING EARLY
21-FPCRCVR-DMHE	1.369E-001	3	OPERATOR FAILS TO RECOVER SPENT FUEL COOLING LATE
21-FPCREPR-B-HE	1.408E-001	3	OPERATOR FAILS TO REPAIR FPC BEFORE BOILING
21-HX-SFPC---PL	7.198E-006	4	SPENT FUEL POOL HEAT EXCHANGER PLUGGED
21-PLUGSFP--MHE	3.220E-002	3	OPERATOR FAILS TO BSFP FILTERS
21-PM-KPRCCF12	5.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SFPC PUMPS FTR
21-PM-KPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)SFPC FILTERS FTS
21-PM-SFPC1A-PR	8.159E-004	4	INDEPENDENT FAILURESPENT FUEL POOL COOLING PUMP A FTR
21-PM-SFPC1A-PS	1.400E-003	3	INDEPENDENT FAILURESPENT FUEL POOL COOLING PUMP A FTS
21-PM-SFPC1B-PR	8.159E-004	4	INDEPENDENT FAILURESPENT FUEL POOL COOLING PUMP B FTR
21-PM-SFPC1B-PS	1.400E-003	3	INDEPENDENT FAILURESPENT FUEL POOL COOLING PUMP B FTR
21-SFPRHRHX-MHE	5.920E-002	3	OPERATOR FAILS TO ALIGN SFP COOLING TO RHR HEAT EXCH.
21-SW-SFP-B-MHE	2.550E-002	3	OPERATOR FAILS TO ALIGN SW TO SFP FORMAKEUP BEFORE BOIL
21-SW-SFP-D-MHE	4.062E-003	3	OPERATOR FAILS TO ALIGN SW TO SFP FORMAKEUP BEFORE CD
21-XV-FPC100-FO	1.000E-004	3	MANUAL VALVE FPC-100 FAILS TO OPEN
21-XV-FPC300-FO	1.000E-004	3	MANUAL VALVE FPC-300 FAILS TO OPEN
21-XV-FPC301-FC	1.000E-004	3	MANUAL VALVE FPC-301 FAILS TO CLOSE
21-XV-FPC7---FC	1.000E-004	3	MANUAL VALVE FPC-7 FAILS TO CLOSE
21-XV-FPC8---FC	1.000E-004	3	MANUAL VALVE FPC-8 FAILS TO CLOSE
21-XV-FPC85--FO	1.000E-004	3	MANUAL VALVE FPC-85 FAILS TO OPEN
21-XV-SW1497-FO	1.000E-004	3	MANUAL VALVE SW-1497 FAILS TO OPEN
23--MAN-ICS--HE	6.436E-003	3	OPERATOR FAILS TO MANUALLY ACTUATE SPRAY
23--RWST-RHR-HE	1.229E-002	3	OPERATOR FAILS TO INITIATE ICS RECIRCULATION
23-AV-ICS201-FC	4.758E-004	3	INDEPENDENT FAILUREAOV ICS-201 FAILS TO CLOSE
23-AV-ICS202-FC	4.758E-004	3	INDEPENDENT FAILUREAOV ICS-202 FAILS TO CLOSE
23-AV-KFCCCF12	9.420E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-AV-KFCCCF12
23-CV--ICS3A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-3A FAILS TO CLOSE
23-CV--ICS3B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-3B FAILS TO CLOSE
23-CV--ICS8A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-8A FAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

23-CV--ICS8B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-8B FAILS TO OPEN
23-CV--ICS9A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-9A FAILS TO OPEN
23-CV--ICS9B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-9B FAILS TO OPEN
23-CV-ICS8A--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-8A FAILS TO CLOSE
23-CV-ICS8B--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-8B FAILS TO CLOSE
23-CV-ICS9A--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-9A FAILS TO CLOSE
23-CV-ICS9B--FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE ICS-9B FAILS TO CLOSE
23-CV3KFCCCF12	7.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CV3KFCCCF12
23-CVCKFCCCF1-4	5.100E-005	3	GLOBAL FAILURE OF 23-CVCKFCCCF1-4
23-CVCKFCCCF12	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF12
23-CVCKFCCCF123	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF123
23-CVCKFCCCF124	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF124
23-CVCKFCCCF13	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF13
23-CVCKFCCCF134	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF134
23-CVCKFCCCF14	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF14
23-CVCKFCCCF23	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF23
23-CVCKFCCCF234	5.550E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF234
23-CVCKFCCCF24	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF24
23-CVCKFCCCF34	1.780E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVCKFCCCF34
23-CVD-ICS4A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-4A FAILS TO OPEN
23-CVD-ICS4B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-4B FAILS TO OPEN
23-CVDKFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVDKFOCCF12
23-CVOKFOCCF1-4	8.530E-006	3	GLOBAL FAILURE OF 23-CVOKFOCCF1-4
23-CVOKFOCCF12	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF12
23-CVOKFOCCF123	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF123
23-CVOKFOCCF124	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF124
23-CVOKFOCCF13	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF13
23-CVOKFOCCF134	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF134
23-CVOKFOCCF14	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF14
23-CVOKFOCCF23	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF23
23-CVOKFOCCF234	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF234
23-CVOKFOCCF24	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF24
23-CVOKFOCCF34	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVOKFOCCF34
23-CVRHR401A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-401A FAILS TO
23-CVRHR401B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-401B FAILS TO
23-CVRKFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVRKFOCCF12
23-CVS-ICS3A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-3A FAILS TO OPEN
23-CVS-ICS3B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE ICS-3B FAILS TO OPEN
23-CVSKFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-CVSKFOCCF12
23-HX-GSC1A--PL	7.198E-006	4	INDEPENDENT FAILUREICS PUMP A GLAND COOLER FAILURE
23-HX-GSC1B--PL	7.198E-006	4	INDEPENDENT FAILUREICS PUMP B GLAND COOLER FAILURE
23-HX-KPLCCF12	3.620E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-HE-KPLCCF12
23-MV--ICS2A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV ICS-2A FAILS TOCLOSE
23-MV--ICS2B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV ICS-2B FAILS TOCLOSE
23-MV--ICS5A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV ICS-5A FAILS TOOPEN

Table 11
Basic Event Descriptions (continued)

23-MV--ICS5B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV ICS-5B FAILS TOOPEN
23-MV--ICS6A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV ICS-6A FAILS TOOPEN
23-MV--ICS6B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV ICS-6B FAILS TOOPEN
23-MVCKFCCCF12	8.570E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVCKFCCCF12
23-MVOKFOCCF1-4	6.560E-005	3	GLOBAL FAILURE OF 23-MVOKFOCCF1-4
23-MVOKFOCCF12	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF12
23-MVOKFOCCF123	2.190E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF123
23-MVOKFOCCF124	2.190E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF124
23-MVOKFOCCF13	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF13
23-MVOKFOCCF134	2.190E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF134
23-MVOKFOCCF14	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF14
23-MVOKFOCCF23	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF23
23-MVOKFOCCF234	2.190E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF234
23-MVOKFOCCF24	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF24
23-MVOKFOCCF34	3.440E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVOKFOCCF34
23-MVRHR400A-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MOV RHR-400A AFTER TEST
23-MVRHR400A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-400A FAILS TO OPEN
23-MVRHR400B-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MOV RHR-400B AFTER TEST
23-MVRHR400B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-400B FAILS TO OPEN
23-MVRKFOCCF12	6.930E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-MVRKFOCCF12
23-PM--ICS1A-PR	8.159E-004	4	INDEPENDENT FAILURECONTAINMENT SPRAY PUMP A FAILS TO RUN
23-PM--ICS1A-PS	1.009E-003	3	INDEPENDENT FAILURECONTAINMENT SPRAY PUMP A FAILS TO
23-PM--ICS1A-TM	2.940E-003	3	ICS PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE
23-PM--ICS1B-PR	8.159E-004	4	INDEPENDENT FAILURECONTAINMENT SPRAY PUMP B FAILS TO RUN
23-PM--ICS1B-PS	1.009E-003	3	INDEPENDENT FAILURECONTAINMENT SPRAY PUMP B FAILS TO
23-PM--ICS1B-TM	3.850E-003	3	ICS PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
23-PMRKPRCCF12	5.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-PMRKPRCCF12
23-PMSKPSCCF12	1.200E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)23-PMSKPSCCF12
23-XV--ICS7A-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE ICS-7A AFTER TEST
23-XV--ICS7B-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE ICS-7B AFTER TEST
23-XV-ICS10A-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MANUAL VALVE ICS-10A AFTER TEST
23-XV-ICS10B-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MANUAL VALVE ICS-10B AFTER TEST
23-XVICS210A-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MANUAL VALVE ICS-210A AFTER TEST
23-XVICS210B-AE	7.991E-004	3	OPERATOR FAILS TO CLOSE MANUAL VALVE ICS-210B AFTER TEST
25--CRAC-MAN-HE	9.800E-003	3	OPERATOR FAILS TO MANUALLY TRANSFER CRAC TO SW
25--CRAC-MANSHE	1.000E+000	3	OPERATOR FAILS TO MANUALLY TRANSFER CRAC TO SW (SEIS)
25-AV-KFCCCF12	9.420E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1040A-1/B-1 FTC
25-AV-KFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1042A-1/B-1 FTO
25-AV-KOCCCF1-4	9.580E-008	4	GLOBAL FAILURE OF SW-1041A/A1/B/B1 TC
25-AV-KOCCCF12	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041A/A-1 TR CLS
25-AV-KOCCCF123	1.730E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1041A/A-1/B TC
25-AV-KOCCCF124	1.730E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1041A/A1/B1 TC

Table 11
Basic Event Descriptions (continued)

25-AV-KOCCCF13	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041A/B TRAN CLS
25-AV-KOCCCF134	1.730E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1041A/B/B1 TC
25-AV-KOCCCF14	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041A/B-1 TRN CL
25-AV-KOCCCF23	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041A-1/B FTC
25-AV-KOCCCF234	1.730E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)SW-1041A1/B/B1 TC
25-AV-KOCCCF24	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041A-1/B-1 TC
25-AV-KOCCCF34	3.660E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1041B/B-1 TRN C
25-AVHKFCCCF12	9.420E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)HS-2203A-1/B-1 FTC
25-AVHS2203A1FC	4.758E-004	3	INDEPENDENT FAILUREAOV HS-2203A-1 FAILS TO CLOSE
25-AVHS2203B1FC	4.758E-004	3	INDEPENDENT FAILUREAOV HS-2203B-1 FAILS TO CLOSE
25-AVIKFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)SW-1040A-2/B-2 FTO
25-AVSW1040A1FC	4.758E-004	3	INDEPENDENT FAILUREAOV SW-1040A-1 FAILS TO CLOSE
25-AVSW1040A2FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-1040A-2 FAILS TO OPEN
25-AVSW1040B1FC	4.758E-004	3	INDEPENDENT FAILUREAOV SW-1040B-1 FAILS TO CLOSE
25-AVSW1040B2FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-1040B-2 FAILS TO OPEN
25-AVSW1041A-OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1041A TRANSFERS CLOSED
25-AVSW1041A1OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1041A-1 TRANSFERS CLOSED
25-AVSW1041B-OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1041B TRANSFERS CLOSED
25-AVSW1041B1OC	1.032E-005	4	INDEPENDENT FAILUREAOV SW-1041B-1 TRANSFERS CLOSED
25-AVSW1042A1FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-1042A-1 FAILS TO OPEN
25-AVSW1042B1FO	2.168E-003	3	INDEPENDENT FAILUREAOV SW-1042B-1 FAILS TO OPEN
25-DM-ACC15--OC	7.198E-006	4	DAMPER ACC-15 TRANSFERS CLOSED
25-DM-ACC16--OC	7.198E-006	4	DAMPER ACC-16 TRANSFERS CLOSED
25-DM-ACC4---OC	7.198E-006	4	DAMPER ACC-4 TRANSFERS CLOSED
25-FN-CRAC-A-PR	2.952E-004	4	INDEPENDENT FAILURECONTROL ROOM HVAC FAN A FAILS TO RUN
25-FN-CRAC-A-PS	3.940E-003	3	INDEPENDENT FAILURECONTROL ROOM HVAC FAN A FAILS TO
25-FN-CRAC-B-PR	2.952E-004	4	INDEPENDENT FAILURECONTROL ROOM HVAC FAN B FAILS TO RUN
25-FN-CRAC-B-PS	3.940E-003	3	INDEPENDENT FAILURECONTROL ROOM HVAC FAN B FAILS TO
25-FN-KPRCCF12	3.840E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)CRAC FANS FTR
25-FN-KPSCCF12	5.120E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)CRAC FANS FTS
25-RF-KPRCCF12	2.640E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)CRAC CHILLERS FTR
25-RF-KPSCCF12	1.100E-003	3	DOUBLE COMMON CAUSE FAILURE (CCF)CRAC CHILLERS FTS
25-RFCHILL-A-PR	2.399E-004	4	INDEPENDENT FAILURECONTROL ROOM CHILLER UNIT A
25-RFCHILL-A-PS	9.999E-003	3	INDEPENDENT FAILURECONTROL ROOM CHILLER UNIT A
25-RFCHILL-B-PR	2.399E-004	4	INDEPENDENT FAILURECONTROL ROOM CHILLER UNIT B
25-RFCHILL-B-PS	9.999E-003	3	INDEPENDENT FAILURECONTROL ROOM CHILLER UNIT B
25-SV-33908--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33908 FAILS TO CLOSE
25-SV-33909--FC	4.999E-004	3	INDEPENDENT FAILURESOV 33909 FAILS TO CLOSE
25-SV-KFCCCF12	2.350E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)25-SV-KFCCCF12
25-SY-CRAC-A-TM	2.220E-002	3	CRAC TRAIN A UNAVAILABLE DUE TO TEST OR MAINTENANCE
25-SY-CRAC-B-TM	3.640E-002	3	CRAC TRAIN B UNAVAILABLE DUE TO TEST OR MAINTENANCE
26-AV-PW52---OC	1.032E-005	4	AOV PW-52 TRANSFERSCLOSED
26-CV-KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)PW-1A/1B FTO
26-CV-PW1A---FC	9.999E-004	3	CHECK VALVE PW-1A FAILS TO CLOSE
26-CV-PW1A---FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE PW-1A FAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

26-CV-PW1B---FC	9.999E-004	3	CHECK VALVE PW-1B FAILS TO CLOSE
26-CV-PW1B---FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE PW-1B FAILS TO OPEN
26-OR-PWS----PL	3.000E-004	3	POTABLE WATER SUPPLY ORIFACE PLUGGED
26-PM-DWPA---PR	8.159E-004	4	INDEPENDENT FAILUREDEEP WELL PUMP A FAILS TO RUN
26-PM-DWPA---PS	1.400E-003	3	INDEPENDENT FAILUREDEEP WELL PUMP A FAILS TO START
26-PM-DWPB---PR	8.159E-004	4	INDEPENDENT FAILUREDEEP WELL PUMP B FAILS TO RUN
26-PM-DWPB---PS	1.400E-003	3	INDEPENDENT FAILUREDEEP WELL PUMP B FAILS TO START
26-PM-KPRCCF12	5.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)26-PM-KPRCCF12
26-PM-KPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)DEEP WELL PUMPS FTS
27A-OR2------HE	9.625E-002	3	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST-WITH CD
27A-OR2----LDHE	1.511E-001	3	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - SLO
27A-OR2----RDHE	1.414E-001	3	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - SGTR
27A-OR3------HE	2.043E-002	3	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - ISL
27A-OR3-----DHE	1.604E-001	3	OPERATOR FAILS TO LIMIT SI AND REFILLRWST - ISL DEPEND
27A-ORR------HE	9.212E-002	3	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - NO CD
27A-ORR----F-HE	5.000E-003	3	FAILURE TO THROTTLESI FLOW OR REFILL RWST (NO COOLDOWN)
27A-RMST-CST-HE	1.237E-003	3	OPERATOR FAILS TO CROSS-TIE CSTS AND RMSTS
27AAV-MU1007-CO	1.032E-005	4	AOV MU-1007 TRANSFERS OPEN, DIVERTING FLOW
27AAVMU1010-1CO	1.032E-005	4	AOV MU-1010-1 TRANSFERS OPEN
27ACV-KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)MU-1002A/1002B FTO
27ACVMU1002A-FC	9.999E-004	3	CHECK VALVE MU-1002A FAILS TO CLOSE
27ACVMU1002A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MU-1002A FTO
27ACVMU1002B-FC	9.999E-004	3	CHECK VALVE MU-1002B FAILS TO CLOSE
27ACVMU1002B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE MU-1002B FTO
27APM--RMP1A-PR	8.159E-004	4	INDEPENDENT FAILUREREACTOR MAKE-UP PUMP A FTR
27APM--RMP1A-PS	1.400E-003	3	INDEPENDENT FAILUREREACTOR MAKE-UP PUMP A FTS
27APM--RMP1B-PR	8.159E-004	4	INDEPENDENT FAILUREREACTOR MAKE-UP PUMP B FTR
27APM--RMP1B-PS	1.400E-003	3	INDEPENDENT FAILUREREACTOR MAKE-UP PUMP B FTS
27APM-KPRCCF12	5.630E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)RX MU PUMPS FTR
27APM-KPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)RX MU PUMPS FTS
27ATK--RMWST-RP	6.482E-007	4	REACTOR MAKEUP WATER STORAGE TANK RUPTURE
27AXV-DW20---FO	1.000E-004	3	MANUAL VALVE DW-20 FAILS TO CLOSE
27BCV-KFCCCF12	7.830E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)27BCV-KFCCCF12
27BCV-KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)PW-83A/83B FTO
27BCV-PW83A--FC	9.999E-004	3	CHECK VALVE PW-83A FAILS TO CLOSE
27BCV-PW83A--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE PW-83A FAILS TO OPEN
27BCV-PW83B--FC	9.999E-004	3	CHECK VALVE PW-83B FAILS TO CLOSE
27BCV-PW83B--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE PW-83B FAILS TO OPEN
27BCV-SWT242-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW(T)-242 FTC
27BCV-SWT251-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SW(T)-251 FTC
27BPM-KPRCCF12	5.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)27BPM-KPRCCF12
27BPM-KPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)PEW PUMPS FTS
27BPM-PEWPA--PR	8.159E-004	4	INDEPENDENT FAILUREPLANT EQUIPMENT WATER PUMP A FTR

Table 11
Basic Event Descriptions (continued)

27BPM-PEWPA--PS FTS	1.400E-003	3	INDEPENDENT FAILUREPLANT EQUIPMENT WATER PUMP A
27BPM-PEWPB--PR FTR	8.159E-004	4	INDEPENDENT FAILUREPLANT EQUIPMENT WATER PUMP B
27BPM-PEWPB--PS FTS	1.400E-003	3	INDEPENDENT FAILUREPLANT EQUIPMENT WATER PUMP B
2HR-FAILS-SD	2.650E-001	3	FAILURE TO RESTORE OSP WITHIN 2 HOURS - SHUTDOWN
2HR-SUCCESS-SD	7.350E-001	3	OSP RECOVERY WITHIN 2 HOURS IS SUCCESSFUL - SD
31-AV-CC302--OC	1.032E-005	4	AOV CC-302 TRANSFERS CLOSED
31-AV-CC610A-FC	4.758E-004	3	AOV CC-610A FAILS TO CLOSE
31-AV-CC610A-OC	1.032E-005	4	AOV CC-610A TRANSFERS CLOSED
31-AV-CC610B-FC	4.758E-004	3	AOV CC-610B FAILS TO CLOSE
31-AV-CC610B-OC	1.032E-005	4	AOV CC-610B TRANSFERS CLOSED
31-CCW-DSP---HE DSP	3.255E-003	3	OPERATOR FAILS TO ESTABLISH COMPONENTCOOLING FROM
31-CCW-MAN---HE MANUALLY	8.100E-003	3	OPERATOR FAILS TO ESTABLISH COMPONENTCOOLING
31-CCWRCVR-BMHE	4.306E-003	3	RECOVERY OF CCWRE
31-CCWRCVR-DMHE	2.030E-003	3	OPERATOR FAILS TO RECOVER CCW BEFORE CORE DAMAGE
31-CV---CC3A-FC	9.999E-004	3	CHECK VALVE CC-3A FAILS TO CLOSE
31-CV---CC3A-FO	5.000E-005	3	CHECK VALVE CC-3A FAILS TO OPEN
31-CV---CC3B-FC	9.999E-004	3	CHECK VALVE CC-3B FAILS TO CLOSE
31-CV---CC3B-FO	5.000E-005	3	CHECK VALVE CC-3B FAILS TO OPEN
31-HX--CCW1A-LK	2.400E-005	4	INDEPENDENT FAILURECCW HEAT EXCHANGER A SHELL LEAK
31-HX--CCW1B-LK	2.400E-005	4	INDEPENDENT FAILURECCW HEAT EXCHANGER B SHELL LEAK
31-HX-KLKCCF12	5.640E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)31-HE-KHSCCF12
31-LO-SW1300-HE	4.959E-003	3	OPERATOR FAILS TO LOCALLY OPEN MOVS SW1300A(B)
31-LO-SW1300FHE (FIRE)	4.959E-002	3	OPERATOR FAILS TO LOCALLY OPEN MOVS SW1300A(B)
31-LO-SW1300SHE (SEISMIC)	1.000E+000	3	OPERATOR FAILS TO LOCALLY OPEN MOVS SW1300A/B
31-MV-CC400A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV CC-400A FAILS TO OPEN
31-MV-CC400B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV CC-400B FAILS TO OPEN
31-MV-CC6A---FO	6.968E-004	3	MOV CC-6A FAILS TO OPEN
31-MV-CC6A---OC	1.200E-006	4	INDEPENDENT FAILUREMOV CC-6A TRANSFERSCLOSED
31-MV-CC6B---FO	6.968E-004	3	MOV CC-6B FAILS TO OPEN
31-MV-CC6B---OC	1.200E-006	4	INDEPENDENT FAILUREMOV CC-6B TRANSFERSCLOSED
31-MV-KFOCCF12	4.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)31-MV-KFOCCF12
31-MV-KOCCCF12	2.820E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)31-MV-KOCCCF12
31-PM--CCW1A-PR	2.004E-003	4	INDEPENDENT FAILURECOMPONENT COOLING PUMP A FTR
31-PM--CCW1A-PS	7.720E-004	3	INDEPENDENT FAILURECOMPONENT COOLING PUMP A FTS
31-PM--CCW1A-TM	4.820E-003	3	CCW PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE
31-PM--CCW1B-PR	2.004E-003	4	INDEPENDENT FAILURECOMPONENT COOLING PUMP B FTR
31-PM--CCW1B-PS	7.720E-004	3	INDEPENDENT FAILURECOMPONENT COOLING PUMP B FTS
31-PM--CCW1B-TM	7.110E-003	3	CCW PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
31-PM-KPRCCF12	7.140E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)31-PM-KPRCCF12
31-PM-KPSCCF12	4.870E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)31-PM-KPSCCF12
31-PSPS26018-OP	2.999E-007	3	FAILURE OF PRESSURESWITCH PS-26018
31-RV-CC611A-FO	3.000E-004	3	RELIEF VALVE CC-611A FAILS TO OPEN
31-RV-CC611B-FO	3.000E-004	3	RELIEF VALVE CC-611B FAILS TO OPEN
31-SV-33014--FO	4.999E-004	3	SOV 33014 FAILS TO OPEN
31-SV-33014--OC	1.200E-005	4	SOV 33014 TRANSFERSCLOSED
31-SV-33015--FO	4.999E-004	3	SOV 33015 FAILS TO OPEN
31-SV-33015--OC	1.200E-005	4	SOV 33015 TRANSFERSCLOSED
31-SV-33785--OC	1.200E-005	4	SOV 33785 TRANSFERSCLOSED

Table 11
Basic Event Descriptions (continued)

31-XV---CC4A-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE CC-4A AFTER TEST
31-XV---CC4B-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE CC-4B AFTER TEST
32-AV-KCOCCF12	5.170E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)32-AV-KCOCCF12
32-AV-MDR134-CO	1.032E-005	4	INDEPENDENT FAILUREAOV MD(R)-134 TRANSFERS OPEN
32-AV-MDR1345AE	3.228E-003	3	OPERATOR FAILS TO CLOSE MD-134/135 AFTER TEST
32-AV-MDR135-CO	1.032E-005	4	INDEPENDENT FAILUREAOV MD(R)-135 TRANSFERS OPEN
32-AVRC507---CO	1.032E-005	4	INDEPENDENT FAILUREAOV RC-507 TRANSFERS OPEN
32-AVRC508---CO	1.032E-005	4	INDEPENDENT FAILUREAOV RC-508 TRANSFERS OPEN
32-AVRKCOCCF12	5.170E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)32-AVRKCOCCF12
33--1TRN-REC-HE	1.727E-002	3	OPERATOR FAILS TO ESTABLISH RECIRC (1 OF 1 TRAIN)
33--2TRN-REC-HE	2.133E-002	3	OPERATOR FAILS TO ESTABLISH RECIRC (1 OF 2 TRAINS)
33--2TRN-RECSHE	1.000E+000	3	OPERATOR FAILS TO ESTABLISH RECIRC (SEISMIC)
33--MAN-HPI--HE	4.434E-004	3	OPERATOR FAILS TO START ECCS PUMPS MANUALLY
33--MAN-HPI-SHE	1.000E+000	3	OPERATOR FAILS TO START ECCS PUMPS MANUALLY (SEISMIC)
33--ORI------HE	1.499E-002	3	OPERATOR FAILS TO RESTORE RCS INVENTORY IN SBO
33--REC-DIAG-HE	1.500E-004	3	OPERATOR FAILS TO DIAGNOSE NEED FOR CNTMNT SUMP RECIRC
33--REC-DIAGSHE	1.000E+000	3	OPERATOR FAILS TO DIAGNOSE CNTMT SUMPRECIRC (SEISMIC)
33-CV---SI6A-CO	6.567E-004	2	CHECK VALVE SI-6A TRANSFERS OPEN
33-CV---SI6A-FC	9.999E-004	3	CHECK VALVE SI-6A FAILS TO CLOSE
33-CV---SI6A-FH	2.690E-004	3	CHECK VALVE SI-6A FAILS TO HOLD ON DEMAND
33-CV---SI6A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-6A FAILS TO OPEN
33-CV---SI6A-LK	4.454E-003	2	CHECK VALVE SI-6A LEAKS
33-CV---SI6B-CO	6.567E-004	2	CHECK VALVE SI-6B TRANSFERS OPEN
33-CV---SI6B-FC	9.999E-004	3	CHECK VALVE SI-6B FAILS TO CLOSE
33-CV---SI6B-FH	2.690E-004	3	CHECK VALVE SI-6B FAILS TO HOLD ON DEMAND
33-CV---SI6B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-6B FAILS TO OPEN
33-CV---SI6B-LK	4.454E-003	2	CHECK VALVE SI-6B LEAKS
33-CV--SI12A-CO	6.567E-004	2	CHECK VALVE SI-12A TRANSFERS OPEN
33-CV--SI12A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-12A FAILS TO CLOSE
33-CV--SI12A-FH	2.690E-004	3	CHECK VALVE SI-12A FAILS TO HOLD ON DEMAND
33-CV--SI12A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-12A FAILS TO OPEN
33-CV--SI12A-LK	4.454E-003	2	CHECK VALVE SI-12A LEAKS
33-CV--SI12B-CO	6.567E-004	2	CHECK VALVE SI-12B TRANSFERS OPEN
33-CV--SI12B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-12B FAILS TO CLOSE
33-CV--SI12B-FH	2.690E-004	3	CHECK VALVE SI-12B FAILS TO HOLD ON DEMAND
33-CV--SI12B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-12B FAILS TO OPEN
33-CV--SI12B-LK	4.454E-003	2	CHECK VALVE SI-12B LEAKS
33-CV--SI13A-CO	6.567E-004	2	CHECK VALVE SI-13A TRANSFERS OPEN
33-CV--SI13A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-13A FAILS TO CLOSE
33-CV--SI13A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-13A FAILS TO OPEN
33-CV--SI13A-LK	4.454E-003	2	CHECK VALVE SI-13A LEAKS
33-CV--SI13B-CO	6.567E-004	2	CHECK VALVE SI-13B TRANSFERS OPEN
33-CV--SI13B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-13B FAILS TO CLOSE

Table 11
Basic Event Descriptions (continued)

33-CV--SI13B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-13B FAILS TO OPEN
33-CV--SI13B-LK	4.454E-003	2	CHECK VALVE SI-13B LEAKS
33-CV--SI16A-CO	6.567E-004	2	CHECK VALVE SI-16A TRANSFERS OPEN
33-CV--SI16A-FH	2.690E-004	3	CHECK VALVE SI-16A FAILS TO HOLD ON DEMAND
33-CV--SI16A-FO	5.000E-005	3	CHECK VALVE SI-16A FAILS TO OPEN
33-CV--SI16A-LK	4.454E-003	2	CHECK VALVE SI-16A LEAKS
33-CV--SI16B-CO	6.567E-004	2	CHECK VALVE SI-16B TRANSFERS OPEN
33-CV--SI16B-FH	2.690E-004	3	CHECK VALVE SI-16B FAILS TO HOLD ON DEMAND
33-CV--SI16B-LK	4.454E-003	2	CHECK VALVE SI-16B LEAKS
33-CV--SI21A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-21A FAILS TO OPEN
33-CV--SI21B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-21B FAILS TO OPEN
33-CV--SI22A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-22A FAILS TO OPEN
33-CV--SI22B-CO	6.567E-004	2	CHECK VALVE SI-22B TRANSFERS OPEN
33-CV--SI22B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-22B FAILS TO OPEN
33-CV--SI22B-LK	4.454E-003	2	CHECK VALVE SI-22B LEAKS
33-CV1KFOCCF1-4	8.600E-006	3	GLOBAL FAILURE OF 33-CV1KFOCCF1-4
33-CV1KFOCCF12	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF12
33-CV1KFOCCF123	2.150E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF123
33-CV1KFOCCF124	2.150E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF124
33-CV1KFOCCF13	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF13
33-CV1KFOCCF134	2.150E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF134
33-CV1KFOCCF14	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF14
33-CV1KFOCCF23	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF23
33-CV1KFOCCF234	2.150E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF234
33-CV1KFOCCF24	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF24
33-CV1KFOCCF34	8.110E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV1KFOCCF34
33-CV2KFOCCF1-4	8.530E-006	3	GLOBAL FAILURE OF 33-CV2KFOCCF1-4
33-CV2KFOCCF12	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF12
33-CV2KFOCCF123	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF123
33-CV2KFOCCF124	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF124
33-CV2KFOCCF13	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF13
33-CV2KFOCCF134	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF134
33-CV2KFOCCF14	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF14
33-CV2KFOCCF23	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF23
33-CV2KFOCCF234	8.110E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF234
33-CV2KFOCCF24	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF24
33-CV2KFOCCF34	1.010E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV2KFOCCF34
33-CV6A1213AVCO	1.009E-007	3	CHECK VALVES SI-6A,SI-12A, SI-13A TRANOPEN-VARIANCE TERM
33-CV6A1213AVLK	3.144E-005	3	CHECK VALVES SI-6A,SI-12A, SI-13A LEAKVARIANCE TERM
33-CV6A1213BVCO	1.009E-007	3	CHECK VALVES SI-6A,SI-12B, SI-13B TRANOPEN-VARIANCE TERM
33-CV6A1213BVLK	3.144E-005	3	CHECK VALVES SI-6A,SI-12B, SI-13B LEAKVARIANCE TERM
33-CV6A1604AVCO	1.009E-007	3	CHECK VALVES SI-6A,SI-16A, SI-304A TRNOPEN-VARIANCE TERM
33-CV6A1604AVLK	3.144E-005	3	CHECK VALVES SI-6A,SI-16A, SI-304A LEAK-VARIANCE TERM
33-CV6A1604BVCO	1.009E-007	3	CHECK VALVES SI-6A,SI-16B, SI-304B TRNOPEN-VARIANCE TERM

Table 11
Basic Event Descriptions (continued)

33-CV6A1604BVLK	3.144E-005	3	CHECK VALVES SI-6A,SI-16B, SI-304B LEAK-VARIANCE TERM
33-CV6B1213AVCO	1.009E-007	3	CHECK VALVES SI-6B,SI-12A, SI-13A TRANOPEN-VARIANCE TERM
33-CV6B1213AVLK	3.144E-005	3	CHECK VALVES SI-6B,SI-12A, SI-13A LEAKVARIANCE TERM
33-CV6B1213BVCO	1.009E-007	3	CHECK VALVES SI-6B,SI-12B, SI-13B TRANOPEN-VARIANCE TERM
33-CV6B1213BVLK	3.144E-005	3	CHECK VALVES SI-6B SI-12B, SI-13B LEAKVARIANCE TERM
33-CV6B1604AVCO	1.009E-007	3	CHECK VALVES SI-6B,SI-16A, SI-304A TRNOPEN-VARIANCE TERM
33-CV6B1604AVLK	3.144E-005	3	CHECK VALVES SI-6B,SI-16A, SI-304A LEAK-VARIANCE TERM
33-CV6B1604BVCO	1.009E-007	3	CHECK VALVES SI-6B,SI-16B, SI-304B TRNOPEN-VARIANCE TERM
33-CV6B1604BVLK	3.144E-005	3	CHECK VALVES SI-6B,SI-16B, SI-304B LEAK-VARIANCE TERM
33-CV6KFOCCF12	1.370E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CV6KFOCCF12
33-CVDKFCCCF1-4	0.000E+000	3	GLOBAL FAILURE OF 33-CVDKFCCCF1-4
33-CVDKFCCCF12	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF12
33-CVDKFCCCF123	0.000E+000	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF123
33-CVDKFCCCF124	0.000E+000	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF124
33-CVDKFCCCF13	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF13
33-CVDKFCCCF134	0.000E+000	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF134
33-CVDKFCCCF14	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF14
33-CVDKFCCCF23	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF23
33-CVDKFCCCF234	0.000E+000	3	TRIPLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF234
33-CVDKFCCCF24	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF24
33-CVDKFCCCF34	1.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-CVDKFCCCF34
33-F925--CAL-AE	4.842E-003	3	TECHNICIAN MISCALIBRATES SI FLOW CHANNEL F925
33-HPI-MAN---HE	5.550E-002	3	OPERATOR FAILS TO ESTABLISH SI MANUALLY -- FIRE
33-ISORWST-F-HE	3.546E-001	3	OPERATOR FAILS TO ISOLATE RWST LINE FLOOD
33-MV---SI5A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-5A FAILS TO CLOSE
33-MV---SI5B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-5B FAILS TO CLOSE
33-MV--SI15A-CO	1.778E-004	2	MOV SI-15A TRANSFERS OPEN
33-MV--SI15A-FH	2.690E-004	3	MOV SI-15A FAILS TOHOLD ON DEMAND
33-MV--SI15A-FO	6.968E-004	3	MOV SI-15A FAILS TOOPEN
33-MV--SI15B-CO	1.778E-004	2	MOV SI-15B TRANSFERS OPEN
33-MV--SI15B-FH	2.690E-004	3	MOV SI-15B FAILS TOHOLD ON DEMAND
33-MV-KCOCCF12	1.360E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-MV-KCOCCF12
33-MV-KFCCCF12	5.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-MV-KFCCCF12
33-MV-KFOCCF12	1.020E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-MV-KFOCCF12
33-MV-SI208--FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-208 FAILS TOCLOSE
33-MV-SI209--FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-209 FAILS TOCLOSE
33-MV2KFCCCF12	5.240E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-MV2KFCCCF12
33-MVRHR299A-CO	1.200E-006	4	INDEPENDENT FAILUREMOV RHR-299A XFERS OPEN TO DIVERT FLOW
33-MVRHR299A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-299A FAILS TO OPEN
33-MVRHR299B-CO	1.200E-006	4	INDEPENDENT FAILUREMOV RHR-299B XFERS OPEN TO DIVERT FLOW
33-MVRHR299B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-299B FAILS TO OPEN
33-PM---SI1A-PR	8.159E-004	4	INDEPENDENT FAILURESAFETY INJECTION PUMP A FTR
33-PM---SI1A-PS	1.047E-003	3	INDEPENDENT FAILURESAFETY INJECTION PUMP A FAILS TO START
33-PM---SI1A-TM	1.380E-003	3	SI PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE

Table 11
Basic Event Descriptions (continued)

33-PM---SI1B-PR	8.159E-004	4	INDEPENDENT FAILURESAFETY INJECTION PUMP B FTR
33-PM---SI1B-PS	1.047E-003	3	INDEPENDENT FAILURESAFETY INJECTION PUMP B FAILS TO START
33-PM---SI1B-TM	2.000E-003	3	SI PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
33-PM-KPRCCF12	3.350E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)33-PM-KPRCCF12
33-PM-KPSCCF12	1.100E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-PM-KPSCCF12
33-SI-FILL--MHE	2.234E-002	3	OPERATOR FAILS TO ALIGN SI FOR REFILL
33-SIFLO-RI-MHE	4.800E-002	3	OPERATOR FAILS TO ALIGN SI FOR REFILL(REDUCED INVENTORY)
33-SW-PBMSI1-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH PB/MSI-1 CONTACTS XFER OPEN
33-SW-PBMSI2-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH PB/MSI-2 CONTACTS XFER OPEN
33-SW-PBRSIA-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH PB/RSI-A CONTACTS XFER OPEN
33-SW-PBRSIB-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH PB/RSI-B CONTACTS XFER OPEN
33-SWAKCOCCF12	1.030E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-SWAKCOCCF12
33-SWMKCOCCF12	1.030E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-SWMKCOCCF12
33-TK---RWST-RP	6.482E-007	4	RWST RUPTURE
33-TK--ACC1A-RP	2.701E-008	4	INDEPENDENT FAILUREACCUMULATOR A RUPTURE
33-TK--ACC1B-RP	2.701E-008	4	INDEPENDENT FAILUREACCUMULATOR B RUPTURE
33-TK-KRPCCF12	6.350E-010	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-TK-KRPCCF12
33-TL--RWST--AE	6.386E-006	3	TECHNICIAN MISCALIBRATES RWST LEVEL INSTRUMENTS
33-XV---SI7A-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE SI-7A AFTER TEST
33-XV---SI7B-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE SI-7B AFTER TEST
33-XV-KFCCCF12	4.700E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)33-XV-KFCCCF12
33-XV-SI7A---FC	1.000E-004	3	INDEPENDENT FAILUREMANUAL VALVE SI-7A FAILS TO CLOSE
33-XV-SI7B---FC	1.000E-004	3	INDEPENDENT FAILUREMANUAL VALVE SI-7B FAILS TO CLOSE
34--ISL-DIAG-HE	6.841E-003	3	OPERATOR FAILS TO DIAGNOSE ISL
34--LR1------HE	1.613E-002	3	OPERATOR FAILS TO ESTABLISH LOW PRESSURE RECIRC
34--LR1-----SHE	1.000E+000	3	OPERATOR FAILS TO ESTABLISH LPI (SEISMIC)
34--MAN-LPI--HE	3.657E-004	3	OPERATOR FAILS TO START RHR PUMPS MANUALLY
34--MAN-LPI-SHE	1.000E+000	3	OPERATOR FAILS TO START RHR PUMPS MANUALLY(SEISMIC)
34--OCV------HE	5.114E-003	3	OPERATOR FAILS TO ISOLATE BREAK
34--OIP------HE	2.128E-002	3	OPERATOR FAILS TO ISOLATE RHR PUMPS
34--RHR------HE	8.235E-002	3	OPERATOR FAILS TO ESTABLISH RHR
34--RHR-----SHE	1.000E+000	3	OPERATOR FAILS TO ESTABLISH RHR - SEISMIC
34--RHR-STOP-HE	1.337E-002	3	OPERATOR FAILS TO STOP RHR PUMP ON MINIFLOW RECIRC.
34--RHR-STOPSHE	1.000E+000	3	OPERATOR FAILS TO STOP RHR PUMP ON RECIRC. (SEISMIC)
34-AV--RHR8A-OC	1.032E-005	4	INDEPENDENT FAILUREAOV RHR-8A TRANSFERS CLOSED
34-AV--RHR8B-FO	2.168E-003	3	AOV RHR-8B FAILS TOOPEN
34-AV--RHR8B-OC	1.032E-005	4	INDEPENDENT FAILUREAOV RHR-8B TRANSFERS CLOSED
34-AV-KOCCCF12	2.420E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-AV-KOCCCF12
34-CV--RHR3A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-3A FAILS TO OPEN
34-CV--RHR3B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-3B FAILS TO OPEN
34-CV--RHR5A-CO	6.567E-004	2	CHECK VALVE RHR-5A TRANSFERS OPEN

Table 11
Basic Event Descriptions (continued)

34-CV--RHR5A-FH	2.690E-004	3	CHECK VALVE RHR-5A FAILS TO HOLD ON DEMAND
34-CV--RHR5A-LK	4.454E-003	2	CHECK VALVE RHR5A LEAKS
34-CV--RHR5B-CO	6.567E-004	2	CHECK VALVE RHR-5B TRANSFERS OPEN
34-CV--RHR5B-FH	2.690E-004	3	CHECK VALVE RHR-5B FAILS TO HOLD ON DEMAND
34-CV--RHR5B-LK	4.454E-003	2	CHECK VALVE RHR5B LEAKS
34-CV-KFOCCF1-4	6.590E-006	3	GLOBAL FAILURE OF 34-CV-KFOCCF1-4
34-CV-KFOCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF12
34-CV-KFOCCF123	5.250E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF123
34-CV-KFOCCF124	5.250E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF124
34-CV-KFOCCF13	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF13
34-CV-KFOCCF134	5.250E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF134
34-CV-KFOCCF14	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF14
34-CV-KFOCCF23	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF23
34-CV-KFOCCF234	5.250E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF234
34-CV-KFOCCF24	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF24
34-CV-KFOCCF34	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV-KFOCCF34
34-CV-SI303A-CO	6.567E-004	2	CHECK VALVE SI-303ATRANSFERS OPEN
34-CV-SI303A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-303AFAILS TO CLOSE
34-CV-SI303A-FH	2.690E-004	3	CHECK VALVE SI-303AFAILS TO HOLD ON DEMAND
34-CV-SI303A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-303AFAILS TO OPEN
34-CV-SI303A-LK	4.454E-003	2	CHECK VALVE SI-303ALEAKS
34-CV-SI303B-CO	6.567E-004	2	CHECK VALVE SI-303BTRANSFERS OPEN
34-CV-SI303B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-303BFAILS TO CLOSE
34-CV-SI303B-FH	2.690E-004	3	CHECK VALVE SI-303BFAILS TO HOLD ON DEMAND
34-CV-SI303B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-303BFAILS TO OPEN
34-CV-SI303B-LK	4.454E-003	2	CHECK VALVE SI-303BLEAKS
34-CV-SI304A-CO	6.567E-004	2	CHECK VALVE SI-304ATRANSFERS OPEN
34-CV-SI304A-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-304AFAILS TO CLOSE
34-CV-SI304A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-304AFAILS TO OPEN
34-CV-SI304A-LK	4.454E-003	2	CHECK VALVE SI-304ALEAKS
34-CV-SI304B-CO	6.567E-004	2	CHECK VALVE SI-304BTRANSFERS OPEN
34-CV-SI304B-FC	9.999E-004	3	INDEPENDENT FAILURECHECK VALVE SI-304BFAILS TO CLOSE
34-CV-SI304B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-304BFAILS TO OPEN
34-CV-SI304B-LK	4.454E-003	2	CHECK VALVE SI-304BLEAKS
34-CV2KFOCCF12	1.710E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)RHR-3A/B FTO
34-CV3KFCCCF1-4	4.520E-005	3	GLOBAL FAILURE OF 34-CV3KFCCCF1-4
34-CV3KFCCCF12	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF12
34-CV3KFCCCF123	2.610E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF123
34-CV3KFCCCF124	2.610E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF124
34-CV3KFCCCF13	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF13
34-CV3KFCCCF134	2.610E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF134
34-CV3KFCCCF14	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF14
34-CV3KFCCCF23	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF23
34-CV3KFCCCF234	2.610E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF234
34-CV3KFCCCF24	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF24
34-CV3KFCCCF34	4.420E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CV3KFCCCF34
34-CVD-RHR5A-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-5A FAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

34-CVD-RHR5B-FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE RHR-5B FAILS TO OPEN
34-CVDKFOCCF12	1.710E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CVDKFOCCF12
34-CVIKFOCCF12	1.710E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-CVIKFOCCF12
34-CVSI301A--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-301AFAILS TO OPEN
34-CVSI301B--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE SI-301BFAILS TO OPEN
34-CVSI3034AVCO	1.009E-007	3	CHECK VALVES RHR-5ASI-303A AND SI304A TRANS OPEN VAR TERM
34-CVSI3034AVLK	3.144E-005	3	CHECK VALVES RHR-5ASI-303A AND SI304A LEAK-VARIANCE TERM
34-CVSI3034BVCO	1.009E-007	3	CHECK VALVES RHR-5BSI-303B AND SI304B TRANS OPEN VAR TERM
34-CVSI3034BVLK	3.144E-005	3	CHECK VALVES RHR-5BSI-303B AND SI-304BLEAK-VARIANCE TERM
34-DIARHRLK-MHE	3.000E-003	3	OPERATOR FAILS TO DIAGNOSE LEAK IN RHR SYSTEM
34-DIARHRPM-MHE	6.000E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF RHR PUMPS
34-F626--CAL-AE	4.842E-003	3	TECHNICIAN MISCALIBRATES RHR FLOW CHANNEL F626
34-F928--CAL-AE	4.842E-003	3	TECHNICIAN MISCALIBRATES RHR FLOW CHANNEL F928
34-FL---SUMP-PL	1.199E-003	4	CONTAINMENT SUMP STRAINERS PLUGGED
34-HX--RHR1A-LK	2.400E-005	4	INDEPENDENT FAILURERHR HEAT EXCHANGER A SHELL LEAK
34-HX--RHR1B-LK	2.400E-005	4	INDEPENDENT FAILURERHR HEAT EXCHANGER B SHELL LEAK
34-HX-KLKCCF12	5.640E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-HE-KHSCCF12
34-ISOL-DRN-MHE	7.090E-002	3	OPERATOR FAILS TO ISOLATE RCS DRAIN PATH
34-MV-KFCCCF12	1.980E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFCCCF12
34-MV-KFOCCF1-4	9.730E-007	3	GLOBAL FAILURE OF 34-MV-KFOCCF1-4
34-MV-KFOCCF12	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF12
34-MV-KFOCCF123	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF123
34-MV-KFOCCF124	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF124
34-MV-KFOCCF13	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF13
34-MV-KFOCCF134	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF134
34-MV-KFOCCF14	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF14
34-MV-KFOCCF23	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF23
34-MV-KFOCCF234	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF234
34-MV-KFOCCF24	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF24
34-MV-KFOCCF34	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KFOCCF34
34-MV-KOCCCF12	2.820E-008	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV-KOCCCF12
34-MV-RHR1A--CO	1.778E-004	2	INDEPENDENT FAILUREMOV RHR-1A TRANSFERS OPEN
34-MV-RHR1A--FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-1A FAILS TOOPEN
34-MV-RHR1B--CO	1.778E-004	2	INDEPENDENT FAILUREMOV RHR-1B TRANSFERS OPEN
34-MV-RHR1B--FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-1B FAILS TOOPEN
34-MV-RHR2A--CO	1.778E-004	2	INDEPENDENT FAILUREMOV RHR-2A TRANSFERS OPEN
34-MV-RHR2A--FH	2.690E-004	3	MOV RHR-2A FAILS TOHOLD ON DEMAND
34-MV-RHR2A--FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-2A FAILS TOOPEN
34-MV-RHR2B--CO	1.778E-004	2	INDEPENDENT FAILUREMOV RHR-2B TRANSFERS OPEN
34-MV-RHR2B--FH	2.690E-004	3	MOV RHR-2B FAILS TOHOLD ON DEMAND
34-MV-RHR2B--FO	6.968E-004	3	INDEPENDENT FAILUREMOV RHR-2B FAILS TOOPEN
34-MV-SI302A-FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-302A FAILS TO CLOSE
34-MV-SI302A-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SI-302A TRANSFERS CLOSED
34-MV-SI302B-FC	1.905E-003	3	INDEPENDENT FAILUREMOV SI-302B FAILS TO CLOSE
34-MV-SI302B-FO	6.968E-004	3	MOV SI-302B FAILS TO OPEN
34-MV-SI302B-OC	1.200E-006	4	INDEPENDENT FAILUREMOV SI-302B TRANSFERS CLOSED
34-MV-SI350A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SI-350A FAILS TO OPEN
34-MV-SI350B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SI-350B FAILS TO OPEN
34-MV-SI351A-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SI-351A FAILS TO OPEN

Table 11
Basic Event Descriptions (continued)

34-MV-SI351B-FO	6.968E-004	3	INDEPENDENT FAILUREMOV SI-351B FAILS TO OPEN
34-MV3KFOCCF1-4	9.730E-007	3	GLOBAL FAILURE OF 34-MV3KFOCCF1-4
34-MV3KFOCCF12	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF12
34-MV3KFOCCF123	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF123
34-MV3KFOCCF124	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF124
34-MV3KFOCCF13	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF13
34-MV3KFOCCF134	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF134
34-MV3KFOCCF14	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF14
34-MV3KFOCCF23	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF23
34-MV3KFOCCF234	3.750E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF234
34-MV3KFOCCF24	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF24
34-MV3KFOCCF34	4.110E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-MV3KFOCCF34
34-MVD-RHR11-CO	1.778E-004	2	MOV RHR-11 TRANSFERS OPEN
34-MVD-RHR11-FH	2.690E-004	3	MOV RHR-11 FAILS TOHOLD ON DEMAND
34-MVD-RHR11-FO	6.968E-004	3	MOV RHR-11 FAILS TOOPEN
34-MVIKOCCCF12	2.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)SI-300A/B TRN CLSD
34-MVRHR12A-VCO	1.927E-007	3	MOVS RHR-1A AND RHR-2A TRANSFERS OPEN-VARIANCE TERM
34-MVRHR12B-VCO	1.927E-007	3	MOVS RHR-1B AND RHR-2B TRANSFERS OPEN-VARIANCE TERM
34-MVSI300A--OC	1.200E-006	4	INDEPENDENT FAILUREMOV SI-300A TRANSFERS CLOSED
34-MVSI300B--FO	6.968E-004	3	MOV SI-300B FAILS TO OPEN
34-MVSI300B--OC	1.200E-006	4	INDEPENDENT FAILUREMOV SI-300B TRANSFERS CLOSED
34-PM--RHR1A-PR	5.399E-004	4	INDEPENDENT FAILURERESIDUAL HEAT REMOVAL PUMP A FTR
34-PM--RHR1A-PS	9.509E-004	3	INDEPENDENT FAILURERESIDUAL HEAT REMOVAL PUMP A FTS
34-PM--RHR1A-TM	2.060E-003	3	RHR PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE
34-PM--RHR1B-PR	5.399E-004	4	INDEPENDENT FAILURERESIDUAL HEAT REMOVAL PUMP B FTR
34-PM--RHR1B-PS	9.509E-004	3	INDEPENDENT FAILURERESIDUAL HEAT REMOVAL PUMP B FTS
34-PM--RHR1B-TM	3.220E-003	3	RHR PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
34-PM-KPRCCF12	5.510E-005	4	DOUBLE COMMON CAUSE FAILURE (CCF)34-PM-KPRCCF12
34-PM-KPSCCF12	1.130E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)34-PM-KPSCCF12
34-RHRELOS---HE	2.563E-003	3	LATE RECOVERY AFTEREARLY COGNITIVE OR TIME DEP. FAILURE
34-RHRINJRI-MHE	5.010E-001	3	OPERATOR FAILS TO ALIGN RHR FOR REFILL (REDUCD INV)
34-RHRLRCR-B-HE	5.175E-001	3	FAILURE TO RECOVER LONG TERM COOLING BEFORE BOILING
34-RHRLRCR-D-HE	2.053E-002	3	FAILURE TO RECOVER LONG TERM COOLING BEFORE CORE DAMAGE
34-RHRRCVR-B-HE	5.175E-001	3	OPERATOR FAILS TO RECOVER RHR COOLING
34-RHRRCVR-D-HE	2.053E-002	3	OPERATOR FAILS TO RECOVER FROM LOSS OF RHRE BEFORE CD
34-RV--SI312-FO	3.000E-004	3	RELIEF VALVE SI-312FAILS TO OPEN
34-RV-RHR33--FC	3.000E-003	3	RELIEF VALVE RHR-33FAILS TO CLOSE
34-RV-RHR33--FO	3.000E-004	3	RELIEF VALVE RHR-33FAILS TO OPEN
34-RV-RHR33-1FC	3.000E-003	3	RELIEF VALVE RHR-33-1 FAILS TO CLOSE
34-RV-RHR33-1FO	3.000E-004	3	RELIEF VALVE RHR-33-1 FAILS TO OPEN
34-RWSTGRAV-MHE	4.205E-001	3	OPERATOR FAILS TO ESTABLISH RWST GRAVITY DRN REFILL
34-XV-RHR-7A-FC	1.000E-004	3	MANUAL VALVE RHR-7AFAILS TO CLOSE
34-XV-RHR100AFC	1.000E-004	3	MANUAL VALVE RHR-100A FAILS TO CLOSE

Table 11
Basic Event Descriptions (continued)

34-XV-RHR201-FO	1.000E-004	3	MANUAL VALVE RHR-201 FAILS TO OPEN
34-XV-RHR202-FO	1.000E-004	3	MANUAL VALVE RHR-202 FAILS TO OPEN
34-XV-RHR210-FC	1.000E-004	3	MANUAL VALVE RHR-210 FAILS TO CLOSE
34-XV-RHR4A--FC	1.000E-004	3	MANUAL VALVE RHR-4AFAILS TO CLOSE
34-XV-RHR4B--FC	1.000E-004	3	MANUAL VALVE RHR-4BFAILS TO CLOSE
34-XV-RHR80A-FC	1.000E-004	3	MANUAL VALVE RHR-80A FAILS TO CLOSE
34-XV-RHR9A--FC	1.000E-004	3	MANUAL VALVE RHR-9AFAILS TO CLOSE
35--CH2------HE	1.162E-001	3	OPERATOR FAILS TO ESTABLISH CHARGING FLOW DURING SBO
35--CH2-----DHE	2.074E-001	3	OPERATOR FAILS TO ESTABLISH CHARGING FLOW-SBO (DEP)
35--CHG-STBY-HE	1.991E-003	3	OPERATOR FAILS TO START STANDBY CHARGING PUMP
35--CHG-STBYSHE	1.000E+000	3	OPERATOR FAILS TO START STBY CHARGINGPUMP (SEISMIC)
35--LTDN-RES-HE	4.520E-002	3	OPERATOR FAILS TO RESTORE LETDOWN AFTER LOSP
35--LTS------HE	1.121E-002	3	OPERATOR FAILS TO MAINTAIN LONG TERM SHUTDOWN
35-AV-CVC11--FC	4.758E-004	3	AOV CVC-11 FAILS TOCLOSE
35-AV-CVC15--FO	2.168E-003	3	AOV CVC-15 FAILS TOOPEN
35-AV-CVC403-OC	1.032E-005	4	AOV CVC-403 TRANSFERS CLOSED
35-AV-CVC406-CO	1.032E-005	4	AOV CVC-406 TRANSFERS OPEN, DIVERTING FLOW
35-AV-CVC408-CO	1.032E-005	4	AOV CVC-408 TRANSFERS OPEN, DIVERTING FLOW
35-AV-CVC7---CO	1.032E-005	4	AOV CVC-7 TRANSFERSOPEN
35-AV-CVC7---OC	1.032E-005	4	AOV CVC-7 TRANSFERSCLOSED
35-AV-KFOCCF12	1.050E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)LD-4A/4B FTO
35-AV-KOCCCF12	2.420E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)LD-4A/4B TRAN CLOS
35-AV-LD10---OC	1.032E-005	4	AOV LD-10 TRANSFERSCLOSED
35-AV-LD14---OC	1.032E-005	4	AOV LD-14 TRANSFERSCLOSED
35-AV-LD27---OC	1.032E-005	4	AOV LD-27 TRANSFERSCLOSED
35-AV-LD4A---FO	2.168E-003	3	INDEPENDENT FAILUREAOV LD-4A FAILS TO OPEN
35-AV-LD4A---OC	1.032E-005	4	INDEPENDENT FAILUREAOV LD-4A TRANSFERSCLOSED
35-AV-LD4B---FO	2.168E-003	3	INDEPENDENT FAILUREAOV LD-4B FAILS TO OPEN
35-AV-LD4B---OC	1.032E-005	4	INDEPENDENT FAILUREAOV LD-4B TRANSFERSCLOSED
35-AV-LD6----OC	1.032E-005	4	AOV LD-6 TRANSFERS CLOSED
35-AV-MU1022-FO	2.168E-003	3	AOV MU-1022 FAILS TO OPEN
35-AVCKCOCCF12	5.170E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)CVC-712A/B TRN OPEN
35-AVCVC712A-CO	1.032E-005	4	INDEPENDENT FAILUREAOV CVC-712A TRANSFERS OPEN
35-AVCVC712B-CO	1.032E-005	4	INDEPENDENT FAILUREAOV CVC-712B TRANSFERS OPEN
35-CHG-DSP---HE	2.564E-002	3	OPERATOR FAILS TO ESTABLISH CHARGING FROM DSP
35-CV-CVC16--FO	5.000E-005	3	CHECK VALVE CVC-16 FAILS TO OPEN
35-CV-CVC411-FO	5.000E-005	3	CHECK VALVE CVC-411FAILS TO OPEN
35-CV-MU1023-FO	5.000E-005	3	CHECK VALVE MU-1023FAILS TO OPEN
35-CVCVC704A-FC	9.999E-004	3	CHECK VALVE CVC-704A FAILS TO CLOSE
35-CVCVC704A-FO	5.000E-005	3	CHECK VALVE CVC-704A FAILS TO OPEN
35-CVCVC704B-FC	9.999E-004	3	CHECK VALVE CVC-704B FAILS TO CLOSE
35-CVCVC704B-FO	5.000E-005	3	CHECK VALVE CVC-704B FAILS TO OPEN
35-HX--LTDN--LK	2.400E-005	4	LETDOWN HEAT EXCHANGER SHELL LEAK
35-MV-CVC301-FO	6.968E-004	3	MOV CVC-301 FAILS TO OPEN
35-MV-CVC440-FO	6.968E-004	3	MOV CVC-440 FAILS TO OPEN
35-PC-CHGP1A-OP	7.197E-005	4	INDEPENDENT FAILURECHG PUMP A SPEED CONTROLLER FAILURE
35-PC-CHGP1B-OP	7.197E-005	4	INDEPENDENT FAILURECHG PUMP B SPEED CONTROLLER FAILURE
35-PC-CHGP1C-OP	7.197E-005	4	INDEPENDENT FAILURECHG PUMP C SPEED CONTROLLER FAILURE

Table 11
Basic Event Descriptions (continued)

35-PC-KOPCCF12	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PC-KOPCCF12
35-PC-KOPCCF123	9.290E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)35-PC-KOPCCF123
35-PC-KOPCCF13	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PC-KOPCCF13
35-PC-KOPCCF23	4.360E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PC-KOPCCF23
35-PM-CHGP1A-PR	2.102E-004	4	INDEPENDENT FAILURECHARGING PUMP A FAILS TO RUN
35-PM-CHGP1A-PS	5.753E-004	3	INDEPENDENT FAILURECHARGING PUMP A FAILS TO START
35-PM-CHGP1A-TM	7.650E-003	3	CHARGING PUMP A UNAVAILABLE DUE TO TEST OR MAINTENANCE
35-PM-CHGP1B-PR	2.102E-004	4	INDEPENDENT FAILURECHARGING PUMP B FAILS TO RUN
35-PM-CHGP1B-PS	5.753E-004	3	INDEPENDENT FAILURECHARGING PUMP B FAILS TO START
35-PM-CHGP1B-TM	1.040E-002	3	CHARGING PUMP B UNAVAILABLE DUE TO TEST OR MAINTENANCE
35-PM-CHGP1C-PR	2.995E-004	4	INDEPENDENT FAILURECHARGING PUMP C FAILS TO RUN
35-PM-CHGP1C-PS	9.374E-003	3	INDEPENDENT FAILURECHARGING PUMP C FAILS TO START
35-PM-CHGP1C-TM	1.180E-002	3	CHARGING PUMP C UNAVAILABLE DUE TO TEST OR MAINTENANCE
35-PM-KPRCCF12	2.610E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPRCCF12
35-PM-KPRCCF123	1.250E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)35-PM-KPRCCF123
35-PM-KPRCCF13	2.610E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPRCCF13
35-PM-KPRCCF23	2.610E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPRCCF23
35-PM-KPSCCF12	1.540E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPSCCF12
35-PM-KPSCCF123	5.420E-005	3	TRIPLE COMMON CAUSE FAILURE (CCF)35-PM-KPSCCF123
35-PM-KPSCCF13	1.540E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPSCCF13
35-PM-KPSCCF23	1.540E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM-KPSCCF23
35-PM1KPRCCF12	5.630E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM1KPRCCF12
35-PM1KPSCCF12	1.670E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)35-PM1KPSCCF12
35-PMBATP1A--PR	8.159E-004	4	INDEPENDENT FAILUREBORIC ACID TRANSFERPUMP A FAILS TO RUN
35-PMBATP1A--PS	1.400E-003	3	INDEPENDENT FAILUREBORIC ACID TRANSFERPUMP A FTS
35-PMBATP1B--PR	8.159E-004	4	INDEPENDENT FAILUREBORIC ACID TRANSFERPUMP B FAILS TO RUN
35-PMBATP1B--PS	1.400E-003	3	INDEPENDENT FAILUREBORIC ACID TRANSFERPUMP B FTS
35-RV-LD5----FO	3.000E-004	3	RELIEF VALVE LD-5 FAILS TO OPEN
35-SV-33109--FO	4.999E-004	3	SOV 33109 FAILS TO OPEN
35-SV-33739--FO	4.999E-004	3	SOV 33739 FAILS TO OPEN
35-TK----BAT-RP	6.482E-007	4	BORIC ACID TANK RUPTURE
35-TL--LT112-FA	2.400E-005	4	LEVEL TRANSMITTER LT-112 FAILS
35-TL--LT141-FA	2.400E-005	4	LEVEL TRANSMITTER LT-141 FAILS
35-VC-CVC7---OP	7.197E-005	4	CONTROLLER FOR AOV CVC-7 FAILURE
35-VC-CVC7DSPOP	7.197E-005	4	DSP CONTROLLER FOR AOV CVC-7 FAILURE
35-VC-RMUC---OP	7.197E-005	4	REACTOR MAKEUP CONTROLLER FAILURE
35-XV-CVC410-FO	1.000E-004	3	MANUAL VALVE CVC-410 FAILS TO OPEN
35-XV-CVC412-FO	1.000E-004	3	MANUAL VALVE CVC-412 FAILS TO OPEN
35-XV-CVC443-AE	7.991E-004	3	OPERATOR FAILS TO OPEN MANUAL VALVE CVC-443 AFTER TEST
36--CLOSE-BV-HE	6.812E-003	3	OPERATOR FAILS TO CLOSE BLOCK VALVE
36--LHS-DEP--HE	1.000E-006	3	OPERATOR ERRORS LEAD TO LOSS OF HEAT SINK
36--LHS-DIAG-HE	1.761E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK
36--LHS-DIAGDHE	2.460E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK
36--LHS-DIAGSHE	1.000E+000	3	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK (SEISMIC)
36--OBF------HE	2.451E-002	3	OPERATOR FAILS TO ESTABLISH BLEED ANDFEED
36--OBF-----MHE	3.512E-002	3	OPERATOR FAILS TO ESTABLISH BLEED ANDFEED (SHUTDOWN)
36--OBF-----SHE	1.000E+000	3	OPERATOR FAILS TO ESTABLISH BLEED ANDFEED (SEISMIC)

Table 11
Basic Event Descriptions (continued)

36--SGTRDIAG-HE	1.123E-003	3	OPERATOR FAILS TO DIAGNOSE SGTR
36--SLO-DEP--HE	1.000E-006	3	OPERATOR ERRORS LEAD TO LOSS OF RECIRC IN SLO
36-AV-KFOCCF12	3.150E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)36-AV-KFOCCF12
36-AV-LD2----FO	2.168E-003	3	AOV LD-2 FAILS TO OPEN
36-AV-LD2----OC	1.032E-005	4	AOV LD-2 TRANSFERS CLOSED
36-AV-LD3----FO	2.168E-003	3	AOV LD-3 FAILS TO OPEN
36-AV-LD3----OC	1.032E-005	4	AOV LD-3 TRANSFERS CLOSED
36-AV-PR2A---FC	2.458E-003	3	AOV PR-2A FAILS TO CLOSE
36-AV-PR2A---FO	2.458E-003	3	INDEPENDENT FAILUREAOV PR-2A FAILS TO OPEN
36-AV-PR2B---FC	2.458E-003	3	AOV PR-2B FAILS TO CLOSE
36-AV-PR2B---FO	2.458E-003	3	INDEPENDENT FAILUREAOV PR-2B FAILS TO OPEN
36-AVS-PS1A--FO	2.168E-003	3	INDEPENDENT FAILUREAOV PS-1A FAILS TO OPEN
36-AVS-PS1B--FO	2.168E-003	3	INDEPENDENT FAILUREAOV PS-1B FAILS TO OPEN
36-AVSKFOCCF12	2.780E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)36-AVSKFOCCF12
36-CV-MU1011-FC	9.999E-004	3	CHECK VALVE MU-1011FAILS TO CLOSE
36-DC--PQ429-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-429 FAILS
36-DC--PQ430-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-430 FAILS
36-DC--PQ431-FA	9.999E-006	4	INDEPENDENT FAILURELOOP POWER SUPPLY PQ-431 FAILS
36-DC-KFACCF12	6.050E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-429,430
36-DC-KFACCF123	1.290E-007	4	TRIPLE COMMON CAUSE FAILURE (CCF)PQ-429,430,431
36-DC-KFACCF13	6.050E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-429,431
36-DC-KFACCF23	6.050E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PQ-430,431
36-HX-RCPATB-LK	8.721E-003	4	REACTOR COOLANT PUMP A THERMAL BARRIER RUPTURES
36-HX-RCPBTB-LK	8.721E-003	4	REACTOR COOLANT PUMP B THERMAL BARRIER RUPTURES
36-LHSF-DIAG-HE	7.300E-003	3	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK IN FLOOD
36-MV-KFOCCF12	1.210E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)36-MV-KFOCCF12
36-MV-PR1A---AE	7.991E-004	3	OPERATOR FAILS TO OPEN MOV PR-1A AFTER TEST
36-MV-PR1A---FC	3.330E-003	3	MOV PR-1A FAILS TO CLOSE
36-MV-PR1A---FO	3.331E-003	3	INDEPENDENT FAILUREMOV PR-1A FAILS TO OPEN
36-MV-PR1B---AE	7.991E-004	3	OPERATOR FAILS TO OPEN MOV PR-1B AFTER TEST
36-MV-PR1B---FC	3.330E-003	3	MOV PR-1A FAILS TO CLOSE
36-MV-PR1B---FO	3.331E-003	3	INDEPENDENT FAILUREMOV PR-1B FAILS TO OPEN
36-SUBCLGCAL-AE	4.533E-003	3	TECHNICIAN MISCALIBRATES RCS SUBCOOLING
36-SV-33113--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33113 FAILS TO OPEN
36-SV-33114--FO	4.999E-004	3	INDEPENDENT FAILURESOV 33114 FAILS TO OPEN
36-SV-33731--FO	4.999E-004	3	SOV 33731 FAILS TO OPEN
36-SV-KFOCCF12	2.350E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)36-SV-KFOCCF12
36-T450A-CAL-AE	2.397E-003	3	TECHNICIAN MISCALIBRATES RCS HOT LEG TEMP T450
36-T450B-CAL-AE	2.397E-003	3	TECHNICIAN MISCALIBRATES RCS COLD LEG TEMP T450
36-TP--PT419-AE	1.208E-003	3	TECHNICIAN MISCALIBRATES PRESSINSTRUMENT PT-419
36-TP--PT420-AE	1.208E-003	3	TECHNICIAN MISCALIBRATES PRESSINSTRUMENT PT-420
36-TP--PT429-FA	2.999E-006	4	INDEPENDENT FAILUREPRES TRANSMITTER PT-429 FAILS
36-TP--PT430-FA	2.999E-006	4	INDEPENDENT FAILUREPRES TRANSMITTER PT-430 FAILS
36-TP--PT431-FA	2.999E-006	4	INDEPENDENT FAILUREPRES TRANSMITTER PT-431 FAILS
36-TP-KFACCF12	1.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PT-429,430
36-TP-KFACCF123	3.870E-008	4	TRIPLE COMMON CAUSE FAILURE (CCF)PT-429,430,431
36-TP-KFACCF13	1.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PT-429,431
36-TP-KFACCF23	1.820E-008	4	DOUBLE COMMON CAUSE FAILURE (CCF)PT-430,431
36-UV-PR3A---FC	3.000E-003	3	SAFETY VALVE PR-3A FAILS TO CLOSE
36-UV-PR3A---FO	3.000E-004	3	SAFETY VALVE PR-3A FAILS TO OPEN
36-UV-PR3B---FC	3.000E-003	3	SAFETY VALVE PR-3B FAILS TO CLOSE
36-UV-PR3B---FO	3.000E-004	3	SAFETY VALVE PR-3B FAILS TO OPEN
38--DOOR-EDC-HE	7.200E-003	3	OPERATOR FAILS TO OPEN BATTERY ROOM DOORS FOR VNTLTN

Table 11
Basic Event Descriptions (continued)

38--DOOR-EDCSHE (S)	1.000E+000	3	OPERATOR FAILS TO OPEN BATTERY ROOM DOORS FOR VENT
38-ALT-DC-HE BUS	2.000E-001	3	FAILURE TO ALIGN ALT DC POWER SUPPLYTO INSTRUMENT
38-BC-BRA108-OP	2.229E-005	4	INDEPENDENT FAILURE125VDC BATTERY CHARGER BRA-108
38-BC-BRB108-OP	2.229E-005	4	INDEPENDENT FAILURE125VDC BATTERY CHARGER BRB-108
38-BC-BRC108-OP	2.229E-005	4	INDEPENDENT FAILURE125VDC BATTERY CHARGER BRC-108
38-BC-BRD108-OP	2.229E-005	4	INDEPENDENT FAILURE125VDC BATTERY CHARGER BRD-108
38-BCAKOPCCF12	5.550E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)38-BCAKOPCCF12
38-BCCKOPCCF12	5.550E-007	4	DOUBLE COMMON CAUSE FAILURE (CCF)38-BCCKOPCCF12
38-BS-BRA102-SG	2.400E-006	4	125VDC BUS BRA-102 FAILURE
38-BS-BRA104-SG	2.400E-006	4	125VDC BUS BRA-104 FAILURE
38-BS-BRB102-SG	2.400E-006	4	125VDC BUS BRB-102 FAILURE
38-BS-BRB104-SG	2.400E-006	4	125VDC BUS BRB-104 FAILURE
38-BS-BRC102-SG	2.400E-006	4	125VDC BUS BRC-102 FAILURE
38-BS-BRC103-SG	2.400E-006	4	125VDC BUS BRC-103 FAILURE
38-BS-BRD102-SG	2.400E-006	4	125VDC BUS BRD-102 FAILURE
38-BS-BRD103-SG	2.400E-006	4	125VDC BUS BRD-103 FAILURE
38-BY-BRA101-OP	9.957E-005	4	INDEPENDENT FAILURE125VDC BATTERY BRA-101 FAILURE
38-BY-BRB101-OP	9.957E-005	4	INDEPENDENT FAILURE125VDC BATTERY BRB-101 FAILURE
38-BY-BRC101-OP	9.957E-005	4	INDEPENDENT FAILURE125VDC BATTERY BRC-101 FAILURE
38-BY-BRD101-OP	9.957E-005	4	INDEPENDENT FAILURE125VDC BATTERY BRD-101 FAILURE
38-BYAKOPCCF12	1.230E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)38-BYAKOPCCF12
38-BYCKOPCCF12	1.940E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)38-BYCKOPCCF12
38-CBA101----CO	7.512E-006	4	BKR FROM BATTERY BRA-101 TO BUS BRA-102 TRANS OPEN
38-CBA102-04-CO	7.512E-006	4	BKR FROM BUS BRA-102 TO BUS BRA-104 TRANS OPEN
38-CBA102-05-CO	7.512E-006	4	BKR FROM CHARGER BRA-108 TO BUS BRA-102 TRANS OPEN
38-CBA104-01-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 1 TRANSFERSOPEN
38-CBA104-02-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 2 TRANSFERSOPEN
38-CBA104-04-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 4 TRANSFERSOPEN
38-CBA104-06-CO	7.512E-006	4	BREAKER BRA-106 CIRCUIT 6 TRANSFERSOPEN
38-CBA104-07-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 7 TRANSFERSOPEN
38-CBA104-08-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 8 TRANSFERSOPEN
38-CBA104-09-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 9 TRANSFERSOPEN
38-CBA104-12-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 12 TRANSFERS OPEN
38-CBA104-13-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 13 TRANSFERS OPEN
38-CBA104-14-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 14 TRANSFERS OPEN
38-CBA104-15-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 15 TRANSFERS OPEN
38-CBA104-21-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 21 TRANSFERS OPEN
38-CBA104-23-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 23 TRANSFERS OPEN
38-CBA104-28-CO	7.512E-006	4	BREAKER BRA-104 CIRCUIT 28 TRANSFERS OPEN
38-CBB101----CO	7.512E-006	4	BKR FROM BATTERY BRB-101 TO BUS BRB-102 TRANS OPEN
38-CBB102-04-CO	7.512E-006	4	BKR FROM BUS BRB-102 TO BUS BRB-104 TRANS OPEN
38-CBB102-05-CO	7.512E-006	4	BKR FROM CHARGER BRB-108 TO BUS BRB-102 TRANS OPEN
38-CBB104-01-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 1 TRANSFERSOPEN
38-CBB104-02-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 2 TRANSFERSOPEN
38-CBB104-04-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 4 TRANSFERSOPEN
38-CBB104-06-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 6 TRANSFERSOPEN
38-CBB104-12-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 12 TRANSFERS OPEN
38-CBB104-21-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 21 TRANSFERS OPEN
38-CBB104-23-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 23 TRANSFERS OPEN
38-CBB104-28-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 28 TRANSFERS OPEN
38-CBB104-32-CO	7.512E-006	4	BREAKER BRB-104 CIRCUIT 32 TRANSFERS OPEN
38-CBC101----CO	7.512E-006	4	BKR FROM BATTERY BRC-101 TO BUS BRC-102 TRANS OPEN
38-CBC102-04-CO	7.512E-006	4	BKR FROM BUS BRC-102 TO BUS BRC-103 TRANS OPEN
38-CBC102-08-CO	7.512E-006	4	BKR FROM CHARGER BRC-108 TO BUS BRC-102 TRANS OPEN

Table 11
Basic Event Descriptions (continued)

38-CBC103-05-CO	7.512E-006	4	BREAKER BRC-103 CIRCUIT 5 TRANSFERSOPEN
38-CBC103-06-CO	7.512E-006	4	BREAKER BRC-103 CIRCUIT 6 TRANSFERSOPEN
38-CBC103-07-CO	7.512E-006	4	BREAKER BRC-103 CIRCUIT 7 TRANSFERSOPEN
38-CBC103-08-CO	7.512E-006	4	BREAKER BRC-103 CIRCUIT 8 TRANSFERSOPEN
38-CBC103-10-CO	7.512E-006	4	BREAKER BRC-103 CIRCUIT 10 TRANSFERS OPEN
38-CBD101----CO	7.512E-006	4	BKR FROM BATTERY BRD-101 TO BUS BRD-102 TRANS OPEN
38-CBD102-04-CO	7.512E-006	4	BKR FROM BUS BRD-102 TO BUS BRD-103 TRANS OPEN
38-CBD102-08-CO	7.512E-006	4	BKR FROM CHARGER BR-108 TO BUS BRD-102 TRANS OPEN
38-CBD103-03-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 3 TRANSFERSOPEN
38-CBD103-05-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 5 TRANSFERSOPEN
38-CBD103-06-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 6 TRANSFERSOPEN
38-CBD103-07-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 7 TRANSFERSOPEN
38-CBD103-08-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 8 TRANSFERSOPEN
38-CBD103-10-CO	7.512E-006	4	BREAKER BRD-104 CIRCUIT 10 TRANSFERS OPEN
38-CBD103-15-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 15 TRANSFERS OPEN
38-CBD103-27-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 27 TRANSFERS OPEN
38-CBD103-29-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 29 TRANSFERS OPEN
38-CBD103-31-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 31 TRANSFERS OPEN
38-CBD103-32-CO	7.512E-006	4	BREAKER BRD-103 CIRCUIT 32 TRANSFERS OPEN
38-CBD115-12-CO	7.512E-006	4	BREAKER BRD-115 CIRCUIT 12 TRANSFERS OPEN
38-CBD115-23-CO	7.512E-006	4	BREAKER BRD-115 CIRCUIT 23 TRANSFERS OPEN
38IBS-BRA105-SG	2.400E-006	4	BUS BRA-105 FAILURE
38IBS-BRA113-SG	2.400E-006	4	BUS BRA-113 FAILURE
38IBS-BRA114-SG	2.400E-006	4	BUS BRA-114 FAILURE
38IBS-BRA127-SG	2.400E-006	4	BUS BRA-127 FAILURE
38IBS-BRB105-SG	2.400E-006	4	BUS BRB-105 FAILURE
38IBS-BRB113-SG	2.400E-006	4	BUS BRB-113 FAILURE
38IBS-BRB114-SG	2.400E-006	4	BUS BRB-114 FAILURE
38IBS-BRB127-SG	2.400E-006	4	BUS BRB-127 FAILURE
38IBS-BRD115-SG	2.400E-006	4	BUS BRD-115 FAILURE
38ICBA105----CO	7.512E-006	4	BREAKER FROM BRA-106 TO BRA-105 TRANSFERS OPEN
38ICBA105-03-CO	7.512E-006	4	BREAKER BRA-105 CIRCUIT 3 TRANSFERSOPEN
38ICBA105-10-CO	7.512E-006	4	BREAKER BRA-105 CIRCUIT 10 TRANSFERS OPEN
38ICBA105-18-CO	7.512E-006	4	BREAKER BRA-105 CIRCUIT 18 TRANSFERS OPEN
38ICBA105-5A-CO	7.512E-006	4	BREAKER BRA-105 CIRCUIT 5A TRANSFERS OPEN
38ICBA113----CO	7.512E-006	4	BREAKER FROM BRA-111 TO BRA-113 TRANSFERS OPEN
38ICBA114----CO	7.512E-006	4	BREAKER FROM BRA-112 TO BRA-114 TRANSFERS OPEN
38ICBA126----CO	7.512E-006	4	BREAKER FROM BRA-126 TO BRA-127 TRANSFERS OPEN
38ICBA127----CO	7.512E-006	4	BREAKER FROM BRA-106 TO BRA-127 TRANSFERS OPEN
38ICBA127-13-CO	7.512E-006	4	BREAKER BRA-127 CIRCUIT 13 TRANSFERS OPEN
38ICBB105----CO	7.512E-006	4	BREAKER FROM BRB-106 TO BRB-105 TRANSFERS OPEN
38ICBB105-04-CO	7.512E-006	4	BREAKER BRB-105 CIRCUIT 4 TRANSFERSOPEN
38ICBB105-06-CO	7.512E-006	4	BREAKER BRB-105 CIRCUIT 6 TRANSFERSOPEN
38ICBB105-14-CO	7.512E-006	4	BREAKER BRB-105 CIRCUIT 14 TRANSFERS OPEN
38ICBB105-23-CO	7.512E-006	4	BREAKER BRB-105 CIRCUIT 23 TRANSFERS OPEN
38ICBB113----CO	7.512E-006	4	BREAKER FROM BRB-111 TO BRB-113 TRANSFERS OPEN
38ICBB114----CO	7.512E-006	4	BREAKER FROM BRB-112 TO BRB-114 TRANSFERS OPEN
38ICBB126----CO	7.512E-006	4	BREAKER FROM BRB-126 TO BRB-127 TRANSFERS OPEN
38ICBB127----CO	7.512E-006	4	BREAKER FROM BRB-106 TO BRB-127 TRANSFERS OPEN
38ICBB127-23-CO	7.512E-006	4	BREAKER BRB-127 CIRCUIT 23 TRANSFERS OPEN
38ICBB127-33-CO	7.512E-006	4	BREAKER BRB-127 CIRCUIT 33 TRANSFERS OPEN
38ICBD115-14-CO	7.512E-006	4	BREAKER BRD-115 CIRCUIT 14 TRANSFERS OPEN
38IIV-BRA111-OP	2.192E-004	4	INDEPENDENT FAILUREINVERTER BRA-111 FAILURE
38IIV-BRA112-OP	2.192E-004	4	INDEPENDENT FAILUREINVERTER BRA-112 FAILURE
38IIV-BRB111-OP	2.192E-004	4	INDEPENDENT FAILUREINVERTER BRB-111 FAILURE
38IIV-BRB112-OP	2.192E-004	4	INDEPENDENT FAILUREINVERTER BRB-112 FAILURE

Table 11
Basic Event Descriptions (continued)

38IIV-BRD109-OP	2.192E-004	4	INVERTER BRD-109 FAILURE
38IIV-KOPCCF1-4	2.040E-006	3	GLOBAL FAILURE OF 38IIV-KOPCCF1-4
38IIV-KOPCCF12	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF12
38IIV-KOPCCF123	3.690E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF123
38IIV-KOPCCF124	3.690E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF124
38IIV-KOPCCF13	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF13
38IIV-KOPCCF134	3.690E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF134
38IIV-KOPCCF14	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF14
38IIV-KOPCCF23	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF23
38IIV-KOPCCF234	3.690E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF234
38IIV-KOPCCF24	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF24
38IIV-KOPCCF34	7.770E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)38IIV-KOPCCF34
38ISA-BRA107-FC	1.000E-003	3	INDEPENDENT FAILUREAUTO SWITCH BRA-107FAILS TO TRANSFER
38ISA-BRB107-FC	1.000E-003	3	INDEPENDENT FAILUREAUTO SWITCH BRB-107FAILS TO TRANSFER
38ISA-KFCCCF12	4.700E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)38ISA-KFCCCF12
38ISA-SSA111-FC	1.000E-003	3	INVERTER BRA-111 STATIC SWITCH FAILSTO TRANSFER
38ISA-SSA112-FC	1.000E-003	3	INVERTER BRA-112 STATIC SWITCH FAILSTO TRANSFER
38ISA-SSB111-FC	1.000E-003	3	INVERTER BRB-111 STATIC SWITCH FAILSTO TRANSFER
38ISA-SSB112-FC	1.000E-003	3	INVERTER BRB-112 STATIC SWITCH FAILSTO TRANSFER
38ISA-SSD109-FC	1.000E-003	3	INVERTER BRD-109 STATIC SWITCH FAILSTO TRANSFER
38ITR-BRA106-SG	2.400E-005	4	INSTRUMENT BUS TRANSFORMER BRA-106FAILURE
38ITR-BRB106-SG	2.400E-005	4	INSTRUMENT BUS TRANSFORMER BRB-106FAILURE
39-BS-BUS1---SG	2.400E-006	4	BUS 1 FAILURE
39-BS-BUS2---SG	2.400E-006	4	BUS 2 FAILURE
39-BS-BUS3---SG	2.400E-006	4	BUS 3 FAILURE
39-BS-BUS4---SG	2.400E-006	4	BUS 4 FAILURE
39-BS-BUS5---SG	2.400E-006	4	BUS 5 FAILURE
39-BS-BUS6---SG	2.400E-006	4	BUS 6 FAILURE
39-CB--1-303-CO	7.829E-006	4	BREAKER 1-303 TRANSFERS OPEN
39-CB--1-309-CO	7.829E-006	4	BREAKER 1-309 TRANSFERS OPEN
39-CB--1-405-CO	7.829E-006	4	BREAKER 1-405 TRANSFERS OPEN
39-CB--1-406-CO	7.829E-006	4	BREAKER 1-406 TRANSFERS OPEN
39-CB--1-409-CO	7.829E-006	4	BREAKER 1-409 TRANSFERS OPEN
39-CB--1-505-CO	7.829E-006	4	BREAKER 1-505 TRANSFERS OPEN
39-CB--1-607-CO	7.829E-006	4	BREAKER 1-607 TRANSFERS OPEN
39-CB-1-101--FC	4.999E-004	3	BREAKER 1-101 FAILSTO CLOSE
39-CB-1-104--CO	7.829E-006	4	BREAKER 1-104 TRANSFERS OPEN
39-CB-1-104--FC	4.999E-004	3	BREAKER 1-104 FAILSTO CLOSE
39-CB-1-201--FC	4.999E-004	3	BREAKER 1-201 FAILSTO CLOSE
39-CB-1-204--CO	7.829E-006	4	BREAKER 1-204 TRANSFERS OPEN
39-CB-1-204--FC	4.999E-004	3	BREAKER 1-204 FAILSTO CLOSE
39-CB-1-301--CO	7.829E-006	4	BREAKER 1-301 TRANSFERS OPEN
39-CB-1-301--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-301 FAIL TO CLOSE
39-CB-1-306--FO	4.999E-004	3	BREAKER 1-306 FAILSTO OPEN
39-CB-1-307--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-307 FAILSTO CLOSE
39-CB-1-401--CO	7.829E-006	4	BREAKER 1-401 TRANSFERS OPEN
39-CB-1-401--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-401 FAILSTO CLOSE
39-CB-1-403--FO	4.999E-004	3	BREAKER 1-403 FAILSTO OPEN
39-CB-1-407--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-407 FAILSTO CLOSE
39-CB-1-501--CO	7.829E-006	4	BREAKER 1-501 TRANSFERS OPEN
39-CB-1-501--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-501 FAIL TO CLOSE
39-CB-1-501--FO	4.999E-004	3	BREAKER 1-501 FAILSTO OPEN
39-CB-1-502--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-502 FAILSTO OPEN
39-CB-1-503--CO	7.829E-006	4	BREAKER 1-503 TRANSFERS OPEN

Table 11
Basic Event Descriptions (continued)

39-CB-1-503--FC	4.999E-004	3	BREAKER 1-503 FAILSTO CLOSE
39-CB-1-503--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-503 FAILSTO OPEN
39-CB-1-504--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-504 FAILSTO OPEN
39-CB-1-506--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-506 FAILSTO OPEN
39-CB-1-508--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-508 FAILSTO OPEN
39-CB-1-511--CO	7.829E-006	4	BREAKER 1-511 TRANSFERS OPEN
39-CB-1-511--FC	4.999E-004	3	BREAKER 1-511 FAILSTO CLOSE
39-CB-1-511--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-511 FAILSTO OPEN
39-CB-1-601--CO	7.829E-006	4	BREAKER 1-601 TRANSFERS OPEN
39-CB-1-601--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-601 FAILSTO CLOSE
39-CB-1-601--FO	4.999E-004	3	BREAKER 1-601 FAILSTO OPEN
39-CB-1-604--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-604 FAILSTO OPEN
39-CB-1-605--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-605 FAILSTO OPEN
39-CB-1-606--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-606 FAILSTO OPEN
39-CB-1-608--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-608 FAILSTO OPEN
39-CB-1-610--CO	7.829E-006	4	BREAKER 1-610 TRANSFERS OPEN
39-CB-1-610--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-610 FAIL TO CLOSE
39-CB-1-610--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-610 FAILSTO OPEN
39-CB-1-611--CO	7.829E-006	4	BREAKER 1-611 TRANSFERS OPEN
39-CB-1-611--FC	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-611 FAIL TO CLOSE
39-CB-1-611--FO	4.999E-004	3	INDEPENDENT FAILUREBREAKER 1-611 FAILSTO OPEN
39-CB-KFCCCF12	3.710E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)BKRS 307, 407 FTO
39-CB-KFOCCF1-8	1.398E-004	3	COMMON CAUSE FAILURE OF 4160 V BKRS TO OPEN
39-CB3KFCCCF12	3.710E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)BKRS 301, 401 FTO
39-CN---86B5-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 86/B5 CONTACTS XFER OPEN
39-CN---86B6-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 86/B6 CONTACTS XFER OPEN
39-CN-52A166-RC	2.999E-004	3	RELAY 52A/1-606 CONTACTS FAIL
39-CN-KCOCCF1-4	3.050E-005	3	GLOBAL FAILURE OF 39-CN-KCOCCF1-4
39-CN-KCOCCF12	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF12
39-CN-KCOCCF123	5.520E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF123
39-CN-KCOCCF124	5.520E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF124
39-CN-KCOCCF13	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF13
39-CN-KCOCCF134	5.520E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF134
39-CN-KCOCCF14	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF14
39-CN-KCOCCF23	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF23
39-CN-KCOCCF234	5.520E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF234
39-CN-KCOCCF24	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF24
39-CN-KCOCCF34	1.160E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KCOCCF34
39-CN-KRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 39-CN-KRCCCF1-4
39-CN-KRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF12
39-CN-KRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF123
39-CN-KRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF124
39-CN-KRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF13
39-CN-KRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF134
39-CN-KRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF14
39-CN-KRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF23
39-CN-KRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF234
39-CN-KRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF24
39-CN-KRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KRCCCF34
39-CN-KROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-CN-KROCCF12
39-CN50452A1-CO	3.284E-003	4	INDEPENDENT FAILUREBREAKER 1-504 52A-1CONTACTS XFER OPEN
39-CN50452A1-RC	2.999E-004	3	INDEPENDENT FAILUREBREAKER 1-504 52A-1CONTACTS FAIL
39-CN50452A2-CO	3.284E-003	4	INDEPENDENT FAILUREBREAKER 1-504 52A-2CONTACTS XFER OPEN

Table 11
Basic Event Descriptions (continued)

39-CN50452A2-RC	2.999E-004	3	INDEPENDENT FAILUREBREAKER 1-504 52A-2CONTACTS FAIL
39-CN60452A1-CO	3.284E-003	4	INDEPENDENT FAILUREBREAKER 1-604 52A-1CONTACTS XFER OPEN
39-CN60452A1-RC	2.999E-004	3	INDEPENDENT FAILUREBREAKER 1-604 52A-1CONTACTS FAIL
39-CN60452A2-CO	3.284E-003	4	INDEPENDENT FAILUREBREAKER 1-604 52A-2CONTACTS XFER OPEN
39-CN60452A2-RC	2.999E-004	3	INDEPENDENT FAILUREBREAKER 1-604 52A-2CONTACTS FAIL
39-RE-52A166-RF	1.859E-004	4	RELAY 52A/1-606 FAILS TO OPERATE
39-SW--46684-CO	3.719E-004	4	INDEPENDENT FAILURESWITCH 46684 CONTACTS XFER OPEN
39-SW--46685-CO	3.719E-004	4	INDEPENDENT FAILURESWITCH 46685 CONTACTS XFER OPEN
39-SW-KCOCCF12	8.740E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)39-SW-KCOCCF12
39-TR-MAT----SG	2.400E-005	4	MAIN AUXILIARY TRANSFORMER FAILURE
39-TR-RAT----SG	2.400E-005	4	RESERVE AUX TRANSFORMER FAILURE
39-TR-TAT----SG	2.400E-005	4	TERTIARY AUX TRANSFORMER FAILURE
40---MCC5262-HE	1.000E+000	6	OPERATOR FAILS TO SWITCH MCC-5262 TO BUS 62
40--ORP------HE	7.690E-003	3	OPERATOR FAILS TO DEENERGIZE BUSES 33 AND 43
40-BS-BUS32--SG	2.400E-006	4	BUS 32 FAILURE
40-BS-BUS35--SG	2.400E-006	4	BUS 35 FAILURE
40-BS-BUS42--SG	2.400E-006	4	BUS 42 FAILURE
40-BS-BUS45--SG	2.400E-006	4	BUS 45 FAILURE
40-BS-BUS46--SG	2.400E-006	4	BUS 46 FAILURE
40-BS-BUS51--SG	2.400E-006	4	BUS 51 FAILURE
40-BS-BUS52--SG	2.400E-006	4	BUS 52 FAILURE
40-BS-BUS61--SG	2.400E-006	4	BUS 61 FAILURE
40-BS-BUS62--SG	2.400E-006	4	BUS 62 FAILURE
40-BS-MCC32D-SG	2.400E-006	4	MCC-32D FAILURE
40-BS-MCC32G-SG	2.400E-006	4	MCC-32G FAILURE
40-BS-MCC35C-SG	2.400E-006	4	MCC-35C FAILURE
40-BS-MCC35E-SG	2.400E-006	4	MCC-35E FAILURE
40-BS-MCC42B-SG	2.400E-006	4	MCC-42B FAILURE
40-BS-MCC42D-SG	2.400E-006	4	MCC-42D FAILURE
40-BS-MCC42G-SG	2.400E-006	4	MCC-42G FAILURE
40-BS-MCC45B-SG	2.400E-006	4	MCC-45B FAILURE
40-BS-MCC45C-SG	2.400E-006	4	MCC-45C FAILURE
40-BS-MCC45E-SG	2.400E-006	4	MCC-45E FAILURE
40-BS-MCC46B-SG	2.400E-006	4	MCC-46B FAILURE
40-BS-MCC46D-SG	2.400E-006	4	MCC-46D FAILURE
40-BS-MCC5262SG	2.400E-006	4	MCC-5262 FAILURE
40-BS-MCC52A-SG	2.400E-006	4	MCC-52A FAILURE
40-BS-MCC52B-SG	2.400E-006	4	MCC-52B FAILURE
40-BS-MCC52C-SG	2.400E-006	4	MCC-52C FAILURE
40-BS-MCC52D-SG	2.400E-006	4	MCC-52D FAILURE
40-BS-MCC52E-SG	2.400E-006	4	MCC-52E FAILURE
40-BS-MCC52F-SG	2.400E-006	4	MCC-52F FAILURE
40-BS-MCC62A-SG	2.400E-006	4	MCC-62A FAILURE
40-BS-MCC62B-SG	2.400E-006	4	MCC-62B FAILURE
40-BS-MCC62C-SG	2.400E-006	4	MCC-62C FAILURE
40-BS-MCC62D-SG	2.400E-006	4	MCC-62D FAILURE
40-BS-MCC62E-SG	2.400E-006	4	MCC 62E FAILURE
40-BS-MCC62H-SG	2.400E-006	4	MCC-62H FAILURE
40-BS-MCC62J-SG	2.400E-006	4	MCC-62J FAILURE
40-CB--13201-CO	7.512E-006	4	BREAKER 13201 TRANSFERS OPEN
40-CB--13206-CO	7.512E-006	4	BREAKER 13206 TRANSFERS OPEN

Table 11
Basic Event Descriptions (continued)

40-CB--13207-CO	7.512E-006	4	BREAKER 13207 TRANSFERS OPEN
40-CB--13242-FC	4.999E-004	3	BREAKER 13242 FAILSTO CLOSE
40-CB--13301-FO	4.999E-004	3	BREAKER 13301 FAILSTO OPEN
40-CB--13501-CO	7.512E-006	4	BREAKER 13501 TRANSFERS OPEN
40-CB--13505-CO	7.512E-006	4	BREAKER 13505 TRANSFERS OPEN
40-CB--13506-CO	7.512E-006	4	BREAKER 13506 TRANSFERS OPEN
40-CB--13507-CO	7.512E-006	4	BREAKER 13507 TRANSFERS OPEN
40-CB--13545-FC	4.999E-004	3	BREAKER 13545 FAILSTO CLOSE
40-CB--14201-CO	7.512E-006	4	BREAKER 14201 TRANSFERS OPEN
40-CB--14202-CO	7.512E-006	4	BREAKER 14202 TRANSFERS OPEN
40-CB--14207-CO	7.512E-006	4	BREAKER 14207 TRANSFERS OPEN
40-CB--14301-FO	4.999E-004	3	BREAKER 14301 FAILSTO OPEN
40-CB--14501-CO	7.512E-006	4	BREAKER 14502 TRANSFERS OPEN
40-CB--14503-CO	7.512E-006	4	BREAKER 14503 TRANSFERS OPEN
40-CB--14504-CO	7.512E-006	4	BREAKER 14504 TRANSFERS OPEN
40-CB--14505-CO	7.512E-006	4	BREAKER 14505 TRANSFERS OPEN
40-CB--14601-CO	7.512E-006	4	BREAKER 14601 TRANSFERS OPEN
40-CB--14601-FO	4.999E-004	3	BREAKER 14601 FAILSTO OPEN
40-CB--14603-CO	7.512E-006	4	BREAKER 14603 TRANSFERS OPEN
40-CB--14604-FC	4.999E-004	3	BREAKER 14604 FAILSTO CLOSE
40-CB--14605-CO	7.512E-006	4	BREAKER 14605 TRANSFERS OPEN
40-CB--14607-FC	4.999E-004	3	BREAKER 14607 FAILSTO CLOSE
40-CB--15101-CO	7.512E-006	4	BREAKER 15101 TRANSFERS OPEN
40-CB--15101-FO	5.000E-004	3	BREAKER 15101 FAIL TO OPEN
40-CB--15111-CO	7.510E-006	4	BREAKER 15111 TRANSFERS OPEN
40-CB--15111-FC	5.000E-004	3	BREAKER 15111 FAIL TO CLOSE
40-CB--15201-CO	7.512E-006	4	BREAKER 15201 TRANSFERS OPEN
40-CB--15203-CO	7.512E-006	4	BREAKER 15203 TRANSFERS OPEN
40-CB--15203-FC	4.999E-004	3	BREAKER 15203 FAILSTO CLOSE
40-CB--15204-CO	7.512E-006	4	BREAKER 15204 TRANSFERS OPEN
40-CB--15205-CO	7.512E-006	4	BREAKER 15205 TRANSFERS OPEN
40-CB--15206-CO	7.512E-006	4	BREAKER 15206 TRANSFERS OPEN
40-CB--15208-CO	7.512E-006	4	BREAKER 15208 TRANSFERS OPEN
40-CB--15209-CO	7.512E-006	4	BREAKER 15209 TRANSFERS OPEN
40-CB--15210-FC	4.999E-004	3	BREAKER 15210 FAILSTO CLOSE
40-CB--15211-CO	7.510E-006	4	BREAKER 15211 TRANSFERS OPEN
40-CB--16101-CO	7.512E-006	4	BREAKER 16101 TRANSFERS OPEN
40-CB--16111-CO	7.510E-006	4	BREAKER 16111 TRANSFERS OPEN
40-CB--16111-FC	5.000E-004	3	BREAKER 16111 FAILSTO CLOSE
40-CB--16201-CO	7.512E-006	4	BREAKER 16201 TRANSFERS OPEN
40-CB--16204-CO	7.512E-006	4	BREAKER 16204 TRANSFERS OPEN
40-CB--16206-CO	7.512E-006	4	BREAKER 16206 TRANSFERS OPEN
40-CB--16208-CO	7.512E-006	4	BREAKER 16208 TRANSFERS OPEN
40-CB--16209-CO	7.512E-006	4	BREAKER 16209 TRANSFERS OPEN
40-CB--16211-CO	7.510E-006	4	BREAKER 16211 TRANSFERS OPEN
40-CB--16212-CO	7.512E-006	4	BREAKER 16212 TRANSFERS OPEN
40-CB-46B4ABRCO	7.512E-006	4	BREAKER FROM MCC-46B TO BRC-108 TRANSFERS OPEN
40-CB-52C/A2-CO	7.512E-006	4	BREAKER FROM MCC-52C TO BRA-108 TRANSFERS OPEN
40-CB-52C/B3-CO	7.512E-006	4	BREAKER FROM MCC-52C TO BRA-111 TRANSFERS OPEN
40-CB-52C/B4-CO	7.512E-006	4	BREAKER FROM MCC-52C TO BRA-106 TRANSFERS OPEN
40-CB-52C/B5-CO	7.512E-006	4	BREAKER FROM MCC-52C TO BRA-112 TRANSFERS OPEN
40-CB-52E/E5-CO	7.512E-006	4	BREAKER FROM MCC-52E TO BRA-106 TRANSFERS OPEN
40-CB-62C/A2-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRB-111 TRANSFERS OPEN
40-CB-62C/A3-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRB-112 TRANSFERS OPEN
40-CB-62C/A4-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRB-108 TRANSFERS OPEN
40-CB-62C/A7-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRD-108 TRANSFERS OPEN

Table 11
Basic Event Descriptions (continued)

40-CB-62C/B4-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRB-106 TRANSFERS OPEN
40-CB-62C/B6-CO	7.512E-006	4	BREAKER FROM MCC-62C TO BRD-109 TRANSFERS OPEN
40-CB-62E/A2-CO	7.512E-006	4	BREAKER FROM MCC-62E TO BRB-106 TRANSFERS OPEN
40-RE-KOPCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 40-RE-KOPCCF1-4
40-RE-KOPCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF12
40-RE-KOPCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF123
40-RE-KOPCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF124
40-RE-KOPCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF13
40-RE-KOPCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF134
40-RE-KOPCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF14
40-RE-KOPCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF23
40-RE-KOPCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF234
40-RE-KOPCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF24
40-RE-KOPCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)40-RE-KOPCCF34
40-RE-UV32---OP	2.999E-004	3	INDEPENDENT FAILUREBUS 32 UNDERVOLTAGERELAYS FAIL
40-RE-UV35---OP	2.999E-004	3	INDEPENDENT FAILUREBUS 35 UNDERVOLTAGERELAYS FAIL
40-RE-UV42---OP	2.999E-004	3	INDEPENDENT FAILUREBUS 42 UNDERVOLTAGERELAYS FAIL
40-RE-UV45---OP	2.999E-004	3	INDEPENDENT FAILUREBUS 45 UNDERVOLTAGERELAYS FAIL
40-TR--1-32--SG	9.845E-006	4	TRANSFORMER 1-32 FAILURE
40-TR--1-35--SG	9.845E-006	4	TRANSFORMER 1-35 FAILURE
40-TR--1-42--SG	9.845E-006	4	TRANSFORMER 1-42 FAILURE
40-TR--1-45--SG	9.845E-006	4	TRANSFORMER 1-45 FAILURE
40-TR--1-46--SG	9.845E-006	4	TRANSFORMER 1-46 FAILURE
40-TR--1-51--SG	9.845E-006	4	TRANSFORMER 1-51 FAILURE
40-TR--1-52--SG	9.845E-006	4	TRANSFORMER 1-52 FAILURE
40-TR--1-61--SG	9.845E-006	4	TRANSFORMER 1-61 FAILURE
40-TR--1-62--SG	9.845E-006	4	TRANSFORMER 1-62 FAILURE
40-XCONN-BUS-HE	4.725E-002	3	OPERATOR FAILS TO CROSS-CONNECT BUSES51 AND 61
42-CN---BSB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BS/B5 CONTACTS FAIL
42-CN---BSB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BS/B6 CONTACTS FAIL
42-CN---SIB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI/B5 CONTACTS FAIL
42-CN---SIB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI/B5 CONTACTS FAIL
42-CN--27AB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/B5 CONTACTS FAIL
42-CN--27AB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/B6 CONTACTS FAIL
42-CN--27CB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/B5 CONTACTS FAIL
42-CN--27CB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/B6 CONTACTS FAIL
42-CN--27XB5-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/B5 CONTACTS XFER OPEN
42-CN--27XB6-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/B6 CONTACTS XFER OPEN
42-CN--52ZB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52Z/B5 CONTACTS FAIL
42-CN--52ZB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52Z/B6 CONTACTS FAIL
42-CN--83XB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 83X/B5 CONTACTS FAIL
42-CN--83XB5-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 83X/B5 CONTACTS XFER OPEN
42-CN--83XB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 83X/B6 CONTACTS FAIL
42-CN--83XB6-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 83X/B6 CONTACTS XFER OPEN
42-CN--BLSB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BLS/B5 CONTACTS FAIL
42-CN--BLSB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BLS/B6 CONTACTS FAIL
42-CN--BLXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BLX/B5 CONTACTS FAIL
42-CN--BLXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY BLX/B6 CONTACTS FAIL
42-CN--S1XB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S1X/B5 CONTACTS FAIL
42-CN--S1XB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S1X/B6 CONTACTS FAIL
42-CN--S2XB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S2X/B5 CONTACTS FAIL
42-CN--S2XB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S2X/B6 CONTACTS FAIL
42-CN--TDB15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-B1/B5 CONTACTS FAIL
42-CN--TDB16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-B1/B6 CONTACTS FAIL
42-CN--VR157-RO	1.859E-004	4	INDEPENDENT FAILURERELAY VR15-7 CNTCTS TRANS OPEN
42-CN--VR167-RO	1.859E-004	4	INDEPENDENT FAILURERELAY VR16-7 CNTCTS TRANS OPEN

Table 11
Basic Event Descriptions (continued)

42-CN-27AR15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/RAT1-5 CONTACTS FAIL
42-CN-27AR16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/RAT1-6 CONTACTS FAIL
42-CN-27AT15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/TAT1-5 CONTACTS FAIL
42-CN-27AT16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27A/TAT1-6 CONTACTS FAIL
42-CN-27AXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AX/B5 CONTACTS FAIL
42-CN-27AXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AX/B6 CONTACTS FAIL
42-CN-27AYB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AY/B5 CONTACTS FAIL
42-CN-27AYB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AY/B6 CONTACTS FAIL
42-CN-27AZB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AZ/B5 CONTACTS FAIL
42-CN-27AZB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AZ/B6 CONTACTS FAIL
42-CN-27CR15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/RAT1-5 CONTACTS FAIL
42-CN-27CR16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/RAT1-6 CONTACTS FAIL
42-CN-27CT15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/TAT1-5 CONTACTS FAIL
42-CN-27CT16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27C/TAT1-6 CONTACTS FAIL
42-CN-27CXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CX/B5 CONTACTS FAIL
42-CN-27CXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CX/B6 CONTACTS FAIL
42-CN-27CYB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CY/B5 CONTACTS FAIL
42-CN-27CYB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CY/B6 CONTACTS FAIL
42-CN-27CZB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CZ/B5 CONTACTS FAIL
42-CN-27CZB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CZ/B6 CONTACTS FAIL
42-CN-27XR15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27X/R1-5 CONTACTS FAIL
42-CN-27XR16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27X/R1-6 CONTACTS FAIL
42-CN-27XT15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27X/TAT1-5 CONTACTS FAIL
42-CN-27XT16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27X/TAT1-6 CONTACTS FAIL
42-CN-52B501-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-501 CONTACTS FAIL
42-CN-52B503-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-503 CONTACTS FAIL
42-CN-52B509-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-509 CONTACTS FAIL
42-CN-52B510-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-510 CONTACTS FAIL
42-CN-52B511-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-511 CONTACTS FAIL
42-CN-52B601-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-601 CONTACTS FAIL
42-CN-52B602-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-602 CONTACTS FAIL
42-CN-52B603-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-603 CONTACTS FAIL
42-CN-52B610-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-610 CONTACTS FAIL
42-CN-52B611-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52SB/1-611 CONTACTS FAIL
42-CN-52C509-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52CY/1-509 CONTACTS FAIL
42-CN-52C603-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 52CT/1-603 CONTACTS FAIL
42-CN-7AZXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AZX/B5 CONTACTS FAIL
42-CN-7AZXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27AZX/B6 CONTACTS FAIL
42-CN-7CZAB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CAZX/B5 CONTACTS FAIL
42-CN-7CZAB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CAZX/B6 CONTACTS FAIL
42-CN-7CZXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CZX/B5 CONTACTS FAIL
42-CN-7CZXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 27CZX/B6 CONTACTS FAIL
42-CN-83BXB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 83BX1/B5 CONTACTS FAIL
42-CN-83BXB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 83BX1/B6 CONTACTS FAIL
42-CN-83T8A5-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX8A/B5 CONTACTS XFER
42-CN-83T8A6-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX8A/B6 CONTACTS XFER
42-CN-83TX65-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX6/B5 CONTACTS XFER
42-CN-83TX66-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX6/B6 CONTACTS XFER
42-CN-83TX75-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX7/B5 CONTACTS XFER
42-CN-83TX76-RO OPEN	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX7/B6 CONTACTS XFER

Table 11
Basic Event Descriptions (continued)

42-CN-83TX85-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX8/B5 CONTACTS XFER OPEN
42-CN-83TX86-RO	1.859E-004	4	INDEPENDENT FAILURERELAY 83TX8/B6 CONTACTS XFER OPEN
42-CN-9B1X15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X1/B5 CONTACTS FAIL
42-CN-9B1X16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X1/B6 CONTACTS FAIL
42-CN-9B1X25-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X2/B5 CONTACTS FAIL
42-CN-9B1X26-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X2/B6 CONTACTS FAIL
42-CN-9BX2A5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X2A/B5 CONTACTS FAIL
42-CN-9BX2A6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S9B1X2A/B6 CONTACTS FAIL
42-CN-ILS1B5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SILS1/B5 CONTACTS FAIL
42-CN-ILS1B6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SILS1/B6 CONTACTS FAIL
42-CN-ILS2B5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SILS2/B5 CONTACTS FAIL
42-CN-ILS2B6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SILS2/B6 CONTACTS FAIL
42-CN-KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN-KRCCCF12
42-CN-KROCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN-KROCCF12
42-CN-S3X1B5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S3X1/B5 CONTACTS FAIL
42-CN-S3X1B6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S3X1/B6 CONTACTS FAIL
42-CN-S3X2B5-RC	2.999E-004	3	RELAY S3X1/B5 SECOND CONTACT SET FAILS
42-CN-S3X2B6-RC	2.999E-004	3	RELAY S3X1/B6 SECOND CONTACT SET FAILS
42-CN-S5X1B5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S5X1/B5 CONACTS FAIL
42-CN-S5X1B6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S5X1/B6 CONTACTS FAIL
42-CN-S6BOX5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S6BOX/B5 CONTACTS FAIL
42-CN-S6BOX6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S6BOX/B6 CONTACTS FAIL
42-CN-S7BOX5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S7BOX/B5 CONTACTS FAIL
42-CN-S7BOX6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S7BOX/B6 CONTACTS FAIL
42-CN-S8B1X5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S8B1X/B5 CONTACTS FAIL
42-CN-S8B1X6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY S8B1X/B6 CONTACTS FAIL
42-CN-SISEQ5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SISEQ/B5 CONTACTS FAIL
42-CN-SISEQ6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SISEQ/B6 CONTACTS FAIL
42-CN-TDB1X5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-B1X/B5 CONTACTS FAIL
42-CN-TDB1X6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-B1X/B6 CONTACTS FAIL
42-CN-TDBSB5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-BLS/B5 CONTACTS FAIL
42-CN-TDBSB6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-BLS/B6 CONTACTS FAIL
42-CN-TDR9X5-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S9X/B5 CONTACTS FAIL
42-CN-TDR9X6-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S9X/B6 CONTACTS FAIL
42-CN-TDRS15-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S1/B5 CONTACTS FAIL
42-CN-TDRS16-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S1/B6 CONTACTS FAIL
42-CN-TDRS25-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S2/B5 CONTACTS FAIL
42-CN-TDRS26-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S2/B6 CONTACTS FAIL
42-CN-TDRS35-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S3/B5 CONTACTS FAIL
42-CN-TDRS36-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S3/B6 CONTACTS FAIL
42-CN-TDRS55-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S5/B5 CONTACTS FAIL
42-CN-TDRS56-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S5/B6 CONTACTS FAIL
42-CN-TDRS75-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S7/B5 CONTACTS FAIL
42-CN-TDRS76-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S7/B6 CONTACTS FAIL
42-CN-TDRS95-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S9/B5 CONTACTS FAIL
42-CN-TDRS96-RC	2.999E-004	3	INDEPENDENT FAILURERELAY TDR-S9/B6 CONTACTS FAIL
42-CN-TS27A51RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/A/27A/R1-51ST CNTCT SET TR OP
42-CN-TS27A52RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/A/27A/R1-52ND CNTCT SET TR OP
42-CN-TS27A61RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/A/27A/R1-61ST CNTCT SET TR OP
42-CN-TS27A62RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/A/27A/R1-62ND CNTCT SET TR OP

Table 11
Basic Event Descriptions (continued)

42-CN-TS27C51RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/G/27C/R1-51ST CNTCT SET TR OP
42-CN-TS27C52RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/G/27C/R1-52ND CNTCT SET TR OP
42-CN-TS27C61RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/G/27C/R1-61ST CNTCT SET TR OP
42-CN-TS27C62RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/G/27C/R1-62ND CNTCT SET TR OP
42-CN-TSD7A51RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/D/27A/T1-51ST CNTCT SET TR OP
42-CN-TSD7A52RO	1.869E-004	4	INDEPENDENT FAILURERELAY TS/D/27A/T1-52ND CNTCT SET TR OP
42-CN-TSD7A61RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/D/27A/T1-61ST CNTCT SET TR OP
42-CN-TSD7A62RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/D/27A/T1-62ND CNTCT SET TR OP
42-CN-TSH7C51RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/H/27C/T1-51ST CNTCT SET TR OP
42-CN-TSH7C52RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/H/27C/T1-52ND CNTCT SET TR OP
42-CN-TSH7C61RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/H/27C/T1-61ST CNTCT SET TR OP
42-CN-TSH7C62RO	1.859E-004	4	INDEPENDENT FAILURERELAY TS/H/27C/T1-62ND CNTCT SET TR OP
42-CN-VR1511-RO	1.859E-004	4	INDEPENDENT FAILURERELAY VR15-11 CNTCTS TRANS OPEN
42-CN-VR1611-RO	1.859E-004	4	INDEPENDENT FAILURERELAY VR16-11 CNTCTS TRANS OPEN
42-CN/KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)SILS1/B5/B5 FTC
42-CN0KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN0KRCCCF12
42-CN0KROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN0KROCCF12
42-CN1KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KRCCCF12
42-CN1KROCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 42-CN1KROCCF1-4
42-CN1KROCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF12
42-CN1KROCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF123
42-CN1KROCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF124
42-CN1KROCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF13
42-CN1KROCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF134
42-CN1KROCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF14
42-CN1KROCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF23
42-CN1KROCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF234
42-CN1KROCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF24
42-CN1KROCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN1KROCCF34
42-CN2KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN2KRCCCF12
42-CN2KROCCF1-16	2.877E-005	3	GLOBAL FAILURE OF RAT/TAT UNAV CNTCTS
42-CN3KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN3KRCCCF12
42-CN3KROCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN3KROCCF12
42-CN4KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN4KRCCCF12
42-CN5KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN5KRCCCF12
42-CN6KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN6KRCCCF12
42-CN7KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN7KRCCCF12
42-CN8KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN8KRCCCF12
42-CN8KROCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN8KROCCF12
42-CN9KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CN9KRCCCF12
42-CNAKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNAKRCCCF12
42-CNBKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNBKRCCCF12
42-CNCKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNCKRCCCF12
42-CNDKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNDKRCCCF12

Table 11
Basic Event Descriptions (continued)

42-CNEKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNEKRCCCF12
42-CNFKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNFKRCCCF12
42-CNGKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNGKRCCCF12
42-CNHKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNHKRCCCF12
42-CNIKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNIKRCCCF12
42-CNJKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNJKRCCCF12
42-CNKKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNKKRCCCF12
42-CNLKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNLKRCCCF12
42-CNMKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 42-CNMKRCCCF1-4
42-CNMKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF12
42-CNMKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF123
42-CNMKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF124
42-CNMKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF13
42-CNMKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF134
42-CNMKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF14
42-CNMKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF23
42-CNMKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF234
42-CNMKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF24
42-CNMKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNMKRCCCF34
42-CNNKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 42-CNNKRCCCF1-4
42-CNNKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF12
42-CNNKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF123
42-CNNKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF124
42-CNNKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF13
42-CNNKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF134
42-CNNKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF14
42-CNNKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF23
42-CNNKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF234
42-CNNKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF24
42-CNNKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNNKRCCCF34
42-CNPKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 42-CNPKRCCCF1-4
42-CNPKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF12
42-CNPKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF123
42-CNPKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF124
42-CNPKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF13
42-CNPKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF134
42-CNPKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF14
42-CNPKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF23
42-CNPKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF234
42-CNPKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF24
42-CNPKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNPKRCCCF34
42-CNQKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNQKRCCCF12
42-CNRKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNRKRCCCF12
42-CNSKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNSKRCCCF12
42-CNTKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNTKRCCCF12
42-CNTKROCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNTKROCCF12
42-CNUKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNUKRCCCF12
42-CNVKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNVKRCCCF12
42-CNWKRCCCF1-12	3.691E-006	3	GLOBAL FAILURE OF UV RELAYS (CNTCTS)
42-CNWKRCCCFA	1.917E-006	3	COMMON CAUSE FAILURE OF BUS 5 UVRELAYS (CONTACTS)
42-CNWKRCCCFB	1.917E-006	3	COMMON CAUSE FAILURE OF BUS 6 UVRELAYS (CONTACTS)
42-CNXKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNXKRCCCF12
42-CNXKROCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)42-CNXKROCCF12
42-CNYKRCCCF1-10	3.691E-006	3	GLOBAL FAILURE OF AUX RELAYS (CNTCTS)
42-CNYKRCCCFA	1.514E-006	3	COMMON CAUSE FLR OF BUS 5 AUX RELAYS (CONTACTS)
42-CNYKRCCCFB	1.514E-006	3	COMMON CAUSE FLR OF BUS 6 AUX RELAYS (CONTACTS)

Table 11
Basic Event Descriptions (continued)

42-CNZKRCCCF1-10	3.139E-005	3	GLOBAL FAILURE OF BREAKER TRIP CNTCTS
42-RE---BSB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BS/B5 FAILS TO OPERATE
42-RE---BSB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BS/B6 FAILS TO OPERATE
42-RE---SIB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI/B5 FAILS TO OPERATE
42-RE---SIB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI/B5 FAILS TO OPERATE
42-RE--27AB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/B5 MECHANICALLY BOUND
42-RE--27AB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/B6 MECHANICALLY BOUND
42-RE--27CB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/B5 MECHANICALLY BOUND
42-RE--27CB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/B6 MECHANICALLY BOUND
42-RE--52ZB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52Z/B5 MECHANICALLY BOUND
42-RE--52ZB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52Z/B6 MECHANICALLY BOUND
42-RE--83XB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 83X/B5 FAILS TO OPERATE
42-RE--83XB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 83X/B6 FAILS TO OPERATE
42-RE--BLSB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BLS/B5 FAILS TO OPERATE
42-RE--BLSB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BLS/B6 FAILS TO OPERATE
42-RE--BLXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BLX/B5 FAILS TO OPERATE
42-RE--BLXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY BLX/B6 FAILS TO OPERATE
42-RE--S1XB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S1X/B5 FAILS TO OPERATE
42-RE--S1XB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S1X/B6 FAILS TO OPERATE
42-RE--S2XB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S2X/B5 FAILS TO OPERATE
42-RE--S2XB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S2X/B6 FAILS TO OPERATE
42-RE--TDB15-RF	1.859E-004	4	INDEPENDENT FAILURERELAY TDR-B1/B5 FAILS TO OPERATE
42-RE--TDB16-RF	1.859E-004	4	INDEPENDENT FAILURERELAY TDR-B1/B6 FAILS TO OPERATE
42-RE-27AR15-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/RAT1-5 MECHANICALLY BOUND
42-RE-27AR16-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/RAT1-6 MECHANICALLY BOUND
42-RE-27AT15-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/TAT1-5 MECHANICALLY BOUND
42-RE-27AT16-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27A/TAT1-6 MECHANICALLY BOUND
42-RE-27AXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27AX/B5 FAILSTO OPERATE
42-RE-27AXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27AX/B6 FAILSTO OPERATE
42-RE-27AYB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27AY/B5 MECHANICALLY BOUND
42-RE-27AYB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27AY/B6 MECHANICALLY BOUND
42-RE-27AZB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27AZ/B5 MECHANICALLY BOUND
42-RE-27AZB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27AZ/B6 MECHANICALLY BOUND
42-RE-27CR15-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/RAT1-5 MECHANICALLY BOUND
42-RE-27CR16-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/RAT1-6 MECHANICALLY BOUND
42-RE-27CT15-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/TAT1-5 MECHANICALLY BOUND
42-RE-27CT16-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27C/TAT1-6 MECHANICALLY BOUND
42-RE-27CXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CX/B5 FAILSTO OPERATE
42-RE-27CXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CX/B6 FAILSTO OPERATE
42-RE-27CYB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27CY/B5 MECHANICALLY BOUND

Table 11
Basic Event Descriptions (continued)

42-RE-27CYB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27CY/B6 MECHANICALLY BOUND
42-RE-27CZB5-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27CZ/B5 MECHANICALLY BOUND
42-RE-27CZB6-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 27CZ/B6 MECHANICALLY BOUND
42-RE-27XR15-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/R1-5 FAILS TO OPERATE
42-RE-27XR16-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/R1-6 FAILS TO OPERATE
42-RE-27XT15-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/TAT1-5 FAILS TO OPERATE
42-RE-27XT16-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27X/TAT1-6 FAILS TO OPERATE
42-RE-52B501-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-501 MECHANICALLY BOUND
42-RE-52B503-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-503 MECHANICALLY BOUND
42-RE-52B509-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-509 MECHANICALLY BOUND
42-RE-52B510-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-510 MECHANICALLY BOUND
42-RE-52B511-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-511 MECHANICALLY BOUND
42-RE-52B601-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-601 MECHANICALLY BOUND
42-RE-52B602-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-602 MECHANICALLY BOUND
42-RE-52B603-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-603 MECHANICALLY BOUND
42-RE-52B610-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-610 MECHANICALLY BOUND
42-RE-52B611-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52SB/1-611 MECHANICALLY BOUND
42-RE-52C509-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52CY/1-509 MECHANICALLY BOUND
42-RE-52C603-RB	1.859E-004	4	INDEPENDENT FAILURERELAY 52CT/1-603 MECHANICALLY BOUND
42-RE-7AZXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27AZX/B5 FAILS TO OPERATE
42-RE-7AZXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27AZX/B6 FAILS TO OPERATE
42-RE-7CZAB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CAZX/B5 FAILS TO OPERATE
42-RE-7CZAB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CAZX/B6 FAILS TO OPERATE
42-RE-7CZXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CZX/B5 FAILS TO OPERATE
42-RE-7CZXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 27CZX/B6 FAILS TO OPERATE
42-RE-83BXB5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 83BX1/B5 FAILS TO OPERATE
42-RE-83BXB6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY 83BX1/B6 FAILS TO OPERATE
42-RE-9B1X15-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X1/B5 FAILS TO OPERATE
42-RE-9B1X16-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X1/B6 FAILS TO OPERATE
42-RE-9B1X25-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X2/B5 FAILS TO OPERATE
42-RE-9B1X26-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X2/B6 FAILS TO OPERATE
42-RE-9BX2A5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X2A/B5 FAILS TO OPERATE

Table 11
Basic Event Descriptions (continued)

42-RE-9BX2A6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S9B1X2A/B6 FAILS TO OPERATE
42-RE-ILS1B5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SILS1/B5 FAILS TO OPERATE
42-RE-ILS1B6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SILS1/B6 FAILS TO OPERATE
42-RE-ILS2B5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SILS2/B5 FAILS TO OPERATE
42-RE-ILS2B6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SILS2/B6 FAILS TO OPERATE
42-RE-KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE-KRFCCF12
42-RE-S3X1B5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S3X1/B5 FAILSTO OPERATE
42-RE-S3X1B6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S3X1/B6 FAILSTO OPERATE
42-RE-S5X1B5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S5X1/B5 FAILSTO OPERATE
42-RE-S5X1B6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S5X1/B6 FAILSTO OPERATE
42-RE-S6BOX5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S6BOX/B5 FAILS TO OPERATE
42-RE-S6BOX6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S6BOX/B6 FAILS TO OPERATE
42-RE-S7BOX5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S7BOX/B5 FAILS TO OPERATE
42-RE-S7BOX6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S7BOX/B6 FAILS TO OPERATE
42-RE-S8B1X5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S8B1X/B5 FAILS TO OPERATE
42-RE-S8B1X6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY S8B1X/B6 FAILS TO OPERATE
42-RE-SISEQ5-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SISEQ/B5 FAILS TO OPERATE
42-RE-SISEQ6-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SISEQ/B6 FAILS TO OPERATE
42-RE-TDB1X5-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-B1X/B5 FAILS TO OPERATE
42-RE-TDB1X6-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-B1X/B6 FAILS TO OPERATE
42-RE-TDBSB5-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-BLS/B5 FAILS TO OPERATE
42-RE-TDBSB6-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-BLS/B6 FAILS TO OPERATE
42-RE-TDR9X5-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S9X/B5 FAILS TO OPERATE
42-RE-TDR9X6-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S9X/B6 FAILS TO OPERATE
42-RE-TDRS15-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S1/B5 FAILS TO OPERATE
42-RE-TDRS16-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S1/B6 FAILS TO OPERATE
42-RE-TDRS25-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S2/B5 FAILS TO OPERATE
42-RE-TDRS26-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S2/B6 FAILS TO OPERATE
42-RE-TDRS35-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S3/B5 FAILS TO OPERATE
42-RE-TDRS36-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S3/B6 FAILS TO OPERATE
42-RE-TDRS55-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S5/B5 FAILS TO OPERATE
42-RE-TDRS56-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S5/B6 FAILS TO OPERATE
42-RE-TDRS75-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S7/B5 FAILS TO OPERATE
42-RE-TDRS76-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S7/B6 FAILS TO OPERATE
42-RE-TDRS95-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S9/B5 FAILS TO OPERATE
42-RE-TDRS96-RF	1.116E-004	4	INDEPENDENT FAILURERELAY TDR-S9/B6 FAILS TO OPERATE
42-RE0KRBCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE0KRBCCF12

Table 11
Basic Event Descriptions (continued)

42-RE0KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE0KRFCCF12
42-RE1KRBCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 42-RE1KRBCCF1-4
42-RE1KRBCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF12
42-RE1KRBCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF123
42-RE1KRBCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF124
42-RE1KRBCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF13
42-RE1KRBCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF134
42-RE1KRBCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF14
42-RE1KRBCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF23
42-RE1KRBCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF234
42-RE1KRBCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF24
42-RE1KRBCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRBCCF34
42-RE1KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE1KRFCCF12
42-RE2KRBCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 42-RE2KRBCCF1-4
42-RE2KRBCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF12
42-RE2KRBCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF123
42-RE2KRBCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF124
42-RE2KRBCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF13
42-RE2KRBCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF134
42-RE2KRBCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF14
42-RE2KRBCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF23
42-RE2KRBCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF234
42-RE2KRBCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF24
42-RE2KRBCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRBCCF34
42-RE2KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE2KRFCCF12
42-RE3KRBCCF1-12	1.147E-006	3	GLOBAL FAILURE OF UV RELAYS (BOUND)
42-RE3KRBCCFA	5.955E-007	3	COMMON CAUSE FAILURE OF BUS 5 UVRELAYS (BOUND)
42-RE3KRBCCFB	5.955E-007	3	COMMON CAUSE FAILURE OF BUS 6 UVRELAYS (BOUND)
42-RE3KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE3KRFCCF12
42-RE4KRBCCF1-10	9.750E-006	3	GLOBAL FAILURE OF BREAKER TRIP RELAYS
42-RE4KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE4KRFCCF12
42-RE5KRBCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE5KRBCCF12
42-RE5KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE5KRFCCF12
42-RE6KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE6KRFCCF12
42-RE7KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE7KRFCCF12
42-RE8KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE8KRFCCF12
42-RE9KRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RE9KRFCCF12
42-REAKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REAKRFCCF12
42-REBKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REBKRFCCF12
42-RECKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RECKRFCCF12
42-REDKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REDKRFCCF12
42-REEKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REEKRFCCF12
42-REFKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REFKRFCCF12
42-REGKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REGKRFCCF12
42-REHKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REHKRFCCF12
42-REIKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REIKRFCCF12
42-REJKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REJKRFCCF12
42-REKKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REKKRFCCF12
42-RELKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RELKRFCCF12
42-REMKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REMKRFCCF12
42-RENKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RENKRFCCF12
42-REPKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REPKRFCCF12
42-REQKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 42-REQKRFCCF1-4
42-REQKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF12
42-REQKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF123
42-REQKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF124

Table 11
Basic Event Descriptions (continued)

42-REQKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF13
42-REQKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF134
42-REQKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF14
42-REQKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF23
42-REQKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF234
42-REQKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF24
42-REQKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-REQKRFCCF34
42-RERKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RERKRFCCF12
42-RESKRFCCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)42-RESKRFCCF12
42-RETKRFCCF1-10	1.147E-006	3	GLOBAL FAILURE OF AUX RELAYS (FTO)
42-RETKRFCCFA	4.703E-007	3	COMMON CAUSE FLR OF BUS 5 AUX RELAYS (FAIL TO OP)
42-RETKRFCCFB	4.703E-007	3	COMMON CAUSE FLR OF BUS 6 AUX RELAYS (FAIL TO OP)
42-REUKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)SILS1/B5/B6 FTO
43-TR-MAIN---SG	2.400E-005	4	MAIN TRANSFORMER FAILURE
45-RM----R13-AE	9.683E-005	3	TECHNICIAN MISCALIBRATES RMS CHANNEL R-13
45-RM----R14-AE	9.683E-005	3	TECHNICIAN MISCALIBRATES RMS CHANNEL R-14
47--ORT------HE	9.919E-003	3	OPERATOR FAILS TO TRIP REACTOR MANUALLY
47-AD--LC461-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-461B FAILS
47-AD--LC462-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-462A FAILS
47-AD--LC463-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-463C FAILS
47-AD--LC471-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-471B FAILS
47-AD--LC472-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-472A FAILS
47-AD--LC473-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR LC-473C FAILS
47-AD--PC429-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-429A FAILS
47-AD--PC430-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-430A FAILS
47-AD--PC431-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-431A FAILS
47-AD-KFACCF12	5.960E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-AD-KFACCF12
47-AD-KFACCF123	1.610E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-AD-KFACCF123
47-AD-KFACCF13	5.960E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-AD-KFACCF13
47-AD-KFACCF23	5.960E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-AD-KFACCF23
47-ADAKFACC12345 ADAKFACC12345	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACC12346 ADAKFACC12346	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACC12356 ADAKFACC12356	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACC12456 ADAKFACC12456	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACC13456 ADAKFACC13456	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACC23456 ADAKFACC23456	5.141E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACCF1-6	6.880E-007	3	GLOBAL FAILURE OF 47-ADAKFACCF1-6
47-ADAKFACCF12	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF12
47-ADAKFACCF123	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF123
47-ADAKFACCF1234 ADAKFACCF1234	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACCF1235 ADAKFACCF1235	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACCF1236 ADAKFACCF1236	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACCF124	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF124
47-ADAKFACCF1245 ADAKFACCF1245	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-
47-ADAKFACCF1246 ADAKFACCF1246	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-

Table 11
Basic Event Descriptions (continued)

47-ADAKFACCF125	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF125
47-ADAKFACCF1256	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF1256
47-ADAKFACCF126	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF126
47-ADAKFACCF13	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF13
47-ADAKFACCF134	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF134
47-ADAKFACCF1345	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF1345
47-ADAKFACCF1346	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF1346
47-ADAKFACCF135	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF135
47-ADAKFACCF1356	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF1356
47-ADAKFACCF136	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF136
47-ADAKFACCF14	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF14
47-ADAKFACCF145	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF145
47-ADAKFACCF1456	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF1456
47-ADAKFACCF146	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF146
47-ADAKFACCF15	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF15
47-ADAKFACCF156	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF156
47-ADAKFACCF16	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF16
47-ADAKFACCF23	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF23
47-ADAKFACCF234	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF234
47-ADAKFACCF2345	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF2345
47-ADAKFACCF2346	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF2346
47-ADAKFACCF235	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF235
47-ADAKFACCF2356	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF2356
47-ADAKFACCF236	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF236
47-ADAKFACCF24	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF24
47-ADAKFACCF245	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF245
47-ADAKFACCF2456	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF2456
47-ADAKFACCF246	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF246
47-ADAKFACCF25	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF25
47-ADAKFACCF256	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF256
47-ADAKFACCF26	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF26
47-ADAKFACCF34	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF34
47-ADAKFACCF345	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF345
47-ADAKFACCF3456	3.303E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF3456
47-ADAKFACCF346	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF346
47-ADAKFACCF35	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF35
47-ADAKFACCF356	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF356
47-ADAKFACCF36	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF36
47-ADAKFACCF45	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF45
47-ADAKFACCF456	5.703E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF456
47-ADAKFACCF46	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF46
47-ADAKFACCF56	1.643E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-ADAKFACCF56
47-CN--RT1XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT1-XA CONTACTS FAIL
47-CN--RT1XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT1-XB CONTACTS FAIL
47-CN--RT2XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT2-XA CONTACTS FAIL
47-CN--RT2XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT2-XB CONTACTS FAIL

Table 11
Basic Event Descriptions (continued)

47-CN--RT3XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT3-XA CONTACTS FAIL
47-CN--RT3XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT3-XB CONTACTS FAIL
47-CN--RT4XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT4-XA CONTACTS FAIL
47-CN--RT4XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY RT4-XB CONTACTS FAIL
47-CN-46004A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46004-XA CONTACTS FAIL
47-CN-46004A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46004-XA SEC CONTACT SET
47-CN-46004B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46004-XB CONTACTS FAIL
47-CN-46004B2RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46004-XB SEC CONTACT SET
47-CN-46285A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46285-XA CONTACTS FAIL
47-CN-46285A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46285-XA SEC CONTACT SET
47-CN-46285B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46285-XB CONTACTS FAIL
47-CN-46285B2RC	2.999E-004	3	INDEPENDENT FAILURERELAY 46285-XB SEC CONTACT SET
47-CN-71AX306RC	3.000E-004	3	INDEPENDENT FAILURERELAY 71XA/1-306 CONTACTS FAIL
47-CN-71BX403RC	3.000E-004	3	INDEPENDENT FAILURERELAY 71XB/1-403 CONTACTS FAIL
47-CN-AFP1XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY AFP1/XA CONTACTS FAIL
47-CN-AFP1XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY AFP1/XB CONTACTS FAIL
47-CN-AFP2XA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY AFP2/XA CONTACTS FAIL
47-CN-AFP2XB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY AFP2/XB CONTACTS FAIL
47-CN-AMSCXA-RC	2.999E-004	3	RELAY AMSAC/XA CONTACTS FAIL
47-CN-AMSCXA2RC	2.999E-004	3	RELAY AMSAC/XA SECOND CONTACT SET FAILS
47-CN-AMSCXA3RC	2.999E-004	3	RELAY AMSAC/XA THIRD CONTACT SET FAILS
47-CN-AMSCXB-RC	2.999E-004	3	RELAY AMSAC/XB CONTACTS FAIL
47-CN-AMSCXB2RC	2.999E-004	3	RELAY AMSAC/XB SECOND CONTACT SET FAILS
47-CN-LC461B2RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-461B-XA SEC CONTACT SET
47-CN-LC461B3RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-461B-XB SEC CONTACT SET
47-CN-LC461BARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-461B-XA CONTACTS FAIL
47-CN-LC461BBRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-461B-XB CONTACTS FAIL
47-CN-LC462A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-462A-XA SEC CONTACT SET
47-CN-LC462A3RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-462A-XB SEC CONTACT SET
47-CN-LC462AARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-462A-XA CONTACTS FAIL
47-CN-LC462ABRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-462A-XB CONTACTS FAIL
47-CN-LC463CARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-463C-XA CONTACTS FAIL
47-CN-LC463CBRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-463C-XB CONTACTS FAIL
47-CN-LC471B2RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-471B-XA SEC CONTACT SET
47-CN-LC471B3RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-471B-XB SEC CONTACT SET
47-CN-LC471BARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-471B-XA CONTACTS FAIL
47-CN-LC471BBRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-471B-XB CONTACTS FAIL
47-CN-LC472A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-472A-XA SEC CONTACT SET
47-CN-LC472A3RC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-472A-XB SEC CONTACT SET
47-CN-LC472AARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-472A-XA CONTACTS FAIL
47-CN-LC472ABRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-472A-XB CONTACTS FAIL
47-CN-LC473CARC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-473C-XA CONTACTS FAIL
47-CN-LC473CBRC	2.999E-004	3	INDEPENDENT FAILURERELAY LC-473C-XB CONTACTS FAIL
47-CN-PC429A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429A-XA SEC CONTACT SET
47-CN-PC429A3RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429A-XB SEC CONTACT SET
47-CN-PC429AARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429A-XA CONTACTS FAIL

Table 11
Basic Event Descriptions (continued)

47-CN-PC429ABRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429A-XB CONTACTS FAIL
47-CN-PC430A2RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430A-XA SEC CONTACT SET
47-CN-PC430A3RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430A-XB SEC CONTACT SET
47-CN-PC430AARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430A-XA CONTACTS FAIL
47-CN-PC430ABRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430A-XB CONTACTS FAIL
47-CN-PC431AARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431A-XA CONTACTS FAIL
47-CN-PC431ABRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431A-XB CONTACTS FAIL
47-CN1KRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 47-CN1KRCCCF1-4
47-CN1KRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF12
47-CN1KRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF123
47-CN1KRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF124
47-CN1KRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF13
47-CN1KRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF134
47-CN1KRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF14
47-CN1KRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF23
47-CN1KRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF234
47-CN1KRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF24
47-CN1KRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN1KRCCCF34
47-CN2KRCCCF12	1.500E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN2KRCCCF12
47-CN3KRCCCF1-30	3.691E-006	3	GLOBAL COMMON CAUSE FAILURE (CCF)RELAY CONTACTS FAIL
47-CN4RCCCF1-6	3.690E-006	3	SEXTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1-6
47-CN4RCCCF12	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF12
47-CN4RCCCF123	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF123
47-CN4RCCCF1234	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1234
47-CN4RCCCF12345	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF12345
47-CN4RCCCF12346	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF12346
47-CN4RCCCF1235	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1235
47-CN4RCCCF12356	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF12356
47-CN4RCCCF1236	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1236
47-CN4RCCCF124	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF124
47-CN4RCCCF1245	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1245
47-CN4RCCCF12456	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF12456
47-CN4RCCCF1246	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1246
47-CN4RCCCF125	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF125
47-CN4RCCCF1256	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1256
47-CN4RCCCF126	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF126
47-CN4RCCCF13	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF13
47-CN4RCCCF134	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF134
47-CN4RCCCF1345	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1345
47-CN4RCCCF13456	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF13456

Table 11
Basic Event Descriptions (continued)

47-CN4RCCCF1346	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1346
47-CN4RCCCF135	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF135
47-CN4RCCCF1356	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1356
47-CN4RCCCF136	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF136
47-CN4RCCCF14	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF14
47-CN4RCCCF145	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF145
47-CN4RCCCF1456	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF1456
47-CN4RCCCF146	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF146
47-CN4RCCCF15	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF15
47-CN4RCCCF156	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF156
47-CN4RCCCF16	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF16
47-CN4RCCCF23	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF23
47-CN4RCCCF234	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF234
47-CN4RCCCF2345	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF2345
47-CN4RCCCF23456	2.760E-007	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF23456
47-CN4RCCCF2346	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF2346
47-CN4RCCCF235	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF235
47-CN4RCCCF2356	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF2356
47-CN4RCCCF236	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF236
47-CN4RCCCF24	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF24
47-CN4RCCCF245	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF245
47-CN4RCCCF2456	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF2456
47-CN4RCCCF246	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF246
47-CN4RCCCF25	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF25
47-CN4RCCCF256	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF256
47-CN4RCCCF26	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF26
47-CN4RCCCF34	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF34
47-CN4RCCCF345	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF345
47-CN4RCCCF3456	1.770E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF3456
47-CN4RCCCF346	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF346
47-CN4RCCCF35	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF35
47-CN4RCCCF356	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF356
47-CN4RCCCF36	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF36
47-CN4RCCCF45	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF45
47-CN4RCCCF456	3.060E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF456
47-CN4RCCCF46	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF46
47-CN4RCCCF56	8.810E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN4RCCCF56
47-CN71X16761RC	3.000E-004	3	INDEPENDENT FAILURERELAY 71XA/16761 CONTACTS FAIL
47-CN71X16762RC	3.000E-004	3	INDEPENDENT FAILURERELAY 1XA/16762 CONTACTS FAIL
47-CN71X16763RC	3.000E-004	3	INDEPENDENT FAILURERELAY 71XA/16763 CONTACTS FAIL
47-CN71X16764RC	3.000E-004	3	INDEPENDENT FAILURERELAY 1XA/16764 CONTACTS FAIL
47-CN71X16765RC	3.000E-004	3	INDEPENDENT FAILURERELAY 1XA/16765 CONTACTS FAIL
47-CN71X16766RC	3.000E-004	3	INDEPENDENT FAILURERELAY 1XA/16766 CONTACTS FAIL
47-CN8KRCC12345	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12345
47-CN8KRCC12346	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12346

Table 11
Basic Event Descriptions (continued)

47-CN8KRCC12347	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12347
47-CN8KRCC12348	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12348
47-CN8KRCC12356	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12356
47-CN8KRCC12357	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12357
47-CN8KRCC12358	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12358
47-CN8KRCC12367	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12367
47-CN8KRCC12368	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12368
47-CN8KRCC12378	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12378
47-CN8KRCC12456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12456
47-CN8KRCC12457	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12457
47-CN8KRCC12458	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12458
47-CN8KRCC12467	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12467
47-CN8KRCC12468	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12468
47-CN8KRCC12478	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12478
47-CN8KRCC12567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12567
47-CN8KRCC12568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12568
47-CN8KRCC12578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12578
47-CN8KRCC12678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC12678
47-CN8KRCC13456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13456
47-CN8KRCC13457	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13457
47-CN8KRCC13458	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13458
47-CN8KRCC13467	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13467
47-CN8KRCC13468	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13468
47-CN8KRCC13478	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13478
47-CN8KRCC13567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13567
47-CN8KRCC13568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13568
47-CN8KRCC13578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13578
47-CN8KRCC13678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC13678

Table 11
Basic Event Descriptions (continued)

47-CN8KRCC14567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC14567
47-CN8KRCC14568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC14568
47-CN8KRCC14578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC14578
47-CN8KRCC15678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC15678
47-CN8KRCC23456	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23456
47-CN8KRCC23457	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23457
47-CN8KRCC23458	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23458
47-CN8KRCC23467	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23467
47-CN8KRCC23468	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23468
47-CN8KRCC23478	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23478
47-CN8KRCC23567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23567
47-CN8KRCC23568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23568
47-CN8KRCC23578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23578
47-CN8KRCC23678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC23678
47-CN8KRCC24567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC24567
47-CN8KRCC24568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC24568
47-CN8KRCC24578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC24578
47-CN8KRCC24678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC24678
47-CN8KRCC25678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC25678
47-CN8KRCC34567	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC34567
47-CN8KRCC34568	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC34568
47-CN8KRCC34578	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC34578
47-CN8KRCC34678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC34678
47-CN8KRCC35678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC35678
47-CN8KRCC45678	3.940E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCC45678
47-CN8KRCCC1234	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1234
47-CN8KRCCC1235	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1235
47-CN8KRCCC1236	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1236

Table 11
Basic Event Descriptions (continued)

47-CN8KRCCC1237	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1237
47-CN8KRCCC1238	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1238
47-CN8KRCCC1245	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1245
47-CN8KRCCC1246	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1246
47-CN8KRCCC1247	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1247
47-CN8KRCCC1248	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1248
47-CN8KRCCC1256	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1256
47-CN8KRCCC1257	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1257
47-CN8KRCCC1258	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1258
47-CN8KRCCC1267	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1267
47-CN8KRCCC1268	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1268
47-CN8KRCCC1278	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1278
47-CN8KRCCC1345	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1345
47-CN8KRCCC1346	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1346
47-CN8KRCCC1347	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1347
47-CN8KRCCC1348	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1348
47-CN8KRCCC1356	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1356
47-CN8KRCCC1357	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1357
47-CN8KRCCC1358	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1358
47-CN8KRCCC1367	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1367
47-CN8KRCCC1368	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1368
47-CN8KRCCC1378	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1378
47-CN8KRCCC1456	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1456
47-CN8KRCCC1457	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1457
47-CN8KRCCC1458	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1458
47-CN8KRCCC1467	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1467
47-CN8KRCCC1468	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1468
47-CN8KRCCC1478	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1478

Table 11
Basic Event Descriptions (continued)

47-CN8KRCCC1567	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1567
47-CN8KRCCC1568	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1568
47-CN8KRCCC1578	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1578
47-CN8KRCCC1678	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC1678
47-CN8KRCCC2345	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2345
47-CN8KRCCC2346	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2346
47-CN8KRCCC2347	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2347
47-CN8KRCCC2348	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2348
47-CN8KRCCC2356	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2356
47-CN8KRCCC2357	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2357
47-CN8KRCCC2358	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2358
47-CN8KRCCC2367	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2367
47-CN8KRCCC2368	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2368
47-CN8KRCCC2376	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2376
47-CN8KRCCC2378	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2378
47-CN8KRCCC2456	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2456
47-CN8KRCCC2457	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2457
47-CN8KRCCC2458	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2458
47-CN8KRCCC2467	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2467
47-CN8KRCCC2468	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2468
47-CN8KRCCC2478	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2478
47-CN8KRCCC2567	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2567
47-CN8KRCCC2568	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2568
47-CN8KRCCC2578	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2578
47-CN8KRCCC2678	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC2678
47-CN8KRCCC3456	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3456
47-CN8KRCCC3457	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3457
47-CN8KRCCC3458	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3458

Table 11
Basic Event Descriptions (continued)

47-CN8KRCCC3467	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3467
47-CN8KRCCC3468	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3468
47-CN8KRCCC3478	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3478
47-CN8KRCCC3567	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3567
47-CN8KRCCC3568	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3568
47-CN8KRCCC3578	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3578
47-CN8KRCCC3678	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC3678
47-CN8KRCCC4567	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC4567
47-CN8KRCCC4568	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC4568
47-CN8KRCCC4578	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC4578
47-CN8KRCCC4678	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC4678
47-CN8KRCCC5678	5.064E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCC5678
47-CN8KRCCCF1-8	3.691E-006	3	GLOBAL FAILURE SIX OR MORE 47-CN8KRCCCF1-8
47-CN8KRCCCF12	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF12
47-CN8KRCCCF123	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF123
47-CN8KRCCCF124	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF124
47-CN8KRCCCF125	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF125
47-CN8KRCCCF126	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF126
47-CN8KRCCCF127	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF127
47-CN8KRCCCF128	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF128
47-CN8KRCCCF13	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF13
47-CN8KRCCCF134	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF134
47-CN8KRCCCF135	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF135
47-CN8KRCCCF136	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF136
47-CN8KRCCCF137	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF137
47-CN8KRCCCF138	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF138
47-CN8KRCCCF14	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF14
47-CN8KRCCCF145	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF145
47-CN8KRCCCF146	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF146
47-CN8KRCCCF147	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF147
47-CN8KRCCCF148	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF148
47-CN8KRCCCF15	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF15
47-CN8KRCCCF156	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF156
47-CN8KRCCCF157	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF157
47-CN8KRCCCF158	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF158
47-CN8KRCCCF16	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF16
47-CN8KRCCCF167	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF167
47-CN8KRCCCF168	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF168
47-CN8KRCCCF17	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF17
47-CN8KRCCCF178	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF178
47-CN8KRCCCF18	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF18
47-CN8KRCCCF23	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF23
47-CN8KRCCCF234	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF234
47-CN8KRCCCF235	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF235

Table 11
Basic Event Descriptions (continued)

47-CN8KRCCCF236	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF236
47-CN8KRCCCF237	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF237
47-CN8KRCCCF238	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF238
47-CN8KRCCCF24	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF24
47-CN8KRCCCF245	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF245
47-CN8KRCCCF246	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF246
47-CN8KRCCCF247	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF247
47-CN8KRCCCF248	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF248
47-CN8KRCCCF25	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF25
47-CN8KRCCCF256	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF256
47-CN8KRCCCF257	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF257
47-CN8KRCCCF258	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF258
47-CN8KRCCCF26	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF26
47-CN8KRCCCF267	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF267
47-CN8KRCCCF268	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF268
47-CN8KRCCCF27	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF27
47-CN8KRCCCF278	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF278
47-CN8KRCCCF28	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF28
47-CN8KRCCCF34	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF34
47-CN8KRCCCF345	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF345
47-CN8KRCCCF346	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF346
47-CN8KRCCCF347	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF347
47-CN8KRCCCF348	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF348
47-CN8KRCCCF35	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF35
47-CN8KRCCCF356	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF356
47-CN8KRCCCF357	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF357
47-CN8KRCCCF358	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF358
47-CN8KRCCCF36	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF36
47-CN8KRCCCF367	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF367
47-CN8KRCCCF368	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF368
47-CN8KRCCCF37	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF37
47-CN8KRCCCF378	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF378
47-CN8KRCCCF38	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF38
47-CN8KRCCCF45	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF45
47-CN8KRCCCF456	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF456
47-CN8KRCCCF457	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF457
47-CN8KRCCCF458	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF458
47-CN8KRCCCF46	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF46
47-CN8KRCCCF467	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF467
47-CN8KRCCCF468	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF468
47-CN8KRCCCF47	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF47
47-CN8KRCCCF478	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF478
47-CN8KRCCCF48	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF48
47-CN8KRCCCF56	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF56
47-CN8KRCCCF567	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF567
47-CN8KRCCCF568	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF568
47-CN8KRCCCF57	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF57
47-CN8KRCCCF578	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF578
47-CN8KRCCCF58	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF58
47-CN8KRCCCF67	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF67
47-CN8KRCCCF678	1.457E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF678
47-CN8KRCCCF68	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF68
47-CN8KRCCCF78	6.296E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-CN8KRCCCF78
47-CNRKRCCCF1-8	5.762E-006	3	GLOBAL FAILURE OF RX TRP RLYS (CNTCS)
47-CNRKRCCCFA	7.171E-006	3	COMMON CAUSE FLR OF TRAIN A REACTOR TRIP RELAYS (CNTCS)

Table 11
Basic Event Descriptions (continued)

47-CNRKRCCCFB (CNTCS)	7.171E-006	3	COMMON CAUSE FLR OF TRAIN B REACTOR TRIP RELAYS
47-RE--RT1XA-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT1-XA MECH BOUND
47-RE--RT1XB-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT1-XB MECH BOUND
47-RE--RT2XA-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT2-XA MECH BOUND
47-RE--RT2XB-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT2-XB MECH BOUND
47-RE--RT3XA-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT3-XA MECH BOUND
47-RE--RT3XB-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT3-XB MECH BOUND
47-RE--RT4XA-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT4-XA MECH BOUND
47-RE--RT4XB-RB	1.859E-004	4	INDEPENDENT FAILURERELAY RT4-XB MECH BOUND
47-RE-46004A-RF	2.187E-003	4	INDEPENDENT FAILURERELAY 46004-XA FAILS TO OPERATE
47-RE-46004B-RF	2.187E-003	4	INDEPENDENT FAILURERELAY 46004-XB FAILS TO OPERATE
47-RE-46285A-RF	2.187E-003	4	INDEPENDENT FAILURERELAY 46285-XA FAILS TO OPERATE
47-RE-46285B-RF	2.187E-003	4	INDEPENDENT FAILURERELAY 46285-XB FAILS TO OPERATE
47-RE-71AX306RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/1-306 MECH BOUND
47-RE-71BX403RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XB/1-403 MECH BOUND
47-RE-AFP1XA-RF	1.859E-004	4	INDEPENDENT FAILURERELAY AFP1/XA FAILSTO OPERATE
47-RE-AFP1XB-RF	1.859E-004	4	INDEPENDENT FAILURERELAY AFP1/XB FAILSTO OPERATE
47-RE-AFP2XA-RF	1.859E-004	4	INDEPENDENT FAILURERELAY AFP2/XA FAILSTO OPERATE
47-RE-AFP2XB-RF	1.859E-004	4	INDEPENDENT FAILURERELAY AFP2/XB FAILSTO OPERATE
47-RE-AMSCXA-RF	5.597E-004	4	RELAY AMSAC/XA FAILS TO OPERATE
47-RE-AMSCXB-RF	5.597E-004	4	RELAY AMSAC/XB FAILS TO OPERATE
47-RE-KRFCCF1-4	2.040E-005	3	GLOBAL FAILURE OF 47-RE-KRFCCF1-4
47-RE-KRFCCF12	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF12
47-RE-KRFCCF123	3.690E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF123
47-RE-KRFCCF124	3.690E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF124
47-RE-KRFCCF13	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF13
47-RE-KRFCCF134	3.690E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF134
47-RE-KRFCCF14	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF14
47-RE-KRFCCF23	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF23
47-RE-KRFCCF234	3.690E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF234
47-RE-KRFCCF24	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF24
47-RE-KRFCCF34	7.770E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE-KRFCCF34
47-RE-LC461BARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-461B-XA MECH BOUND
47-RE-LC461BBRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-461B-XB MECH BOUND
47-RE-LC462AARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-462A-XA MECH BOUND
47-RE-LC462ABRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-462A-XB MECH BOUND
47-RE-LC463CARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-463C-XA MECH BOUND
47-RE-LC463CBRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-463C-XB MECH BOUND
47-RE-LC471BARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-471B-XA MECH BOUND
47-RE-LC471BBRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-471B-XB MECH BOUND
47-RE-LC472AARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-472A-XA MECH BOUND
47-RE-LC472ABRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-472A-XB MECH BOUND
47-RE-LC473CARB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-473C-XA MECH BOUND
47-RE-LC473CBRB	1.859E-004	4	INDEPENDENT FAILURERELAY LC-473C-XB MECH BOUND
47-RE-PC429AARB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-429A-XA MECH BOUND
47-RE-PC429ABRB	1.859E-004	4	INDEPENDANT FAILUR RELAY PC-429A-XB MECH BOUND
47-RE-PC430AARB	1.859E-004	4	INDEPENDANT FAILUR RELAY PC-430A-XA MECH BOUND
47-RE-PC430ABRB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-430A-XB MECH BOUND
47-RE-PC431AARB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-431A-XA MECH BOUND
47-RE-PC431ABRB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-431A-XB MECH BOUND
47-RE2KRFCCF12	8.200E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE2KRFCCF12
47-RE3KRBCCF1-18	1.147E-006	3	GLOBAL COMMON CAUSE FAILURE (CCF)RELAY MECH. FAILURE
47-RE4RFCCF1-6	2.020E-005	3	SEXTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1-6
47-RE4RFCCF12	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF12

Table 11
Basic Event Descriptions (continued)

47-RE4RFCCF123	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF123
47-RE4RFCCF1234	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1234
47-RE4RFCCF12345	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF12345
47-RE4RFCCF12346	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF12346
47-RE4RFCCF1235	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1235
47-RE4RFCCF12356	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF12356
47-RE4RFCCF1236	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1236
47-RE4RFCCF124	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF124
47-RE4RFCCF1245	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1245
47-RE4RFCCF12456	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF12456
47-RE4RFCCF1246	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1246
47-RE4RFCCF125	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF125
47-RE4RFCCF1256	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1256
47-RE4RFCCF126	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF126
47-RE4RFCCF13	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF13
47-RE4RFCCF134	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF134
47-RE4RFCCF1345	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1345
47-RE4RFCCF13456	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF13456
47-RE4RFCCF1346	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1346
47-RE4RFCCF135	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF135
47-RE4RFCCF1356	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1356
47-RE4RFCCF136	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF136
47-RE4RFCCF14	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF14
47-RE4RFCCF145	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF145
47-RE4RFCCF1456	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF1456
47-RE4RFCCF146	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF146
47-RE4RFCCF15	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF15
47-RE4RFCCF156	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF156
47-RE4RFCCF16	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF16
47-RE4RFCCF23	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF23
47-RE4RFCCF234	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF234
47-RE4RFCCF2345	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF2345
47-RE4RFCCF23456	1.510E-006	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF23456
47-RE4RFCCF2346	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF2346
47-RE4RFCCF235	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF235
47-RE4RFCCF2356	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF2356
47-RE4RFCCF236	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF236

Table 11
Basic Event Descriptions (continued)

47-RE4RFCCF24	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF24
47-RE4RFCCF245	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF245
47-RE4RFCCF2456	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF2456
47-RE4RFCCF246	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF246
47-RE4RFCCF25	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF25
47-RE4RFCCF256	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF256
47-RE4RFCCF26	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF26
47-RE4RFCCF34	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF34
47-RE4RFCCF345	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF345
47-RE4RFCCF3456	9.710E-007	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF3456
47-RE4RFCCF346	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF346
47-RE4RFCCF35	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF35
47-RE4RFCCF356	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF356
47-RE4RFCCF36	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF36
47-RE4RFCCF45	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF45
47-RE4RFCCF456	1.680E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF456
47-RE4RFCCF46	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF46
47-RE4RFCCF56	4.830E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-RE4RFCCF56
47-RE71X16761RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16761 MECH BOUND
47-RE71X16762RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16762 MECH BOUND
47-RE71X16763RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16763 MECH BOUND
47-RE71X16764RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16764 MECH BOUND
47-RE71X16765RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16765 MECH BOUND
47-RE71X16766RB	3.280E-003	4	INDEPENDENT FAILURERELAY 71XA/16766 MECH BOUND
47-REAKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 47-REAKRFCCF1-4
47-REAKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF12
47-REAKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF123
47-REAKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF124
47-REAKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF13
47-REAKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF134
47-REAKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF14
47-REAKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF23
47-REAKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF234
47-REAKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF24
47-REAKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-REAKRFCCF34
47-RERKRBCCF1-8	1.790E-006	3	GLOBAL FAILURE OF RX TRP RLYS (BOUND)
47-RERKRBCCFA	2.288E-006	3	COMMON CAUSE FLR OF TRAIN A REACTOR TRIP RELAYS (BOUND)
47-RERKRBCCFB	2.288E-006	3	COMMON CAUSE FLR OF TRAIN B REACTOR TRIP RELAYS (BOUND)
47-SD----PLC-FA	2.999E-007	4	AMSAC PROCESSOR MINI-PLC-2/16 FAILS
47-SD--OO-05-FA	3.353E-003	4	AMSAC AC ISOLATED OUTPUT CARD OO-05 FAILS
47-SD-AMSCPS-FA	1.114E-002	4	AMSAC RACK POWER SUPPLY 1771-P3 FAILS
47-SD-INP121-FA	2.999E-006	4	AMSAC ISOLATED ANALOG INPUT CARD MODULE 2 121 FAILS
47-SD-INP130-FA	2.999E-006	4	AMSAC ISOLATED ANALOG INPUT CARD MODULE 3 130 FAILS
47-SD-PLCCPS-FA	9.999E-006	4	AMSAC PROCESSOR INTEGRAL POWER SUPPLY FAILS
47-SW--46004-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH 46004 CONTACTS XFER OPEN
47-SW--46285-CO	4.370E-003	4	INDEPENDENT FAILURESWITCH 46285 CONTACTS XFER OPEN
47-SW-ABLOCK-CO	1.119E-003	4	AMSAC BLOCK SWITCH CONTACTS TRANSFER OPEN
47-SW-KCOCCF12	1.030E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)47-SW-KCOCCF12
47-SY-RPSTRA-TM	4.870E-003	3	RPS TRAIN A UNAVAILABLE DUE TO TEST OR MAINTENANCE
47-SY-RPSTRB-TM	4.160E-003	3	RPS TRAIN B UNAVAILABLE DUE TO TEST OR MAINTENANCE

Table 11
Basic Event Descriptions (continued)

49-CB----BYA-FO	9.639E-004	3	BREAKER BYA FAILS TO OPEN
49-CB----BYB-FO	9.639E-004	3	BREAKER BYB FAILS TO OPEN
49-CB----RTA-FO	1.132E-003	3	INDEPENDENT FAILUREBREAKER RTA FAILS TO OPEN
49-CB----RTB-FO	1.132E-003	3	INDEPENDENT FAILUREBREAKER RTB FAILS TO OPEN
49-CB-KFOCCF12	1.740E-004	3	DOUBLE COMMON CAUSE FAILURE (CCF)49-CB-KFOCCF12
49-CN52X3302-RC	2.999E-004	3	RELAY 52AX/13302 CONTACTS FAIL
49-CN52X4302-RC	2.999E-004	3	RELAY 52AX/14302 CONTACTS FAIL
49-RE52X3302-RF	5.597E-004	4	RELAY 52AX/13302 FAILS TO ACTUATE
49-RE52X4302-RF	5.597E-004	4	RELAY 52AX/14302 FAILS TO ACTUATE
49-ROD-MECH--FA	1.800E-006	3	CONTROL RODS FAIL TO DROP INTO THE CORE
51-CV-NG214--FO	5.000E-005	3	CHECK VALVE NG-214 FAILS TO OPEN
51-CV-NG224--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE NG-224 FAILS TO OPEN
51-CV-NG234--FO	5.000E-005	3	INDEPENDENT FAILURECHECK VALVE NG-234 FAILS TO OPEN
51-CV-NG244--FO	5.000E-005	3	CHECK VALVE NG-244 FAILS TO OPEN
51-CV2KFOCCF12	1.080E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)51-CV2KFOCCF12
51-GB-CHP1A--LK	9.598E-004	4	CHARGING PUMP A SPEED CONT NITROGENCYLINDER LEAKS
51-GB-CVC-7--LK	9.598E-004	4	CVC-7 NITROGEN CYLINDER LEAKS
51-GB-KLKCCF12	2.260E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)51-GB-KLKCCF12
51-GB-SD3A---LK	9.598E-004	4	INDEPENDENT FAILURESD-3A NITROGEN CYLINDER LEAKS
51-GB-SD3B---LK	9.598E-004	4	INDEPENDENT FAILURESD-3B NITROGEN CYLINDER LEAKS
51-XV-NG62---FO	1.000E-004	3	MANUAL VALVE NG-62 FAILS TO OPEN
55-AD--PC429-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-429C FAILS
55-AD--PC430-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-430E FAILS
55-AD--PC431-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-431G FAILS
55-AD--PC945-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-945-BFAILS
55-AD--PC946-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-946-BFAILS
55-AD--PC947-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-947-BFAILS
55-AD--PC948-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-948-BFAILS
55-AD--PC949-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-949-BFAILS
55-AD--PC950-FA	1.116E-004	4	INDEPENDENT FAILURECOMPARATOR PC-950-BFAILS
55-AD-KFACCF12	6.780E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD-KFACCF12
55-AD-KFACCF123	1.440E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-AD-KFACCF123
55-AD-KFACCF13	6.780E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD-KFACCF13
55-AD-KFACCF23	6.780E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD-KFACCF23
55-AD5KFACCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD5KFACCF12
55-AD7KFACCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD7KFACCF12
55-AD9KFACCF12	2.630E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-AD9KFACCF12
55-CN-----VA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY VA CONTACTS FAIL
55-CN-----VB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY VB CONTACTS FAIL
55-CN----CIA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CIA CONTACTS FAIL
55-CN----CIB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CIB CONTACTS FAIL
55-CN----CSA-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CSA CONTACTS FAIL
55-CN----CSB-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CSB CONTACTS FAIL
55-CN---CIRA-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CIRA CONTACTS2, 6 TRANSFER OPEN
55-CN---CIRB-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CIRB CONTACTS2, 6 TRANSFER OPEN
55-CN---CPRA-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CPRA CONTACTS3, 7 TRANSFER OPEN
55-CN---CPRB-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CPRB CONTACTS3, 7 TRANSFER OPEN
55-CN---CSRA-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CSRA CONTACTS2, 6 TRANSFER OPEN

Table 11
Basic Event Descriptions (continued)

55-CN---CSRB-RO	1.859E-004	4	INDEPENDENT FAILURERELAY CSRB CONTACTS2, 6 TRANSFER OPEN
55-CN---SIRA-RO	1.859E-004	4	INDEPENDENT FAILURERE SIR-A CONTACTS 2, 6 TRANSFER OPEN
55-CN---SIRB-RO	1.859E-004	4	INDEPENDENT FAILURERE SIR-B CONTACTS 2, 6 TRANSFER OPEN
55-CN---TRA2-RO	1.859E-004	4	INDEPENDENT FAILURERELAY TRA2 CONTACTS3, 7 TRANSFER OPEN
55-CN---TRB2-RO	1.859E-004	4	INDEPENDENT FAILURERELAY TRB2 CONTACTS3, 7 TRANSFER OPEN
55-CN---V11X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY V11X CONTACTSFAIL
55-CN---V21X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY V21X CONTACTSFAIL
55-CN--CI13X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CI13X CONTACTS FAIL
55-CN--CI20X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CI20X CONTACTS FAIL
55-CN--CP10X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CP10X CONTACTS FAIL
55-CN--CP20X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CP20X CONTACTS FAIL
55-CN--CS10X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CONTACTS FAIL
55-CN--CS20X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY CONTACTS FAIL
55-CN--F10X1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY F10X-1 CONTACTS FAIL
55-CN--F20X1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY F20X-1 CONTACTS FAIL
55-CN--F30X1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY F30X-1 CONTACTS FAIL
55-CN--F40X1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY F40X-1 CONTACTS FAIL
55-CN--SI14X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI14X CONTACTS FAIL
55-CN--SI15X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI15X CONTACTS FAIL
55-CN--SI24X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI24X CONTACTS FAIL
55-CN--SI25X-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SI25X CONTACTS FAIL
55-CN--SIAA1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SIA-A1 CONTACTS FAIL
55-CN--SIAA2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SIA-A2 CONTACTS FAIL
55-CN--SIAB1-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SIA-B1 CONTACTS FAIL
55-CN--SIAB2-RC	2.999E-004	3	INDEPENDENT FAILURERELAY SIA-B2 CONTACTS FAIL
55-CN--SIBAX-RO	1.859E-004	4	INDEPENDENT FAILURERE SIB-AX CONTACTS 3, 7 TRANSFER OPEN
55-CN--SIBBX-RO	1.859E-004	4	INDEPENDENT FAILURERE SIB-BX CONTACTS 3, 7 TRANSFER OPEN
55-CN-KRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 55-CN-KRCCCF1-4
55-CN-KRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF12
55-CN-KRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF123
55-CN-KRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF124
55-CN-KRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF13
55-CN-KRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF134
55-CN-KRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF14
55-CN-KRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF23
55-CN-KRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF234
55-CN-KRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF24
55-CN-KRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN-KRCCCF34
55-CN-PBRCIA-RO	1.859E-004	4	INDEPENDENT FAILUREPUSHBUTTON PB/RCIA CONTACTS XFER OPEN
55-CN-PBRCIB-RO	1.859E-004	4	INDEPENDENT FAILUREPUSHBUTTON PB/RCIB CONTACTS XFER OPEN
55-CN-PBRCSA-RO	1.859E-004	4	INDEPENDENT FAILUREPUSHBUTTON PB/RCSA CONTACTS XFER OPEN
55-CN-PBRCSB-RO	1.859E-004	4	INDEPENDENT FAILUREPUSHBUTTON PB/RCSB CONTACTS XFER OPEN
55-CN-PC429C2RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429C-XA SEC CONTACT SET

Table 11
Basic Event Descriptions (continued)

55-CN-PC429C3RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429C-XB SEC CONTACT SET
55-CN-PC429CARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429C-XA CONTACTS FAIL
55-CN-PC429CBRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-429C-XB CONTACTS FAIL
55-CN-PC430EARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430E-XA CONTACTS FAIL
55-CN-PC430EBRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-430E-XB CONTACTS FAIL
55-CN-PC431G2RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431G-XA SEC CONTACT SET
55-CN-PC431G3RC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431G-XB SEC CONTACT SET
55-CN-PC431GARC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431G-XA CONTACTS FAIL
55-CN-PC431GBRC	2.999E-004	3	INDEPENDENT FAILURERELAY PC-431G-XB CONTACTS FAIL
55-CN-PT945A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-945-XA CONTACTS FAIL
55-CN-PT945B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-945-XB CONTACTS FAIL
55-CN-PT946A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-946-XA CONTACTS FAIL
55-CN-PT946B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-946-XB CONTACTS FAIL
55-CN-PT947A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-947-XA CONTACTS FAIL
55-CN-PT947B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-947-XB CONTACTS FAIL
55-CN-PT948A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-948-XA CONTACTS FAIL
55-CN-PT948B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-948-XB CONTACTS FAIL
55-CN-PT949A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-949-XA CONTACTS FAIL
55-CN-PT949B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-949-XB CONTACTS FAIL
55-CN-PT950A-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-950-XA CONTACTS FAIL
55-CN-PT950B-RC	2.999E-004	3	INDEPENDENT FAILURERELAY PT-950-XB CONTACTS FAIL
55-CN-S14X09-RO	1.859E-004	4	INDEPENDENT FAILURERELAY SI14X CONTACT9 TRANSFERS OPEN
55-CN-S14X13-RO	1.859E-004	4	INDEPENDENT FAILURERELAY SI14X CONTACT13 TRANSFERS OPEN
55-CN-S24X09-RO	1.859E-004	4	INDEPENDENT FAILURERELAY SI24X CONTACT9 TRANSFERS OPEN
55-CN-S24X13-RO	1.859E-004	4	INDEPENDENT FAILURERELAY SI24X CONTACT13 TRANSFERS OPEN
55-CN1KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KRCCCF12
55-CN1KROCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-CN1KROCCF1-4
55-CN1KROCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF12
55-CN1KROCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF123
55-CN1KROCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF124
55-CN1KROCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF13
55-CN1KROCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF134
55-CN1KROCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF14
55-CN1KROCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF23
55-CN1KROCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF234
55-CN1KROCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF24
55-CN1KROCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN1KROCCF34
55-CN2KROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN2KROCCF12
55-CN3KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)CI13X,CI20X CNT FL
55-CN4KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN4KRCCCF12
55-CN5KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN5KRCCCF12
55-CN7KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN7KRCCCF12
55-CN8KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN8KRCCCF12
55-CN9KRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CN9KRCCCF12
55-CNAKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNAKRCCCF12
55-CNAKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNAKROCCF12
55-CNBKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNBKRCCCF12
55-CNBKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNBKROCCF12

Table 11
Basic Event Descriptions (continued)

55-CNCKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNCKRCCCF12
55-CNCKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNCKROCCF12
55-CNDKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNDKRCCCF12
55-CNDKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNDKROCCF12
55-CNEKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNEKROCCF12
55-CNFKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 55-CNFKRCCCF1-4
55-CNFKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF12
55-CNFKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF123
55-CNFKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF124
55-CNFKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF13
55-CNFKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF134
55-CNFKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF14
55-CNFKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF23
55-CNFKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF234
55-CNFKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF24
55-CNFKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKRCCCF34
55-CNFKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNFKROCCF12
55-CNGKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNGKRCCCF12
55-CNHKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNHKRCCCF12
55-CNJKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 55-CNJKRCCCF1-4
55-CNJKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF12
55-CNJKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF123
55-CNJKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF124
55-CNJKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF13
55-CNJKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF134
55-CNJKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF14
55-CNJKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF23
55-CNJKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF234
55-CNJKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF24
55-CNJKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNJKRCCCF34
55-CNKKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 55-CNKKRCCCF1-4
55-CNKKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF12
55-CNKKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF123
55-CNKKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF124
55-CNKKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF13
55-CNKKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF134
55-CNKKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF14
55-CNKKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF23
55-CNKKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF234
55-CNKKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF24
55-CNKKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNKKRCCCF34
55-CNLKRCCCF1-4	5.580E-006	3	GLOBAL FAILURE OF 55-CNLKRCCCF1-4
55-CNLKRCCCF12	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF12
55-CNLKRCCCF123	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF123
55-CNLKRCCCF124	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF124
55-CNLKRCCCF13	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF13
55-CNLKRCCCF134	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF134
55-CNLKRCCCF14	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF14
55-CNLKRCCCF23	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF23
55-CNLKRCCCF234	1.010E-006	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF234
55-CNLKRCCCF24	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF24
55-CNLKRCCCF34	2.130E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNLKRCCCF34
55-CNPKROCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNPKROCCF12
55-CNVKRCCCF12	1.410E-005	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-CNVKRCCCF12
55-RE-----VA-RF	1.859E-004	4	INDEPENDENT FAILURERELAY VA FAILS TO OPERATE
55-RE-----VB-RF	1.859E-004	4	INDEPENDENT FAILURERELAY VB FAILS TO OPERATE

Table 11
Basic Event Descriptions (continued)

55-RE----CIA-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CIA FAILS TO OPERATE
55-RE----CIB-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CIB FAILS TO OPERATE
55-RE----CSA-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CSA FAILS TO OPERATE
55-RE----CSB-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CSB FAILS TO OPERATE
55-RE---V11X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY V11X FAILS FAILS TO OPERATE
55-RE---V21X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY V21X FAILS TOOPERATE
55-RE--CI13X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CI13X FAILS TO OPERATE
55-RE--CI20X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CI20X FAILS TO OPERATE
55-RE--CP10X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CP10X FAILS TO OPERATE
55-RE--CP20X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CP20X FAILS TO OPERATE
55-RE--CS10X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CS10X FAILS TO OPERATE
55-RE--CS20X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY CS20X FAILS TO OPERATE
55-RE--F10X1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY F10X-1 FAILS TO OPERATE
55-RE--F20X1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY F20X-1 FAILS TO OPERATE
55-RE--F30X1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY F30X-1 FAILS TO OPERATE
55-RE--F40X1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY F40X-1 FAILS TO OPERATE
55-RE--SI14X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI14X FAILS TO OPERATE
55-RE--SI15X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI15X FAILS TO OPERATE
55-RE--SI24X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI24X FAILS TO OPERATE
55-RE--SI25X-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SI25X FAILS TO OPERATE
55-RE--SIAA1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SIA-A1 FAILS TO OPERATE
55-RE--SIAA2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SIA-A2 FAILS TO OPERATE
55-RE--SIAB1-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SIA-B1 FAILS TO OPERATE
55-RE--SIAB2-RF	1.859E-004	4	INDEPENDENT FAILURERELAY SIA-B2 FAILS TO OPERATE
55-RE-KRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-RE-KRFCCF1-4
55-RE-KRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF12
55-RE-KRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF123
55-RE-KRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF124
55-RE-KRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF13
55-RE-KRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF134
55-RE-KRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF14
55-RE-KRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF23
55-RE-KRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF234
55-RE-KRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF24
55-RE-KRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RE-KRFCCF34
55-RE-PC429CARB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-429C-XA MECH BOUND
55-RE-PC429CBRB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-429C-XB MECH BOUND
55-RE-PC430EARB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-430E-XA MECH BOUND
55-RE-PC430EBRB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-430E-XB MECH BOUND
55-RE-PC431GARB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-431G-XA MECH BOUND
55-RE-PC431GBRB	1.859E-004	4	INDEPENDENT FAILURERELAY PC-431G-XB MECH BOUND
55-RE-PT945A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-945-XA FAILS TO OPERATE
55-RE-PT945B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-945-XB FAILS TO OPERATE
55-RE-PT946A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-946-XA FAILS TO OPERATE
55-RE-PT946B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-946-XB FAILS TO OPERATE
55-RE-PT947A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-947-XA FAILS TO OPERATE
55-RE-PT947B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-947-XB FAILS TO OPERATE
55-RE-PT948A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-948-XA FAILS TO OPERATE

Table 11
Basic Event Descriptions (continued)

55-RE-PT948B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-948-XB FAILS TO OPERATE
55-RE-PT949A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-949-XA FAILS TO OPERATE
55-RE-PT949B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-949-XB FAILS TO OPERATE
55-RE-PT950A-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-950-XA FAILS TO OPERATE
55-RE-PT950B-RF	1.859E-004	4	INDEPENDENT FAILURERELAY PT-950-XB FAILS TO OPERATE
55-REAKFACC12345	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC12345
55-REAKFACC12346	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC12346
55-REAKFACC12356	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC12356
55-REAKFACC12456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC12456
55-REAKFACC13456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC13456
55-REAKFACC23456	8.569E-008	3	QUINTUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACC23456
55-REAKFACCF1-6	1.147E-006	3	GLOBAL FAILURE OF 55-REAKFACCF1-6
55-REAKFACCF12	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF12
55-REAKFACCF123	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF123
55-REAKFACCF1234	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1234
55-REAKFACCF1235	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1235
55-REAKFACCF1236	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1236
55-REAKFACCF124	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF124
55-REAKFACCF1245	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1245
55-REAKFACCF1246	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1246
55-REAKFACCF125	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF125
55-REAKFACCF1256	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1256
55-REAKFACCF126	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF126
55-REAKFACCF13	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF13
55-REAKFACCF134	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF134
55-REAKFACCF1345	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1345
55-REAKFACCF1346	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1346
55-REAKFACCF135	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF135
55-REAKFACCF1356	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1356
55-REAKFACCF136	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF136
55-REAKFACCF14	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF14
55-REAKFACCF145	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF145
55-REAKFACCF1456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF1456
55-REAKFACCF146	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF146
55-REAKFACCF15	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF15

Table 11
Basic Event Descriptions (continued)

55-REAKFACCF156	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF156
55-REAKFACCF16	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF16
55-REAKFACCF23	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF23
55-REAKFACCF234	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF234
55-REAKFACCF2345	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF2345
55-REAKFACCF2346	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF2346
55-REAKFACCF235	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF235
55-REAKFACCF2356	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF2356
55-REAKFACCF236	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF236
55-REAKFACCF24	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF24
55-REAKFACCF245	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF245
55-REAKFACCF2456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF2456
55-REAKFACCF246	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF246
55-REAKFACCF25	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF25
55-REAKFACCF256	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF256
55-REAKFACCF26	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF26
55-REAKFACCF34	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF34
55-REAKFACCF345	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF345
55-REAKFACCF3456	5.505E-008	3	QUADRUPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF3456
55-REAKFACCF346	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF346
55-REAKFACCF35	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF35
55-REAKFACCF356	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF356
55-REAKFACCF36	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF36
55-REAKFACCF45	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF45
55-REAKFACCF456	9.506E-008	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF456
55-REAKFACCF46	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF46
55-REAKFACCF56	2.738E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKFACCF56
55-REAKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REAKRFCCF12
55-REBKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REBKRFCCF12
55-RECKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RECKRFCCF12
55-REDKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REDKRFCCF12
55-REEKRFCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)55-REEKRFCCF12
55-REFKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-REFKRFCCF1-4
55-REFKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF12
55-REFKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF123
55-REFKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF124
55-REFKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF13
55-REFKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF134
55-REFKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF14
55-REFKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF23
55-REFKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF234
55-REFKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF24
55-REFKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REFKRFCCF34
55-REGKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REGKRFCCF12
55-REHKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-REHKRFCCF1-4
55-REHKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF12
55-REHKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF123
55-REHKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF124
55-REHKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF13
55-REHKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF134
55-REHKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF14

Table 11
Basic Event Descriptions (continued)

55-REHKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF23
55-REHKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF234
55-REHKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF24
55-REHKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REHKRFCCF34
55-REIKRFCCF12	4.370E-006	4	DOUBLE COMMON CAUSE FAILURE (CCF)RLYS CI13X, 20X FL
55-REJKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-REJKRFCCF1-4
55-REJKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF12
55-REJKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF123
55-REJKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF124
55-REJKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF13
55-REJKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF134
55-REJKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF14
55-REJKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF23
55-REJKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF234
55-REJKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF24
55-REJKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REJKRFCCF34
55-REKKRFCCF1-4	1.730E-006	3	GLOBAL FAILURE OF 55-REKKRFCCF1-4
55-REKKRFCCF12	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF12
55-REKKRFCCF123	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF123
55-REKKRFCCF124	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF124
55-REKKRFCCF13	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF13
55-REKKRFCCF134	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF134
55-REKKRFCCF14	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF14
55-REKKRFCCF23	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF23
55-REKKRFCCF234	3.130E-007	3	TRIPLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF234
55-REKKRFCCF24	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF24
55-REKKRFCCF34	6.600E-007	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REKKRFCCF34
55-RESKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-RESKRFCCF12
55-REVKRFCCF12	4.370E-006	3	DOUBLE COMMON CAUSE FAILURE (CCF)55-REVKRFCCF12
55-SY---ESF1-SF	4.865E-003	3	TRAIN A CONTAINMENTPRESSURE SIGNAL FAILS
55-SY---ESF3-SF	4.865E-003	3	TRAIN B CONTAINMENTPRESSURE SIGNAL FAILS
55-SY--FWISO-FA	1.415E-004	3	FEEDWATER ISOLATIONSIGNAL FAILS
55-SY-ESFTRA-TM	3.410E-003	3	ESFAS TRAIN A UNAVAILABLE DUE TO TEST OR MAINTENANCE
55-SY-ESFTRB-TM	3.110E-003	3	ESFAS TRAIN B UNAVAILABLE DUE TO TEST OR MAINTENANCE
56-CI-CAT-A--SF	1.200E-004	3	ISOLATION FAILURE OF CATEGORY A PENETRATIONS
56-CI-CAT-B--HE	1.200E-002	3	OPERATOR FAILS TO ISOLATE CATEGORY B PENETRATIONS
56-CI-CAT-B-SHE	1.000E+000	3	OPERATOR FAILS TO ISOLATE CATEGORY B PENETRATIONS (SEIS)
56-LCTMT-HI--AE	9.999E-005	3	TECHNICIAN MISCALIBRATES CNT HIGH RANGE LEVEL HI
56-LCTMT-LOW-AE	9.999E-005	3	TECHNICIAN MISCALIBRATES CNT HIGH RANGE LEVEL LO
59-OSPRCVR-B-HE	1.880E-002	3	FAILURE TO RECOVER OSP BEFORE BOILING
59-OSPRCVR-D-HE	4.415E-002	3	FAILURE TO RECOVER OSP BEFORE CORE DAMAGE
67-DM-TCV200-OC	1.288E-006	4	DAMPER TCV-200 TRANSFERS CLOSED
67-DM-TCV210-OC	1.288E-006	4	DAMPER TCV-210 TRANSFERS CLOSED
86-INSTRFCRF-HE	1.800E-002	3	FAIL TO CONTROL AFW
86-INSTRRCRF-HE	1.800E-002	3	FAIL TO CONTROL AFW
8HR/2HR-FAILS	2.300E-001	3	FAILURE TO RECOVER OSP WITHIN 8 HRS GIVEN 2HR-FAILS
8HR/2HR-SUCCESS	7.700E-001	3	OSP IS RECOVRD WITHIN 8 HOURS GIVEN 2HR-FAILS
AC-0159	4.115E-001	3	OFFSITE POWER NOT RECOVERED WITHIN 1 HOUR, 59 MINUTES
AC-0159-SUC	5.885E-001	3	OFFSITE POWER RECOVERED WITHIN 1 HOURS, 59 MINUTES

Table 11
Basic Event Descriptions (continued)

AC-0221	3.547E-001	3	OFFSITE POWER NOT RECOVERED WITHIN 2 HOURS, 21 MINUTES
AC-0221-SUC	6.453E-001	3	OFFSITE POWER RECOVERED WITHIN 2 HOURS, 21 MINUTES
AC-0241	3.427E-001	3	OFFSITE POWER NOT RECOVERED WITHIN 2 HOURS, 41 MINUTES
AC-0241-SUC	6.573E-001	3	OFFSITE POWER RECOVERED WITHIN 2 HOURS, 41 MINUTES
AC-0356	3.045E-001	3	OFFSITE POWER NOT RECOVERED WITHIN 3 HOURS, 56 MINUTES
AC-0715	1.761E-001	3	OFFSITE POWER NOT RECOVERED WITHIN 7 HOURS, 15 MINUTES
AC-0715-SUC	8.239E-001	3	OFFSITE POWER RECOVERED WITHIN 7 HOURS, 15 MINUTES
AC-1632	7.958E-002	3	OFFSITE POWER RECOVERED WITHIN 16HOURS, 32 MINUTES
AC-1632-SUC	9.204E-001	3	OFFSITE POWER RECOVERED WITHIN 16HOURS, 32 MINUTES
BOIL	1.000E+000	3	BOIL FLAG
BR-PIPE	5.000E-003	3	LOW PRESSURE RESIDUAL HEAT REMOVAL PIPE FAILS
CD	1.000E+000	3	CORE DAMAGE FLAG
CPCWLTB	1.000E-004	3	FAILURE OF AUTO CIRC WTR PUMP TRIP ON HI WTR LEVEL
CURB	2.500E-001	3	Curb Installed 75% of time
CWPUMPTRIPNA	1.000E+000	3	Failure to Trip CW Pumps (No Impact on Flooding)
CX06-ISOL-A	5.000E-001	3	Fail to Isolate Before Failure of any Buses CW Mod
CX06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP CW Mod
CX06-ISOL-C	5.000E-001	3	FAIL TO ISOLATE BEFORE FAILURE OF BUS 6 CW MOD
CX06-ISOL-D	5.000E-001	3	FAIL TO ISOLATE BEFORE 18 INCHES ON TDAFP CW MOD
DC-LONGTERM	3.000E-001	3	LONGTERM DC POWER VIA ALT BATTERY CHGR
DUMMY	0.000E+000	3	DUMMY TO PREVENT DOUBLE COUNTING OF HUMAN ERRORS
FAIL-PTL-CX--HE	1.000E-001	3	Fail to Take from PTL Mod CW Break
FAIL-PTL-FI--HE	1.000E-001	3	Fail to Take from PTL Large FP Break
FAIL-PTL-SI--HE	1.000E-001	3	Fail to Take from PTL Large SW Break
FAIL-PTL-TI--HE	1.000E-001	3	Fail to Take from PTL Large STM Break
FAIL-PTL-TX--HE	1.000E-001	3	Fail to Take from PTL Mod STM Break
FAIL-PTL-WI--HE	1.000E-001	3	Fail to Take from PTL Large FW Break
FAIL-PTL-WX--HE	1.000E-001	3	Fail to Take from PTL Mod FW Break
FAILBATRMCLG-HE	7.900E-002	3	Fail to Establish Battery Room Cooling
FAILCOOLRCSCXHE	1.000E-001	3	Fail to Cooldown RCS Moderate CW Break
FAILCOOLRCSFIHE	1.000E-001	3	Fail to Cooldown RCS Large FP Break
FAILCOOLRCSSIHE	1.000E-001	3	Fail to Cooldown RCS Large SW Break
FAILCOOLRCSTIHE	1.000E-001	3	Fail to Cooldown RCS Large STM Break
FAILCOOLRCSTXHE	1.000E-001	3	Fail to Cooldown RCS Moderate STM Break
FAILCOOLRCSWIHE	1.000E-001	3	Fail to Cooldown RCS Large FW Break
FAILCOOLRCSWXHE	1.000E-001	3	Fail to Cooldown RCS Moderate FW Break
FAILTDPON-CX-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING MOD CW BREAK
FAILTDPON-FI-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING LARGE FP BREAK
FAILTDPON-SI-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING LARGE SW BREAK
FAILTDPON-TI-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING LARGE STM BREAK
FAILTDPON-TX-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING MOD STM BREAK
FAILTDPON-WI-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING LARGE FW BREAK
FAILTDPON-WX-HE	9.000E-001	3	FAIL TO MAINTAIN TDAFP RUNNING MOD FW BREAK
FAULT-A	5.000E-001	3	STEAM GENERATOR A IS FAULTED
FAULT-B	5.000E-001	3	STEAM GENERATOR B IS FAULTED
FI06-ISOL-A	5.000E-001	3	Fail to Isolate Before Failure of any Buses FP Large
FI06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP FP Large
FI06-ISOL-C	5.000E-001	3	Fail to Start MDAFPFP Large
FL-ATWS	1.000E+000	6	ATWS FLAG
FL-BUS5-FAIL	1.000E+000	6	BUS 5 FAILS
FL-BUS6-FAIL	1.000E+000	6	BUS 6 FAILS

Table 11
Basic Event Descriptions (continued)

FL-CRRV-NEED	1.000E+000	6	CONTROL ROOM AND RELAY ROOM VENT NEEDED FOR CFCUS
FL-DGA-FAIL	1.000E+000	6	DIESEL GENERATOR A FAILS
FL-DGB-FAIL	1.000E+000	6	DIESEL GENERATOR B FAILS
FL-EPS-RECOV	1.000E+000	6	OFFSITE POWER HAS BEEN RECOVERED
FL-EPS-SUCC	1.000E+000	6	EPS SUCCESS
FL-GDRN-FLD	1.000E+000	6	RWST GRAV DRN FAILED BY PLANT CONDITIONS
FL-HPI-A	1.000E+000	6	HIGH PRESSURE INJECTION TRAIN A FAILS
FL-HPI-B	1.000E+000	6	HIGH PRESSURE INJECTION TRAIN B FAILS
FL-HPI-SUCC	1.000E+000	6	HIGH PRESSURE INJECTION IS SUCCESSFUL
FL-LATE	1.000E+000	6	LATE SEQUENCES POWER RECOVERY APPLIES
FL-OSP-INIT	1.000E+000	6	OFFSITE POWER LOST DUE TO THE INITIATOR
FL-RECOV	1.000E+000	6	LOSS OF OFFSITE POWER IS RECOVERED
FL-RHR-A	1.000E+000	6	FAILURE OF RHR TRAIN A IN SI AND COOLDOWN MODE
FL-RHR-B	1.000E+000	6	FAILURE OF RHR TRAIN B IN SI AND COOLDOWN MODE
FL-SIACF-PWR	1.000E+000	6	POWER TO AIR COMPRESSOR F FAILS
FL-SIACG-PWR	1.000E+000	6	POWER TO AIR COMPRESSOR G FAILS
FL-SLO-LERF	1.000E+000	6	SMALL LOCA LEADING TO LERF
FL-SWA-FAIL	1.000E+000	6	SERVICE WATER TRAINA FAILS
FL-SWB-FAIL	1.000E+000	6	SERVICE WATER TRAINB FAILS
FLB-A-CNTMNT	8.887E-003	3	BREAK IN FEEDWATER LINE A IN CONTAINMENT
FLB-A-ISOL	1.995E-001	3	BREAK IN FEEDWATER LINE A UPSTREAM OF FW-7A
FLB-A-UNISOL	7.716E-002	3	BREAK IN FEEDWATER LINE A BETWEEN FW-7A AND FW-13A
FLB-B-CNTMNT	5.888E-003	3	BREAK IN FEEDWATER LINE B IN CONTAINMENT
FLB-B-ISOL	3.183E-002	3	BREAK IN FEEDWATER LINE B UPSTREAM OF FW-7B
FLB-B-UNISOL	7.645E-002	3	BREAK IN FEEDWATER LINE B BETWEEN FW-7B AND FW-13B
FPLISOTB	1.000E-002	3	FAILURE TO ISOLATE FIRE PROT LINE BRK IN TURB BLDG
IE-CI06B	2.790E-005	3	LARGE CIRC WTR LINE BREAK IN TURB BLDG BASEMENT
IE-CWLTB	1.000E-003	3	LARGE CIRC WTR LINE BREAK IN TURB BLDG BASEMENT
IE-CX06B	1.970E-005	3	MEDIUM CIRC WTR LINE BREAK IN TURB BLDG BASEMENT
IE-FI02B	0.000E+000	3	LARGE FIRE PROT PIPE BREAK IN DG 1A ROOM
IE-FI04B	0.000E+000	3	LARGE FIRE PROT PIPE BREAK IN CARDOX ROOM
IE-FI06B	7.080E-005	3	LARGE FIRE PROTECT LINE BREAK IN TURB BLDG BASEMENT
IE-FIR1	0.000E+000	3	FIRE NEAR MCC-62J OCCURS
IE-FIR10	0.000E+000	3	FIRE IN BUS 5 SWITCHES IN ECCA OCCURS
IE-FIR11	0.000E+000	3	FIRE IN BUS 6 SWITCHES IN ECCA OCCURS
IE-FIR12	0.000E+000	3	FIRE IN SG PORV SWITCHES IN MCCA OCCURS
IE-FIR13	0.000E+000	3	FIRE IN PRZR PORV SWITCHES IN MCCC OCCURS
IE-FIR14	0.000E+000	3	FIRE IN DIESEL GENERATOR ROOM A OCCURS
IE-FIR2	0.000E+000	3	FIRE IN CABLE SPREADING ROOM OCCURS
IE-FIR3	0.000E+000	3	FIRE IN BUS 1 AND 2ROOM OCCURS
IE-FIR4	0.000E+000	3	FIRE IN DIESEL GENERATOR ROOM B OCCURS
IE-FIR5	0.000E+000	3	FIRE IN RELAY ROOM OCCURS
IE-FIR6	0.000E+000	3	AUXILIARY FEEDWATERPUMP A OIL FIRE OCCURS
IE-FIR7	0.000E+000	3	AUXILIARY FEEDWATERPUMP B OIL FIRE OCCURS
IE-FIR8	0.000E+000	3	FIRE NEAR BUSES 51 AND 52 OCCURS
IE-FIR9	0.000E+000	3	FIRE DUE TO GAS BOTTLES ON FAN FLOOR OCCURS
IE-FLD1	0.000E+000	3	FLOOD FROM CW LINESIN TURBINE BUILDINGOCCURS
IE-FLD10	0.000E+000	3	FLOOD FROM SW HDR IN SCREENHOUSE OCCURS
IE-FLD2	0.000E+000	3	FLOOD FROM SERVICE WATER LINES IN AUX BLDG N BSMNT OCCURS
IE-FLD2A	0.000E+000	3	UNISOLABLE FLOOD FROM SI LINES IN ABN BSMNT OCCURS
IE-FLD2B	0.000E+000	3	ISOLABLE FLOOD FROM SI LINES IN ABN BSMNT OCCURS
IE-FLD3	0.000E+000	3	FLOOD FROM SW LINESIN DG ROOM A OCCURS
IE-FLD4	0.000E+000	3	FLOOD FROM SW LINE IN DG ROOM B OCCURS
IE-FLD5	0.000E+000	3	FLOOD FROM CONDENSATE LINE IN AFW PMP B RM OCCURS

Table 11
Basic Event Descriptions (continued)

IE-FLD5A OCCURS	0.000E+000	3	FLOOD FROM SERVICE WATER LINES IN AFW PUMP B RM
IE-FLD6	0.000E+000	3	FLOOD FROM SW LINE IN CRDM EQUIPMENT ROOM OCCURS
IE-FLD7	0.000E+000	3	FLOOD FROM SW HEADER IN BUS 51/52ROOM OCCURS
IE-FLD8 OCCURS	0.000E+000	3	FLOOD FROM SERVICE WATER LINES IN SI PUMP AREA
IE-FLD8A OCCURS	0.000E+000	3	UNISOLABLE FLOOD FROM SI LINES IN SIPUMP AREA
IE-FLD8B	0.000E+000	3	ISOLABLE FLOOD FROMSI LINES IN SI PUMP AREA OCCURS
IE-FLD9	0.000E+000	3	FLOOD FROM SW LINE IN SG BLOWDOWN AREA OCCURS
IE-FPA-1PUMP	0.000E+000	3	LOSS OF TRN-A FPC COMPONENTS, SHUTDOWN INIT.
IE-FPA-BUS	0.000E+000	3	LOSS OF TRN-A ELECTRICAL SUPPORT SYSTEMS TO FPC
IE-FPB-1PUMP	0.000E+000	3	LOSS OF TRN-B FPC COMPONENTS, SHUTDOWN INIT.
IE-FPB-BUS	0.000E+000	3	LOSS OF TRN-B ELECTRICAL SUPPORT SYSTEMS TO FPC
IE-FPC-HX	0.000E+000	3	INITIATOR FAILING FPC HX FLOW TO FPC HX
IE-FPC-PUMPS	0.000E+000	3	INITIATOR FAILING BOTH FPC PUMPS
IE-FPLTB BASEMENT	1.000E-003	3	LARGE FIRE PROTECT LINE BREAK IN TURB BLDG
IE-FWLTB	1.000E-003	3	LARGE FEEDWATER BREAK IN TURBINE BLDG BASEMENT
IE-ISL	0.000E+000	3	INTERFACING SYSTEM LOSS OF COOLANT ACCIDENT OCCURS
IE-LLO	0.000E+000	3	LARGE BREAK LOSS OFCOOLANT ACCIDENT OCCURS
IE-LOSP	0.000E+000	3	LOSS OF OFFSITE POWER OCCURS
IE-MK05B	0.000E+000	3	SMALL MISCELLANEOUSPIPE BREAK NEAR BUS 51/52
IE-MK5B3	0.000E+000	3	SMALL MISCELLANEOUSPIPE BREAK NEAR MDAFP 1B
IE-MLO	0.000E+000	3	MEDIUM LOSS OF COOLANT ACCIDENT OCCURS
IE-NK5B3	0.000E+000	3	SMALL CST PIPE BREAK NEAR MDAFP 1B
IE-NK5B4	0.000E+000	3	SMALL CST PIPE BREAK NEAR TDAFP
IE-RHA-1PUMP	0.000E+000	3	LOSS OF TRN-A RHR COMPONENTS, SHUTDOWN INIT.
IE-RHA-BUS	0.000E+000	3	LOSS OF TRN-A ELECTRICAL SUPPORT SYSTEMS TO RHR
IE-RHA-HX	0.000E+000	3	LOSS OF TRN-A RHR HEAT EXCHANGER COOLING
IE-RHB-1PUMP	0.000E+000	3	LOSS OF TRN-B COMPONENTS, SHUTDOWN INIT.
IE-RHB-BUS	0.000E+000	3	LOSS OF TRN-B ELECTRICAL SUPPORT SYSTEMS TO RHR
IE-RHB-HX	0.000E+000	3	LOSS OF TRN-B RHR HEAT EXCHANGER COOLING
IE-RHR-HXS	0.000E+000	3	INITIATOR FAILING RHR HX FLOW TO BOTH HXS
IE-RHR-MIDLOOP TRNS	0.000E+000	3	FAILURE TO MAINTAINLEVEL IN MIDLOOP FAILS BOTH RHR
IE-RHR-OVERDRN LVL	0.000E+000	3	RCS OVERDRAIN WHILEGOING TO MIDLOOP, FLR TO MAINT
IE-RHR-PUMPS	0.000E+000	3	INTIATOR FAILING BOTH RHR PUMPS
IE-SC02B	0.000E+000	3	LARGE TRAIN A SW PIPE BREAK NEAR DG 1A
IE-SC22B	0.000E+000	3	LARGE TRAIN A SW BRK IN SCREENHOUSE
IE-SE05B	0.000E+000	3	SMALL TRAIN A SW PIPE BREAK NEAR BUS 51/52
IE-SE5B2	0.000E+000	3	SMALL TRAIN A SW PIPE BREAK NEAR MDAFP 1A
IE-SE5B3	0.000E+000	3	SMALL TRAIN A SW PIPE BREAK NEAR MDAFP 1B
IE-SEIS	0.000E+000	3	SEISMIC EVENT OCCURS
IE-SF02B	0.000E+000	3	LARGE TRAIN B SW PIPE BREAK NEAR DG 1A
IE-SF03B	0.000E+000	3	LARGE TRAIN B SW PIPE BREAK NEAR DG 1B
IE-SF22B	0.000E+000	3	LARGE TRAIN B SW BRK IN SCREENHOUSE
IE-SGTR	0.000E+000	3	STEAM GENERATOR TUBE RUPTURE OCCURS
IE-SH05B	0.000E+000	3	SMALL TRAIN B SW PIPE BREAK NEAR BUS 51/52
IE-SH5B2	0.000E+000	3	SMALL TRAIN B SW PIPE BREAK NEAR MDAFP 1A
IE-SH5B3	0.000E+000	3	SMALL TRAIN B SW PIPE BREAK NEAR MDAFP 1B
IE-SI04B	0.000E+000	3	LARGE SW PIPE BREAK IN CARDOX ROOM
IE-SI05B	0.000E+000	3	LARGE SW PIPE BREAK IN SAFEGUARDS ALLEY
IE-SI06B	3.220E-005	3	LARGE SERVICE WTR LINE BREAK IN TURB BLDG BASEMENT
IE-SI22B	0.000E+000	3	LARGE SW BRK IN SCREENHOUSE

Table 11
Basic Event Descriptions (continued)

IE-SK5B3	0.000E+000	3	SMALL ISOLABLE SW PIPE BREAK NEAR MDAFP 1B
IE-SK5B4	0.000E+000	3	SMALL SW BRK NEAR TDAFP
IE-SLB	0.000E+000	3	STEAM OR FEEDWATER LINE BREAK OCCURS
IE-SLO	0.000E+000	3	SMALL BREAK LOSS OF COOLANT ACCIDENTOCCURS
IE-SLOFP	0.000E+000	3	FUEL POOL SMALL LOCA INITIATING EVENT
IE-SOPORV	0.000E+000	3	STUCK OPEN PORV OCCURS
IE-SWLTB	1.000E-003	3	LARGE SERVICE WTR LINE BREAK IN TURB BLDG BASEMENT
IE-TB5	0.000E+000	3	MULTIPLIER FOR LOSSOF 4160 V AC BUS 5 IE FREQUENCY
IE-TB6	0.000E+000	3	MULTIPLIER FOR LOSSOF 4160 V AC BUS 6 IE FREQUENCY
IE-TCC	0.000E+000	3	MULTIPLIER FOR LOSSOF COMPONENT COOLING IE FREQ
IE-TDA	0.000E+000	3	MULTIPLIER FOR LOSSOF 125 V DC BUS BRA-104 IE FREQ
IE-TDB	0.000E+000	3	MULTIPLIER FOR LOSSOF 125 V DC BUS BRB-104 IE FREQ
IE-TI06B	2.530E-004	3	STEAMLINE BRK IN TURB BLDG CAUSESLARGE FIRE PROT
IE-TIA	0.000E+000	3	MULTIPLIER FOR LOSSOF INSTRUMENT AIR IE FREQUENCY
IE-TMF	1.000E+000	6	LOSS OF MAIN FEEDWATER OCCURS
IE-TRA	0.000E+000	3	TRANSIENT WITH MAIN FEEDWATER AVAILABLE OCCURS
IE-TSW	0.000E+000	3	MULTIPLIER FOR LOSSOF SERVICE WATER IE FREQUENCY
IE-TX06B	1.870E-005	3	STEAMLINE BRK IN TURB BLDG CAUSESMEDIUM FIRE PROT
IE-VEF	0.000E+000	3	VESSEL FAILURE OCCURS
IE-WI06B	1.350E-004	3	LARGE FEEDWATER BREAK IN TURBINE BLDG BASEMENT
IE-WX06B	4.690E-005	3	MEDIUM FEEDWATER BREAK IN TURBINE BLDG BASEMENT
ISL-ISOLATE	5.000E-001	3	ISL IS SUCCESSFULLYISOLATED EARLY
LERF	1.000E+000	3	LERF FLAG
LL-SUCT	1.740E-002	3	LOCA LOCATION IS INTHE RHR SUCTION PIPING
LLO-CLA	2.500E-001	3	LARGE COLD LEG LOCAIN LOOP A
LLO-CLB	2.500E-001	3	LARGE COLD LEG LOCAIN LOOP B
LLO-MT-ICSA	5.263E-002	3	1 HOUR MISSION TIMEFOR ICS ACTUATION
LLO-MT-ICSB	5.263E-002	3	1 HOUR MISSION TIMEFOR ICS ACTUATION
LMLO-MT-LPI	3.750E-001	3	9 HOUR MISSION TIMEFOR LPI IN LARGE AND MEDIUM LOCA
LOCA-A	2.500E-001	3	LOCA IS IN RCS LOOP A COLD LEG
LOCA-B	2.500E-001	3	LOCA IS IN RCS LOOPB COLD LEG
LOSP-24	9.277E-005	3	LOSS OF ALL POWER FROM GRID DURING 24HOURS
MLO-CLA	1.593E-001	3	MEDIUM COLD LEG LOCA IN LOOP A
MLO-CLB	1.593E-001	3	MEDIUM COLD LEG LOCA IN LOOP B
MLO-MT-AFW	3.750E-001	3	9 HOUR MISSION TIMEFOR AFW IN AN MLO
MLO-MT-MFW	3.750E-001	3	9 HOUR MISSION TIMEFOR MFW IN MEDIUM LOCA
NO INSTPWRFPHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO INSTPWRTIHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO INSTPWRTXHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO INSTPWRWIHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO INSTPWRWXHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO LONG-TERM DC	1.000E-002	3	Long Term DC Fails
NO-INSTPWRCXHE	1.000E-001	3	Failure to Align Inst Inverter to Alt Source Mod CW
NO-INSTPWRFIHE	1.000E-001	3	Failure to Supply Instruemtn Pwr from Norm or Backup
NO-INSTPWRFPHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO-INSTPWRSIHE	1.000E-001	3	Failure to Align Inst Inverter to Alt Source Larg SW

Table 11
Basic Event Descriptions (continued)

NO-INSTPWRTIHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO-INSTPWRTXHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO-INSTPWRWIHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO-INSTPWRWXHE	1.000E-001	3	Failure to Supply Instrument Pwr from Norm & Backup
NO-LONG-TERM-DC	1.000E-002	3	Long Term DC Fails
NOALTBATCHGCXHE	1.000E-001	3	Fail to Align Alt Battery Charger Mod CW Break
NOALTBATCHGFIHE	1.000E-001	3	Fail to Align Alt Battery Charger Large FP Break
NOALTBATCHGSIHE	1.000E-001	3	Fail to Align Alt Battery Charger Large SW Break
NOALTBATCHGTIHE	1.000E-001	3	Fail to Align Alt Battery Charger Large STM Break
NOALTBATCHGTXHE	1.000E-001	3	Fail to Align Alt Battery Charger Moderate STM Break
NOALTBATCHGWIHE	1.000E-001	3	Fail to Align Alt Battery Charger Large FW
NOALTBATCHGWXHE	1.000E-001	3	Fail to Align Alt Battery Charger Moderate FW Break
NOBLINDFEEDCXHE	6.700E-001	3	Failure of AFW Blind Feed Mod CW Break
NOBLINDFEEDFIHE	5.000E-001	3	Failure of AFW Blind Feed FP LargeBreak
NOBLINDFEEDFPHE	5.000E-001	3	Failure of AFW Blind Feed FP LargeBreak No AC
NOBLINDFEEDFPIE	5.000E-001	3	Failure of AFW Blind Feed FP LargeBreak No AC
NOBLINDFEEDSIHE	6.700E-001	3	Failure of AFW Blind Feed Large SW Break
NOBLINDFEEDTIHE	5.000E-001	3	Failure of AFW Blind Feed STM Large Break No AC
NOBLINDFEEDTXHE	5.000E-001	3	Failure of AFW Blind Feed STM Mod Break No AC
NOBLINDFEEDWIHE	5.000E-001	3	Failure of AFW Blind Feed Large FW Break No AC
NOBLINDFEEDWXHE	5.000E-001	3	Failure of AFW Blind Feed Mod FW Break No AC
NOLOCALCNTRFIHE	1.000E-001	3	Failure of Local Control FP Large Break No AC
NOLOCALCNTRFPHE	1.000E-001	3	Failure of Local Control FP Large Break No AC
NOLOCALCNTRTIHE	1.000E-001	3	Failure of Local Control STM Large Break No AC
NOLOCALCNTRTXHE	1.000E-001	3	Failure of Local Control Large FW Break No AC
NOLOCALCNTRWIHE	1.000E-001	3	Failure of Local Control Mod FW Break No AC
NOLOCALCNTRWXHE	1.000E-001	3	Failure of Local Control Mod FW Break No AC
NULL	0.000E+000	3	SET TO 0
O4FPTDAFPSRFIHE	1.000E-001	3	Short Term Restart Large FP Break
PORV-CHALLENGE	1.923E-002	3	PORV IS CHALLENGED BY THE INITIATOR
POS-CORE-RCS-DUR	1.000E+000	3	REDUCED FUEL INVENTORY IN RCS IN EARLY POS
POS-FUELPOOL-DUR	1.000E+000	3	FUEL IN FUEL POOL EARLY
RCP-SEAL-LOPSR	1.000E-001	3	RCP SEAL LOCA ADJUSTMENT FOR LOW PRESSURE
ROD	1.000E+000	3	SEISMIC FAILURE OF CONTROL ROD INSERTION
RST	1.000E+000	3	SEISMIC FAILURE OF REFUELING WATER STORAGE TANK
RVP	1.000E+000	3	SEISMIC FAILURE OF REACTOR VESSEL
S-AC-ACC-----FA	1.000E+000	3	SEISMIC FAILURE OF SIS ACCUMULATORS
S-AC-PORV----FA	1.000E+000	3	SEISMIC FAILURE OF PRESSURIZER PORV AIR ACCUMULATORS
S-AC-SD3AB---FA	1.000E+000	3	SEISMIC FAILURE OF SD-3A AND SD-3B AIRACCUMULATORS
S-AV-CHG-----FA	1.000E+000	3	SEISMIC FAILURE OF CHG AIR VALVES
S-AV-CI------FA	1.000E+000	3	SEISMIC FAILURE OF CI AIR VALVES
S-AV-OCD-----FA	1.000E+000	3	SEISMIC FAILURE OF MS AIR VALVES
S-AV-PORV----FA	1.000E+000	3	SEISMIC FAILURE OF PRESSURIZER PORVS
S-BC-125-----FA	1.000E+000	3	SEISMIC FAILURE OF 125VDC BATTERY CHARGERS
S-BD-ADM-----FA	1.000E+000	3	SEISMIC FAILURE OF ADMINISTRATION BUILDING
S-BD-AUX-----FA	1.000E+000	3	SEISMIC FAILURE OF AUXILIARY BUILDING
S-BD-SCREEN--FA	1.000E+000	3	SEISMIC FAILURE OF SCREENHOUSE
S-BD-TURB----FA	1.000E+000	3	SEISMIC FAILURE OF TURBINE BUILDING
S-BY-125-----FA	1.000E+000	3	SEISMIC FAILURE OF 125VDC BATTERIES

Table 11
Basic Event Descriptions (continued)

S-BY-RACKS---FA	1.000E+000	3	SEISMIC FAILURE OF 125VDC BATTERY RACKS
S-CV-ACC-----FA	1.000E+000	3	SEISMIC FAILURE OF ACC CHECK VALVES
S-CV-AFW-----FA	1.000E+000	3	SEISMIC FAILURE OF AFW CHECK VALVES
S-CV-BF------FA	1.000E+000	3	SEISMIC FAILURE OF BLEED AND FEED CHECK VALVES
S-CV-CCW-----FA	1.000E+000	3	SEISMIC FAILURE OF CCW CHECK VALVES
S-CV-CI------FA	1.000E+000	3	SEISMIC FAILURE OF CI CHECK VALVES
S-CV-HPI-----FA	1.000E+000	3	SEISMIC FAILURE OF HPI CHECK VALVES
S-CV-LPI-----FA	1.000E+000	3	SEISMIC FAILURE OF LPI CHECK VALVES
S-CV-MSI-----FA	1.000E+000	3	SEISMIC FAILURE OF MAIN STEAM ISOLATION VALVES
S-CV-SWSAB---FA	1.000E+000	3	SEISMIC FAILURE OF SWS CHECK VALVES
S-DG-DGAB----FA	1.000E+000	3	SEISMIC FAILURE OF DIESEL GENERATOR
S-DG-VALVES--FA	1.000E+000	3	SEISMIC FAILURE OF DIESEL GENERATOR MISC VALVES
S-DM-CAC-----FA	1.000E+000	3	SEISMIC FAILURE OF CAC DAMPERS
S-DP-120-----FA	1.000E+000	3	SEISMIC FAILURE OF 120V AC DISTRIBUTION PANELS
S-DP-125-----FA	1.000E+000	3	SEISMIC FAILURE OF 125VDC CONTROL PANELS
S-DP-AFW-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-CCW-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-CHG-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-CI------FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-HPI-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-HPR-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-LPR-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-MCC52A--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-52A
S-DP-MCC52B--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-52B
S-DP-MCC52E--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-52E
S-DP-MCC62E--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-62E
S-DP-MCC62H--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-62H
S-DP-MCC62J--FA	1.000E+000	3	SEISMIC FAILURE OF MCC-62J
S-DP-RPS-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-DP-SWS-----FA	1.000E+000	3	SEISMIC FAILURE OF DEPENDENT MCC GROUP
S-EC-DGE-----FA	1.000E+000	3	SEISMIC FAILURE OF DIESEL GENERATOR EXCITER
CABINET			
S-FL-SCREEN--FA	1.000E+000	3	SEISMIC FAILURE OF SWS SCREENS
S-FN-CAC-ABCDFA	1.000E+000	3	SEISMIC FAILURE OF CAC FAN COIL UNITS
S-FN-RHRAB---FA	1.000E+000	3	SEISMIC FAILURE OF RHR PUMPS FAN COIL UNITS
S-FP-120-----FA	1.000E+000	3	SEISMIC FAILURE OF 120V AC FUSE PANELS
S-FP-125-----FA	1.000E+000	3	SEISMIC FAILURE OF 125V DC FUSE PANELS
S-HE-CCWAB---FA	1.000E+000	3	SEISMIC FAILURE OF CCW HEAT EXCHANGERS
S-HE-RHRAB---FA	1.000E+000	3	SEISMIC FAILURE OF RHR HEAT EXCHANGERS
S-IV-120-----FA	1.000E+000	3	SEISMIC FAILURE OF 120V AC INVERTERS
S-LO-COOLERS-FA	1.000E+000	3	SEISMIC FAILURE OF AFW PUMP LUBE OIL COOLERS
S-MS-AFW-----FA	1.000E+000	3	SEISMIC FAILURE OF DC MOTOR STARTERS
S-MV-AFW-----FA	1.000E+000	3	SEISMIC FAILURE OF AFW MOTOR VALVES
S-MV-CCW-----FA	1.000E+000	3	SEISMIC FAILURE OF CCW MOTOR VALVES
S-MV-CI------FA	1.000E+000	3	SEISMIC FAILURE OF CI MOTOR VALVES
S-MV-HPR-----FA	1.000E+000	3	SEISMIC FAILURE OF HPR MOTOR VALVES
S-MV-LPR-----FA	1.000E+000	3	SEISMIC FAILURE OF LPR MOTOR VALVES
S-MV-MSI-----FA	1.000E+000	3	SEISMIC FAILURE OF SLB ISOLATION MOTORVALVES
S-PD-AFWC----FA	1.000E+000	3	SIESMIC FAILURE OF TURBINE DRIVEN AFW PUMP
S-PM--SWS----FA	1.000E+000	3	SEISMIC FAILURE OF SWS PUMPS
S-PM-AFWAB---FA	1.000E+000	3	SIESMIC FAILURE OF MOTOR DRIVEN AFW PUMP
S-PM-CCWAB---FA	1.000E+000	3	SEISMIC FAILURE OF CCW PUMPS
S-PM-CVCAC---FA	1.000E+000	3	SEISMIC FAILURE OF CHARGING PUMPS A AND C
S-PM-CVCB----FA	1.000E+000	3	SEISMIC FAILURE OF CHARGING PUMP B
S-PM-RHRAB---FA	1.000E+000	3	SEISMIC FAILURE OF RHR PUMPS
S-PM-SISAB---FA	1.000E+000	3	SEISMIC FAILURE OF SIS PUMPS

Table 11
Basic Event Descriptions (continued)

S-PN-BOSEQ---FA	1.000E+000	3	SEISMIC FAILURE OF BLACKOUT SEQUENCER PANELS
S-PN-DGCP----FA	1.000E+000	3	SEISMIC FAILURE OF DIESEL GENERATOR CONTROL PANEL
S-PN-SISEQ---FA	1.000E+000	3	SEISMIC FAILURE OF SI SEQUENCER PANELS
S-PP-AFWAB---FA	1.000E+000	3	SEISMIC FAILURE OF AFW SYSTEM PIPING
S-PP-PORV----FA	1.000E+000	3	SEISMIC FAILURE OF PRESSURIZER PORV PIPING
S-PP-SWSAB---FA	1.000E+000	3	SEISMIC FAILURE OF SERVICE WATER PIPING
S-RP-DGE-----FA	1.000E+000	3	SEISMIC FAILURE OF DIESEL GENERATOR RELAY PANEL
S-RR-ESFAS---FA	1.000E+000	3	SEISMIC FAILURE OF ESFAS RELAY RACKS
S-SV-AFW-----FA	1.000E+000	3	SEISMIC FAILURE OF AFW SOLENOID VALVES
S-SV-MSI-----FA	1.000E+000	3	SEISMIC FAILURE OF SLB ISOLATION SOLENOID VALVES
S-SWGR-4160--FA	1.000E+000	3	SEISMIC FAILURE OF 4160VAC SWITCHGEAR
S-SWGR-480---FA	1.000E+000	3	SEISMIC FAILURE OF 480VAC SWITCHGEAR
S-TK-CCW-----FA	1.000E+000	3	SEISMIC FAILURE OF COMPONENT COOLING SURGE TANK
S-TK-DGFO----FA	1.000E+000	3	SEISMIC FAILURE OF FUEL OIL DAY TANKS
S-TK-RWST----FA	1.000E+000	3	SEISMIC FAILURE OF REFUELING WATER STORAGE TANK
S-TK-VCT-----FA	1.000E+000	3	SEISMIC FAILURE OF VOLUME CONTROL TANK
S-TR-480-----FA	1.000E+000	3	SEISMIC FAILURE OF 480VAC TRANSFORMERS
S-UV-CHG-----FA	1.000E+000	3	SEISMIC FAILURE OF CHG RELIEF VALVES
SBO	1.000E+000	3	FLAG FOR LOSS OF OFFSITE POWER WITH SBO
SBO-MT-AFW	1.790E-001	3	STATION BLACKOUT MISSION TIME MULT. FOR AFW
SEAL	1.000E+000	3	SEISMIC SEAL LOCA
SEALLOCA-21	2.000E-001	3	SEAL LOCA GREATER THAN 21 GPM
SEICDF	9.390E-006	3	SIESMIC EVENT LEADSTO CORE DAMAGE
SGTR-MT-HPI	4.167E-002	3	MULTIPLIER FOR 1 HOUR HPI MISSION TIME IN AN SGTR
SI06-ISOL-A	5.000E-001	3	FAIL TO ISOLATE BEFORE FAILURE OF ANY BUSES SW LARGE
SI06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP SW Large
SI06-ISOL-C	5.000E-001	3	FAIL TO ISOLATE BEFORE AFWP ALOP FAIL SW LARGE
SI06-ISOL-D	5.000E-001	3	FAIL ISOLATION BEFORE 18 INCHES ON TDAFP SW LARGE
SL182	5.000E-001	3	MEDIUM REACTOR COOLANT PUMP SEAL LOCA (182 GPM)
SL480	2.500E-003	3	LARGE REACTOR COOLANT PUMP SEAL LOCA (480 GPM)
SL76	8.000E-001	3	SMALL REACTOR COOLANT PUMP SEAL LOCA (21,57,76 GPM)
SLB-A-CNTMNT	5.598E-002	3	BREAK IN STEAM LINEA IN CONTAINMENT
SLB-A-ISOL	3.019E-001	3	BREAK IN STEAM LINEA IN AUX BUILDING DOWNSTREAM OF MSIV
SLB-A-UNISOL	1.685E-002	3	BREAK IN STEAM LINEA IN AUX BUILDING UPSTREAM OF MSIV
SLB-B-CNTMNT	5.896E-002	3	BREAK IN STEAM LINEB IN CONTAINMENT
SLB-B-ISOL	1.523E-001	3	BREAK IN STEAM LINEB IN AUX BUILDING DOWNSTREAM OF MSIV
SLB-B-UNISOL	1.421E-002	3	BREAK IN STEAM LINEB IN AUX BUILDING UPSTREAM OF MSIV
SLB-MT-ICSA	2.105E-001	3	4 HOUR MISSION TIMEFOR ICS ACTUATION
SLB-MT-ICSB	2.105E-001	3	4 HOUR MISSION TIMEFOR ICS ACTUATION
SLERF	5.410E-001	3	SEISMIC CONDITIONALLARGE EARLY RELEASEFREQUENCY
SLO-CLB	3.938E-002	3	SMALL COLD LEG LOCAIN LOOP B
SLO56--DIVERSION	9.700E-001	3	FRACTION OF IE- SLO56 DUE TO FLOW DIVERSIONS
SLO56-PIPERUPTUR	3.000E-002	3	FRACTION OF IE- SLO56 DUE TO PIPE/ COMPT BREAKS
SNONLERF	4.590E-001	3	SEISMIC EVENT LEADSTO CORE DAMAGE BUT NOT LERF
SPB	1.000E+000	3	SEISMIC SMALL PIPE BREAK
SSP	1.000E+000	3	SEISMIC FAILURE OF STEAM LINE
STBY-ABBFA	5.000E-001	3	AUX BLDG BSMT FAN COIL UNIT A IS IN STANDBY
STBY-ABBFB	5.000E-001	3	AUX BLDG BSMT FAN COIL UNIT B IS IN STANDBY
STBY-ABBFC	5.000E-001	3	AUX BLDG BSMT FAN COIL UNIT C IS IN STANDBY
STBY-ABBFD	5.000E-001	3	AUX BLDG BSMT FAN COIL UNIT D IS IN STANDBY

Table 11
Basic Event Descriptions (continued)

STBY-ABMFA	5.000E-001	3	AUX BLDG MEZZ FAN COIL UNIT A IS IN STANDBY
STBY-ABMFB	5.000E-001	3	AUX BLDG MEZZ FAN COIL UNIT B IS IN STANDBY
STBY-CCWPA	5.000E-001	3	COMPONENT COOLING PUMP A IS IN STANDBY
STBY-CCWPB	5.000E-001	3	COMPONENT COOLING PUMP B IS IN STANDBY
STBY-CHGPA	3.330E-001	3	CHARGING PUMP A IS IN STANDBY
STBY-CHGPB	3.330E-001	3	CHARGING PUMP B IS IN STANDBY
STBY-CHGPC	3.330E-001	3	CHARGING PUMP C IS IN STANDBY
STBY-CRACA	5.000E-001	3	CONTROL ROOM AIR CONDITIONING TRAIN A IS IN STANDBY
STBY-CRACB	5.000E-001	3	CONTROL ROOM AIR CONDITIONING TRAIN B IS IN STANDBY
STBY-CWPA	2.205E-001	3	CIRCULATING WATER PUMP A IS IN STANDBY
STBY-CWPB	2.205E-001	3	CIRCULATING WATER PUMP B IS IN STANDBY
STBY-CWPNONE	5.590E-001	3	BOTH CIRCULATING WATER PUMPS ARE RUNNING
STBY-PEWPA	5.000E-001	3	PLANT EQUIPMENT WATER PUMP A IS IN STANDBY
STBY-PEWPB	5.000E-001	3	PLANT EQUIPMENT WATER PUMP B IS IN STANDBY
STBY-RMUWPA	5.000E-001	3	REACTOR MAKEUP WATER PUMP A IS IN STANDBY
STBY-RMUWPB	5.000E-001	3	REACTOR MAKEUP WATER PUMP B IS IN STANDBY
STBY-SIACF	5.000E-001	3	AIR COMPRESSOR F ISIN STANDBY
STBY-SIACG	5.000E-001	3	AIR COMPRESSOR G ISIN STANDBY
STBY-SWPA1	2.500E-001	3	SERVICE WATER PUMP A1 IS IN STANDBY
STBY-SWPA2	2.500E-001	3	SERVICE WATER PUMP A2 IS IN STANDBY
STBY-SWPB1	2.500E-001	3	SERVICE WATER PUMP B1 IS IN STANDBY
STBY-SWPB2	2.500E-001	3	SERVICE WATER PUMP B2 IS IN STANDBY
SUCC-CHG	8.139E-001	3	CHARGING SUCCESS
SUR-ROD	1.000E+000	3	SURROGATE ELEMENT FOR ROD
SUR-SSP	1.000E+000	3	SURROGATE ELEMENT FOR SSP
SUR-SXACC	1.000E+000	3	SURROGATE ELEMENT FOR SXACC
SUR-SXACP	1.000E+000	3	SURROGATE ELEMENT FOR SXACP
SUR-SXAFW	1.000E+000	3	SURROGATE ELEMENT FOR SXAFW
SUR-SXCCW	1.000E+000	3	SURROGATE ELEMENT FOR SXCCW
SUR-SXCHG	1.000E+000	3	SURROGATE ELEMENT FOR SXCHG
SUR-SXCI	1.000E+000	3	SURROGATE ELEMENT FOR SXCI
SUR-SXDCP	1.000E+000	3	SURROGATE ELEMENT FOR SXDCP
SUR-SXESF	1.000E+000	3	SURROGATE ELEMENT FOR SXESF
SUR-SXFCH	1.000E+000	3	SURROGATE ELEMENT FOR SXFCH
SUR-SXHPI	1.000E+000	3	SURROGATE ELEMENT FOR SXHPI
SUR-SXHPR	1.000E+000	3	SURROGATE ELEMENT FOR SXHPR
SUR-SXISO	1.000E+000	3	SURROGATE ELEMENT FOR SXISO
SUR-SXLPI	1.000E+000	3	SURROGATE ELEMENT FOR SXLPI
SUR-SXLPR	1.000E+000	3	SURROGATE ELEMENT FOR SXLPR
SUR-SXOBF	1.000E+000	3	SURROGATE ELEMENT FOR SXOBF
SUR-SXOCD	1.000E+000	3	SURROGATE ELEMENT FOR SXOCD
SUR-SXSWS	1.000E+000	3	SURROGATE ELEMENT FOR SXSWS
SWLISOTB	1.000E-002	3	FAILURE TO ISOLATE LARGE SERVICE WTR BRK IN TURB BLDG
TDPRESTARTCX-HE	1.000E-001	3	Fail to Restart TDPin 47 min Mod CW Break
TDPRESTARTFI-HE	1.000E-001	3	Fail to Restart TDPin 47 min Large FP Break
TDPRESTARTSI-HE	1.000E-001	3	Fail to Restart TDPin 47 min Large SW Break
TDPRESTARTTI-HE	1.000E-001	3	Fail to Restart TDPin 47 min Large STM Break
TDPRESTARTTX-HE	1.000E-001	3	Fail to Restart TDPin 47 min Mod STM Break
TDPRESTARTWI-HE	1.000E-001	3	Fail to Restart TDPin 47 min Large FW Break
TDPRESTARTWX-HE	1.000E-001	3	Fail to Restart TDPin 47 min Mod FW Break
TI06-ISOL-A	5.000E-001	3	Fail to Isolate Before Failure of any Buses STM Large
TI06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP STM Large

Table 11
Basic Event Descriptions (continued)

TI06-ISOL-C	5.000E-001	3	Fail to Start MDAFPSTM Large
TRA-SSI ACTUATION	1.858E-002	3	TRANSIENT IS DUE TOSPURIOUS SAFETY INJECTION
TRAINA-FAILS	1.000E+000	3	TRAIN A OF SYSTEM FAILS - DUMMY EVENT
TRAINB-FAILS	1.000E+000	3	TRAIN B OF SYSTEM FAILS - DUMMY EVENT
TX06-ISOL-A	5.000E-001	3	Fail to Isolate Before Failure of any Buses STM Mod
TX06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP STM Mod
TX06-ISOL-C	5.000E-001	3	Fail to Start MDAFPSTM Moderate
UET-0PORVS	1.070E-001	3	UNFAVORABLE EXPOSURE TIME FOR 0PORVS AVAILABLE
UET-1PORV	1.130E-001	3	UNFAVORABLE EXPOSURE TIME FOR 1PORV AVAILABLE
UET-2PORVS	1.620E-001	3	UNFAVORABLE EXPOSURE TIME FOR 2PORVS AVAILABLE
WI06-ISOL-A	1.000E+000	3	Fail to Isolate Before Failure of any Buses FW Large
WI06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP FW Large
WI06-ISOL-C	5.000E-001	3	Fail to Start MDAFPFW Large
WX06-ISOL-A	5.000E-001	3	Fail to Isolate Before Failure of any Buses FW Mod
WX06-ISOL-B	5.000E-001	3	Fail to Isolate Before Failure of AFWP FW Mod
WX06-ISOL-C	5.000E-001	3	Fail to Start MDAFPFW Moderate
XCOM-AC-0159	5.885E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-0221	6.453E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-0241	6.573E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-0715	8.239E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-0725	8.266E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-1632	9.204E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AC-1642	9.214E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ACFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ACLLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ACMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ACSLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFATWS	9.673E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFCI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFCWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR14	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFFPLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-AFFWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFISL	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFLOSP	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFMK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFMK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFNK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFNK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRCX06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRFI06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRSI06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRTI06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRTX06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRWI06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFRWX06B	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSBO	9.646E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSCX06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSFI06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSGTR	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSLO	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSSI06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSTI06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSTX06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSWI06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFSWX06B	9.957E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTCC	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTCX064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTCX06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTFI064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTFI06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTMF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTRA	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTSI064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTSI06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTSW	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTTI064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTTI06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-AFTTX064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTTX06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTWI064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTWI06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTWX064	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFTWX06B	9.627E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFWI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1ACX	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1AFI	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1ASI	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1ATI	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1ATX	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1AWI	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1AWX	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1CXB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1FIB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1SIB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1TIB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1TXB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1WIB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-1WXB	9.924E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2CX4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2CXB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2FI4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2FIB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2SI4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2SIB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2TI4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2TIB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2TX4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2TXB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2WI4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2WIB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2WX4	3.600E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFX-2WXB	9.820E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-ACXB	5.770E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-AFIB	7.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-ASIB	8.560E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-ATIB	7.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-ATXB	9.631E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-AWIB	5.770E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-AWXB	8.560E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BCX4	8.139E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BFI4	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BFIB	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BSI4	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BSIB	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BTI4	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BTIB	8.772E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BTX4	9.838E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BTXB	9.838E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BWI4	8.139E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BWIB	8.139E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BWX4	9.366E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AFZ-BWXB	9.366E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-AMSAC	9.815E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-ATWS-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-29	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-40	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-41	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-42	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-44	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-50	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-52	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-56	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-62	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-63	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-64	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-65	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-66	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-67	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-69	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-70	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-71	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-72	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-73	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-74	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-75	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-76	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-77	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-78	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-79	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-80	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-81	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-82	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-83	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-84	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-85	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-86	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-87	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-88	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-89	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-90	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-91	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWS-92	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWSTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ATWSX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-BDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-BR-PIPE	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCCI06B	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCCWLTB	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFI02B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFI04B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFI06B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-CCFIR14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFPLTB	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCFWLTB	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCLOSP	9.994E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCMK05B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCMK5B3	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCNK5B3	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCNK5B4	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSC02B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSC22B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSE05B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSE5B3	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSF02B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSF03B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSF22B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSH05B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSH5B3	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSI04B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSI06B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSK5B4	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCSWLTB	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTMF	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTRA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCTSW	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CCWI06B	9.873E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CDFTOP	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHCI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHCWLTB	9.164E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFI02B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFI04B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFI06B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-CHFIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFPLTB	9.164E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHFWLTB	9.164E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHLOSP	9.981E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHMK05B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHMK5B3	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHNK5B3	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHNK5B4	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSBO	8.139E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSC02B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSC22B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSE05B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSE5B3	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSF02B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSF03B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSF22B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSH05B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSH5B3	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSI04B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSI06B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSK5B4	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHSWLTB	9.164E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTCC	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTMF	9.164E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTRA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHTSW	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CHWI06B	9.165E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CICI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CICWLTB	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFI02B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFI04B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFI06B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-CIFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFPLTB	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIFWLTB	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIISL	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIL	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILCI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILCWLTB	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILFI02B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILFI04B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILFI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILFPLTB	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILFWLTB	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILMK05B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILMK5B3	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILNK5B3	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILNK5B4	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILOSP	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSC02B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSC22B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSE05B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSE5B3	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSF02B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSF03B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSF22B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSH05B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSH5B3	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSI04B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSI05B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSK5B4	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILSWLTB	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CILWI06B	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIMK05B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIMK5B3	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CINK5B3	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CINK5B4	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBCC	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBLP	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBMF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBSW	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISBTR	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISC02B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISC22B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISE05B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISE5B3	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-CISF02B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISF03B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISF22B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISH05B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISH5B3	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISI04B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISI05B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISI06B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISK5B4	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISLO	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CISWLTB	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITCC	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITMF	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITRA	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CITSW	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIVEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CIWI06B	9.863E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CKV	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CPCI06B	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CPCWLTB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CSSLB	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-CSSLO	9.622E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPCI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPCWLTB	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPFI02B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPFI04B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPFI06B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPFPLTB	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPFWLTB	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPLOSP	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPMK05B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPMK5B3	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPNK5B3	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPNK5B4	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSC02B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSC22B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSE05B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSE5B3	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSF02B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSF03B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSF22B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSH05B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSH5B3	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSI04B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSI06B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSK5B4	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPSWLTB	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTCC	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-EPTDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTMF	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTRA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPTSW	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-EPWI06B	9.901E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-F2SLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-F2SLO	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCCI06B	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCCWLTB	3.857E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFI02B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFI04B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFI06B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR14	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFPLTB	3.857E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCFWLTB	3.857E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCISL	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCLLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCLOSP	9.989E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCMK05B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCMK5B3	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCNK5B3	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCNK5B4	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBCC	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBDA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBLP	9.989E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBMF	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSBTR	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSC02B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSC22B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSE05B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSE5B3	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSF02B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSF03B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-FCSF22B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSH05B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSH5B3	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSI04B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSI06B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSK5B4	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSLO	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCSWLTB	3.857E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTCC	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTDA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTIA	9.994E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTMF	3.857E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTRA	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCTSW	9.987E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCUSI05B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCVEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FCWI06B	3.856E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR10TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR11TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR12-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR12TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR13-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR13-53	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR13TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-02	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-FIR14-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR14TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR2-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR2-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR2-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR2TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR3-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR3TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR4TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR5TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-02	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR6TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR7-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR7-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR7-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR7-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR7TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-02	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-FIR8-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR8TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR9-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR9-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR9-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR9-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIR9TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIRETOP	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIRETOT	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FIRLERTP	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD1-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD1-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD1-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD1TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD3TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD4TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD5-22	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD5-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD5-29	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD5-32	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD5TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD6-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD6-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FLD6TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-FLDX	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-FPLISOTB	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIATWS	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HICI06B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HICWLTB	8.795E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFI02B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFI04B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFI06B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR14	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFPLTB	8.795E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIFWLTB	8.795E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIISL	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HILLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HILOSP	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIMK05B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIMK5B3	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HINK5B3	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HINK5B4	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISC02B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISC22B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISE05B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISE5B3	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISF02B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISF03B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISF22B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISGTR	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISH05B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISH5B3	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISI04B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISI06B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISK5B4	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISLO	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HISWLTB	8.795E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITCC	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-HITMF	8.795E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITRA	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HITSW	9.994E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIVEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HIWI06B	8.796E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPICX06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIFI064	9.929E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIFI06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPISI06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPITI064	9.929E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPITI06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPITX064	9.929E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPITX06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIWI064	9.929E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIWI06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIWX064	9.929E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HPIWX06B	9.931E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRCI06B	9.973E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRCWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFIR9	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFLD5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFPLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRFWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRISL	9.756E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRLOSP	9.985E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRMK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRMK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRNK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRNK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBB5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBDA	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBDB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBLP	9.985E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBMF	9.976E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSBTR	9.755E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-HRSE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSLB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSLO	9.756E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRSWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTB5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTDA	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTDB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTIA	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTMF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTRA	9.755E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRTSW	9.978E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-HRWI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I18CX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I18SI06B	4.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-CI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-CX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-FI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-SI06B	4.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-TI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-TX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-WI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I5-WX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-CX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-FI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-SI06B	4.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-TI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-TX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-WI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-I6-WX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ICS	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-ATWS	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-CI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-CWLTB	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-CX06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FI02B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FI04B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FI06B	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR1	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR10	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR11	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR14	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR2	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR3	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR4	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-IE-FIR5	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR7	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR8	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FIR9	9.987E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FLD1	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FLD3	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FLD4	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FLD5	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FLD6	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FPLTB	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-FWLTB	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-ISL	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-LLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-LOSP	9.661E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-MK05B	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-MK5B3	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-MLO	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-NK5B3	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-NK5B4	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SB05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SBOL	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SBOX	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SC02B	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SC22B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SE05B	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SE5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SF02B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SF03B	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SF22B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SGTR	9.962E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SH05B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SH5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SI04B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SI05B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SK5B4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SLB	9.910E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SLO	9.959E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SLOP	9.970E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-SWLTB	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TB5	9.991E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TB6	9.983E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TCC	9.547E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TDA	9.955E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TDB	9.955E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TI06B	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TIA	9.916E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TMF	9.028E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TRA	6.000E-004	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TSW	7.611E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-TX06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-VEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-WI06B	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-IE-WX06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISAUX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-ISCNT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-48	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-52	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-65	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-69	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-73	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-75	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-76	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISL-77	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISLTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISLX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOFI02B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOFI04B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOFI06B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOMK05B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOMK5B3	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISONK5B3	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISONK5B4	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSC02B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSC22B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSE05B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSE5B3	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSF02B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSF03B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSF22B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSH05B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSH5B3	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSI04B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSI06B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOSK5B4	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISOWI06B	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ISSGTR	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDCX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDFI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDSI06B	4.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDTI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDTX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDWI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ITDWX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-L1FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-L1MLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-L1SLO	9.816E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-L2FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-L2MLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LERF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LERFX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LIFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LILLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LIMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LISLO	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LIVEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LLO-02	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LLO-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LLOTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-LLOX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-20	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-24	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-29	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSP-30	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSPTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LOSPX	9.988E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRCI06B	9.979E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRCWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFPLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRFWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRISL	9.763E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRLLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRLOSP	9.987E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRMK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRMK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRNK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRNK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBDA	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBLP	9.987E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBMF	9.977E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSBTR	9.762E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-LRSF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSLB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRSWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTDA	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTIA	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTMF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTRA	9.762E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRTSW	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRVEF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LRWI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-LTS	9.858E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MEX	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFLD1	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFLD3	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFLD4	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFISL	9.744E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFMK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFMK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFNK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFNK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSGTR	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSLB	9.977E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFSLO	9.787E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTB5	9.991E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTB6	9.991E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTCC	9.990E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-MFTDA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTDB	9.980E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTIA	9.953E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTRA	9.911E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MFTSW	9.639E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MGO	9.798E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLO-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLO-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLO-33	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLO-41	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLOTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-MLOX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O1FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O1SLO	9.589E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O2FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O2SLO	9.443E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O3SGTR	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-O4SGTR	9.993E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBCI06B	9.718E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBCWLTB	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFI02B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFI04B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFI06B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR8	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFIR9	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFPLTB	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBFWLTB	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBISL	9.717E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBLOSP	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBMK05B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBMK5B3	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBNK5B3	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBNK5B4	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSC02B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSC22B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSE05B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSE5B3	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSF02B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSF03B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSF22B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSH05B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSH5B3	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-OBSI04B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSI06B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSK5B4	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSLB	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSLO	9.717E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBSWLTB	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTB6	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTCC	9.987E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTDA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTIA	9.997E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTMF	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTRA	9.718E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBTSW	9.933E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OBWI06B	9.043E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCCX06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCCX06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCFI06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCFI06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCSI06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCSI06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCSLB	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCTI06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCTI06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCTX06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCTX06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCV	9.880E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCWI06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCWI06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCWX06B4	9.080E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OCWX06BB	9.210E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OILOSP	9.988E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OIP	9.717E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITCC	9.986E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITDA	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITDB	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITMF	9.977E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-OITRA	9.768E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORFIR12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORISL	9.631E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORMLO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORP	9.913E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBB5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBB6	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBCC	9.947E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBDA	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBDB	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBLP	9.507E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBMF	9.897E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSBTR	8.943E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSGTR	9.996E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-ORSLB	9.991E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-ORT	9.899E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-PPR	8.256E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1CI06B	9.884E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1CWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FLD3	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FLD4	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FPLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1FWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1LOSP	9.539E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1MK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1MK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1NK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1NK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SLO	8.988E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1SWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TB5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TB6	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TCC	9.949E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TDA	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TDB	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TMF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TRA	8.985E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1TSW	9.962E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R1WI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2CI06B	8.920E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2CWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FI02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FIR13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FIR3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FLD3	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FLD4	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FLD5	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FPLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2FWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2LOSP	9.507E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-R2MK05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2MK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2NK5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2NK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SC02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SC22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SE05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SE5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SF02B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SF03B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SF22B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SH05B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SH5B3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SI04B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SK5B4	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SLO	8.946E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2SWLTB	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TB5	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TB6	9.992E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TCC	9.947E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TDA	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TDB	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TMF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TRA	8.943E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2TSW	9.732E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-R2WI06B	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPCX06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPFI06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPSI06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPTI06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPTX06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPWI06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RCPWX06B	9.529E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RIF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RSL	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RTLOSP	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RVC	9.940E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RVO	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCCX06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCFI06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCSI06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCTI06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCTX06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCWI06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RWCWX06B	9.950E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXT	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTCI06B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTCWLTB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTFI02B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTFI04B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTFI06B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTFPLTB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTFWLTB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTMK05B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTMK5B3	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-RXTNK5B3	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTNK5B4	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSC02B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSC22B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSE05B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSE5B3	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSF02B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSF03B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSF22B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSH05B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSH5B3	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSI04B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSI06B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSK5B4	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTSWLTB	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-RXTWI06B	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBAUX	9.922E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBCNT	9.988E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBO5-20	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBO5-24	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-24	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-33	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-41	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-51	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-55	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-61	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-65	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-66	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOL-69	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SBOX	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-20	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTR-21	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTRTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SGTRX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SIDL	9.999E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SL182	8.025E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SL480	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-SL76	2.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-11	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-56	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-64	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-73	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-74	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-75	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-78	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-79	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-82	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-83	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-84	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-85	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-86	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-87	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-88	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB-89	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB103	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB105	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB107	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB111	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB112	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB113	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB114	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB115	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLB116	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLBTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLBX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCCX064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCCX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCFI064	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCFI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCSI064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCSI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCTI064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCTI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCTX064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCTX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCWI064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCWI06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCWX064	9.975E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLCWX06B	5.000E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLERF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-SLO-13	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-20	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-21	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-22	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-24	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-29	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-33	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-36	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-40	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-41	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-42	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-43	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-44	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-45	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-46	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-47	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-48	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-49	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-52	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-53	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-54	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-55	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLO-56	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLOTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SLOX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SNONLERF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SOPORV	9.989E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPCI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPCWLTB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFI02B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFI04B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFLD1	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFLD3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFLD4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFLD5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFLD6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFPLTB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPFWLTB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPLOSP	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPMK05B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPMK5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPNK5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPNK5B4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-SPSC02B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSC22B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSE05B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSE5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSF02B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSF03B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSF22B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSH05B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSH5B3	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSI04B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSK5B4	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSLB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPSWLTB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTB5	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTB6	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTCC	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTDA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTDB	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTIA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTMF	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTRA	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPTSW	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SPWI06B	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SWLISOTB	9.900E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SWTCC	9.995E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXACP	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXAF1	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXAF7	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXCCI	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXCCP	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXCCW	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXCH2	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXDCP	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXESF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXHI1	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXHI2	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXHI3	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXHPR	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXISO	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXLI1	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXLI2	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXLR1	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXLR2	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXOB5	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXOBF	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXOCD	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXOCS	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXRST	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-SXSWS	0.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TACX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-TB5-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5-40	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB5TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TB6TOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TBF	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TBL	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-07	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-12	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-17	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-18	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-20	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-21	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCC-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCCTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TCCX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-36	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDA-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDATOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-TDB-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-36	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDB-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDBTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TDCX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-03	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-16	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-24	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIA-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIATOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TIAX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-14	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-15	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-19	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-23	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMF-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMFTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TMFX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-37	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRA-39	9.998E-001	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRATOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TRAX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-05	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-06	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-08	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-09	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-25	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-26	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-27	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-28	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-30	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-31	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-32	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-34	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-35	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit

Table 11
Basic Event Descriptions (continued)

XCOM-TSW-38	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSW-39	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSWTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-TSWX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEF-01	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEF-02	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEF-04	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEF-10	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEFTOT	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XCOM-VEFX	1.000E+000	0	NUPRA Special EventSuccess Branch DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XEQN-IE-CI06B	0.000E+000	0	NUPRA Special EventUnity Equation DataDo NOT Edit
XHOS-1-101-OPEN	1.000E+000	6	BREAKER 1-101 FROM RAT TO BUS 1 IS OPEN
XHOS-1-104-OPEN	0.000E+000	6	BREAKER 1-104 FROM MAT TO BUS 1 IS OPEN
XHOS-1-201-OPEN	1.000E+000	6	BREAKER 1-201 FROM RAT TO BUS 2 IS OPEN
XHOS-1-204-OPEN	0.000E+000	6	BREAKER 1-204 FROM MAT TO BUS 2 IS OPEN
XHOS-1-301-OPEN	0.000E+000	6	BREAKER 1-301 FROM MAT TO BUS 3 IS OPEN
XHOS-1-307-OPEN	1.000E+000	6	BREAKER 1-307 FROM RAT TO BUS 3 IS OPEN
XHOS-1-401-OPEN	0.000E+000	6	BREAKER 1-401 FROM MAT TO BUS 4 IS OPEN
XHOS-1-407-OPEN	1.000E+000	6	BREAKER 1-407 FROM RAT TO BUS 4 IS OPEN
XHOS-1-501-CLSE	1.000E+000	6	BREAKER 1-501 FROM TAT TO BUS 5 IS CLOSED
XHOS-1-501-OPEN	0.000E+000	6	BREAKER 1-501 FROM TAT TO BUS 5 IS OPEN
XHOS-1-503-CLSE	0.000E+000	6	BREAKER 1-503 FROM RAT TO BUS 5 IS CLOSED
XHOS-1-503-OPEN	1.000E+000	6	BREAKER 1-503 FROM RAT TO BUS 5 IS OPEN
XHOS-1-511-CLSE	0.000E+000	6	BREAKER 1-511 FROM MAT TO BUS 5 IS CLOSED
XHOS-1-511-OPEN	1.000E+000	6	BREAKER 1-511 FROM MAT TO BUS 5 IS OPEN
XHOS-1-601-CLSE	1.000E+000	6	BREAKER 1-601 FROM RAT TO BUS 6 IS CLOSED
XHOS-1-601-OPEN	0.000E+000	6	BREAKER 1-601 FROM RAT TO BUS 6 IS OPEN
XHOS-1-610-CLSE	0.000E+000	6	BREAKER 1-610 FROM MAT TO BUS 6 IS CLOSED
XHOS-1-610-OPEN	1.000E+000	6	BREAKER 1-610 FROM MAT TO BUS 6 IS OPEN
XHOS-1-611-CLSE	0.000E+000	6	BREAKER 1-611 FROM TAT TO BUS 6 IS CLOSED
XHOS-1-611-OPEN	1.000E+000	6	BREAKER 1-611 FROM TAT TO BUS 6 IS OPEN
XHOS-15101-OPEN	0.000E+000	6	BREAKER FROM BUS 5 TO BUS 51 IS OPEN
XHOS-15161-OPEN	1.000E+000	6	BREAKERS FROM BUS 51 TO BUS 61 ARE OPEN
XHOS-15201-OPEN	0.000E+000	6	BREAKER FROM BUS 5 TO BUS 52 IS OPEN
XHOS-15262-OPEN	1.000E+000	6	BREAKERS FROM BUS 52 TO BUS 62 ARE OPEN
XHOS-16101-OPEN	0.000E+000	6	BREAKER FROM BUS 6 TO BUS 61 IS OPEN
XHOS-16201-OPEN	0.000E+000	6	BREAKER FROM BUS 6 TO BUS 62 IS OPEN
XHOS-ABBFA	0.000E+000	6	AUX BLDG FAN COIL UNIT A IS IN STANDBY
XHOS-ABBFB	0.000E+000	6	AUX BLDG FAN COIL UNIT B IS IN STANDBY
XHOS-ABBFC	1.000E+000	6	AUX BLDG FAN COIL UNIT C IS IN STANDBY
XHOS-ABBFD	1.000E+000	6	AUX BLDG FAN COIL UNIT D IS IN STANDBY
XHOS-ABMFA	0.000E+000	6	AUX BLDG MEZZ FAN COIL UNIT A IS IN STANDBY
XHOS-ABMFB	1.000E+000	6	AUX BLDG MEZZ FAN COIL UNIT B IS IN STANDBY
XHOS-AFW10A-CLS	0.000E+000	6	MOV AFW-10A IS CLOSED
XHOS-AFW10B-CLS	0.000E+000	6	MOV AFW-10B IS CLOSED
XHOS-AFWPA	1.000E+000	6	AUXILIARY FEEDWATERPUMP A IS IN STANDBY
XHOS-AFWPB	1.000E+000	6	AUXILIARY FEEDWATERPUMP B IS IN STANDBY
XHOS-AFWPT	1.000E+000	6	TURBINE DRIVEN AUXILIARY FEEDWATERPUMP IS IN STANDBY

Table 11
Basic Event Descriptions (continued)

XHOS-BYA-CLOSED	0.000E+000	6	REACTOR TRIP BYPASSBREAKER A CLOSED
XHOS-BYA-OPEN	1.000E+000	6	REACTOR TRIP BYPASS BREAKER A OPEN
XHOS-BYB-CLOSED	0.000E+000	6	REACTOR TRIP BYPASSBREAKER B CLOSED
XHOS-BYB-OPEN	1.000E+000	6	REACTOR TRIP BYPASS BREAKER B OPEN
XHOS-CC6A-CLOSED	0.000E+000	6	MOV CC-6A IS CLOSED
XHOS-CC6B-CLOSED	0.000E+000	6	MOV CC-6B IS CLOSED
XHOS-CCWPA	0.000E+000	6	COMPONENT COOLING PUMP A IS IN STANDBY
XHOS-CCWPB	1.000E+000	6	COMPONENT COOLING PUMP B IS IN STANDBY
XHOS-CHGPA	0.000E+000	6	CHARGING PUMP A IS IN STANDBY
XHOS-CHGPB	1.000E+000	6	CHARGING PUMP B IS IN STANDBY
XHOS-CHGPC	0.000E+000	6	CHARGING PUMP C IS IN STANDBY
XHOS-CRACA	0.000E+000	6	CONTROL ROOM AIR CONDITIONING TRAIN A IS IN STANDBY
XHOS-CRACB	1.000E+000	6	CONTROL ROOM AIR CONDITIONING TRAIN B IS IN STANDBY
XHOS-DRAINDOWN	0.000E+000	6	DRAINDOWN ACTIVITY IN PROGRESS =1, ELSE=0
XHOS-FUEL-POOL	0.000E+000	3	HOUSE EVENT FOR SPENT FUEL POOL OPS=1, ALL OTHERS=0
XHOS-FWPA	0.000E+000	6	FEEDWATER PUMP A ISIN STANDBY
XHOS-FWPB	0.000E+000	6	FEEDWATER PUMP B ISIN STANDBY
XHOS-G1-OPEN	0.000E+000	6	BKR G-1 IS OPEN. GENERATOR IS NOT CONNECTED TO GRID
XHOS-GEN-LINK	1.000E+000	6	ISOLATED PHASE DISCONNECT LINKS INSTALLED
XHOS-LARGE-VENT	0.000E+000	3	HOUSE EVENT FOR S/DLARGE RCS VENT =1, SMALL OR NO VENT=0
XHOS-LVL-CAVITY	0.000E+000	3	HOUSE EVENT FOR CORE UNLOAD/LOAD, 1=CAV FULL, ELSE 0
XHOS-LVL-FLNGE-6	1.000E+000	3	RCS LEVEL 6 INCHES BELOW THE REACTOR PRESS VSL FLANGE=1
XHOS-LVL-MIDLOOP	0.000E+000	3	HOUSE EVENT FOR RCS LEVEL @ MIDLOOP=1, OTHER LEVELS=0
XHOS-LVL-PZR	0.000E+000	3	COLD SHUTDOWN WITH PRESSURIZER LEVEL NORMAL S/D BAND
XHOS-LVL-SOLID	0.000E+000	3	COLD SHUTDOWN WITH PRESSURIZER WATER SOLID
XHOS-MODE1-PWR	1.000E+000	3	MODE 1 (HIGH POWER)HOUSE EVENT, 1=MODE 1, ELSE 0
XHOS-MODE2-HSB	0.000E+000	3	MODE 2 (LOW POWER &STARTUP/SHUTDOWN), 1=MODE 2, ELSE 0
XHOS-MODE3-HSD	0.000E+000	3	MODE 3 (HOT SD) HOUSE EVT, 1=MODE 3, ELSE 0
XHOS-MODE4-ISL	0.000E+000	3	MODE 4 (HOT S/D, TEMP <350) HS EVT 1-MD4 LOWER, ELSE 0
XHOS-MODE4-ISU	0.000E+000	3	MODE 4 (HOT S/D, TEMP >350) HS EVT 1=MD4 UPPER, ELSE 0
XHOS-MODE5-CSD	0.000E+000	3	MODE 5 (COLD SHUTDOWN) HOUSE, 1=MODE 5, ELSE 0
XHOS-MODE6-REF	0.000E+000	3	MODE 6 (REFUELING) HOUSE EVENT, 1=MODE 6, ELSE 0
XHOS-NO-LRG-VENT	1.000E+000	3	HOUSE EVENT - FOR ALARGE RCS VENT =0, NO VENT =1
XHOS-NUPRA	1.000E+000	6	NUPRA MODEL
XHOS-PEWPA	0.000E+000	6	PLANT EQUIPMENT WATER PUMP A IS IN STANDBY
XHOS-PEWPB	1.000E+000	6	PLANT EQUIPMENT WATER PUMP B IS IN STANDBY
XHOS-PR1A-CLOSE	0.000E+000	6	PRESSURIZER PORV A BLOCK VALVE IS CLOSED
XHOS-PR1B-CLOSE	0.000E+000	6	PRESSURIZER PORV B BLOCK VALVE IS CLOSED
XHOS-RHRPA	1.000E+000	6	RHR PUMP A IS IN STANDBY
XHOS-RHRPB	1.000E+000	6	RHR PUMP B IS IN STANDBY
XHOS-RHRPWR	1.000E+000	6	RHR SYSTEM IS ALIGNED TO AT POWERMODE
XHOS-RMUWPA	0.000E+000	6	REACTOR MAKEUP WATER PUMP A IS IN STANDBY
XHOS-RMUWPB	1.000E+000	6	REACTOR MAKEUP WATER PUMP B IS IN STANDBY
XHOS-RUN-CWPA	1.000E+000	6	CIRCULATING WATER PUMP A IS RUNNING

Table 11
Basic Event Descriptions (continued)

XHOS-RUN-CWPB	0.000E+000	6	CIRCULATING WATER PUMP B IS RUNNING
XHOS-SFCP-2PUMP	0.000E+000	6	TWO SPENT FUEL COOLING PUMPS ARE REQUIRED
XHOS-SFPC-RHRHXA	0.000E+000	6	SPENT FUEL POOL COOLING IS LINED UPTO RHR HX A
XHOS-SFPC-SFPHX	1.000E+000	6	SPENT FUEL POOL COOLING IS LINED UPTO THE SFP HX
XHOS-SFPCA	0.000E+000	6	SPENT FUEL POOL COOLING PUMP A IS IN STANDBY
XHOS-SFPCB	1.000E+000	6	SPENT FUEL POOL COOLING PUMP B IS IN STANDBY
XHOS-SIACF	0.000E+000	6	AIR COMPRESSOR F ISIN STANDBY
XHOS-SIACG	1.000E+000	6	AIR COMPRESSOR G ISIN STANDBY
XHOS-SM	0.000E+000	6	SAFETY MONITOR MODEL
XHOS-SW-NOXTIE	1.000E+000	6	SERVICE WATER HEADERS ARE NOT CROSS-TIED
XHOS-SW-XTIE	0.000E+000	6	SERVICE WATER HEADERS ARE CROSS-TIED
XHOS-SWA-TBH	1.000E+000	6	SERVICE WATER TRAINA ALIGNED TO TURBINE BLDG HDR
XHOS-SWB-TBH	0.000E+000	6	SERVICE WATER TRAINB ALIGNED TO TURBINE BLDG HDR
XHOS-SWPA1	0.000E+000	6	SERVICE WATER PUMP A1 IS IN STANDBY
XHOS-SWPA2	0.000E+000	6	SERVICE WATER PUMP A2 IS IN STANDBY
XHOS-SWPB1	1.000E+000	6	SERVICE WATER PUMP B1 IS IN STANDBY
XHOS-SWPB2	1.000E+000	6	SERVICE WATER PUMP B2 IS IN STANDBY

Attachment A

Sensitivity Analysis of HEPs for Operator Actions
with Less than a 30-minute Time Window Increased by 100%

A sensitivity analysis was performed to investigate the impact of doubling the HEPs for operator actions with less than a 30-minute time window. A separate directory was created, NEW SDI 30 MIN 2X, for quantification of this sensitivity analysis. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity analysis is in the KNPP.BED file used for quantification. The changes to the KNPP.BED file are shown below:

Basic Event	Description	Base Case	<30 min X2
02-SW4A-B29F-HE	CLOSE SW-4A SW-4B DURING FLOOD - 29 MIN.	2.00E-02	4.00E-02
04-CWSTP13-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 13 MINUTES	2.60E-01	5.20E-01
04-CWSTP19-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 19 MINUTES	1.20E-01	2.40E-01
04-CWSTP22-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 22 MINUTES	1.20E-01	2.40E-01
04-CWSTP25-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 25 MINUTES	1.20E-01	2.40E-01
08-FPSISO29F-HE	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 29 MIN.	4.50E-01	9.00E-01

The model was then quantified as described in Section 4.0 for the base case. KNPP.BED reset the Human Error Probabilities to those shown above.

The cutsets for this sensitivity case are documented in Table A-1. The Core Damage Frequency if the HEPs for operator actions with less than a 30-minute time window are increased by 100% is 5.791E-5.

INTERNAL FLOODING – Quantification for Turbine Building Floods

Table A-1

Sensitivity Analysis of HEPs for Operator Actions With Less Than A 30-Minute Time Window Increased by 100%

```
==========================================================================
WinNUPRA 3.0 Production                              Licensed to: KPS
CDFTBFLD.EQP                                         File created: 10-28-2005
==========================================================================
   Equation File                                  = CDFTBFLD.EQN
   Basic Event Data file referenced               = FLOOD.BED
   Number of cut sets in equation                 = 23595
   Top event unavailability  (rare event)         = 5.791E-005
--------------------------------------------------------------------------
```

1	2.7900E-005	IE-CI06B	04-CW-TRIP-F-HE	
2	4.7280E-006	IE-CX06B	04-CWSTP25-F-HE	
3	4.7114E-006	XCOM-AFZ-BWI4	06-BLINDAFWF-HE	IE-WI06B
		08-ISO-FS40F-HE		
4	4.2613E-006	XCOM-AFZ-BTI4	06-BLINDAFWF-HE	IE-TI06B
		08-FPSISO56F-HE		
5	2.4627E-006	XCOM-AFZ-BCX4	06-BLINDAFWF-HE	IE-CX06B
		04-CWSTP22-F-HE		
6	1.6835E-006	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD49F-HE
		IE-WI06B	08-ISO-FS40F-HE	
7	1.4708E-006	IE-TI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
8	9.5399E-007	XCOM-AFZ-BFI4	06-BLINDAFWF-HE	IE-FI06B
		08-FPISO56-F-HE		
9	9.3175E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-TI06B	08-FPSISO56F-HE	
10	8.7998E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD36F-HE
		IE-CX06B	04-CWSTP22-F-HE	
11	8.7199E-007	IE-WI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
12	6.4400E-007	IE-SI06B	02-SW4A-B66F-HE	
13	4.7794E-007	XCOM-AFZ-BWX4	06-BLINDAFWF-HE	IE-WX06B
		08-ISO-FS2HF-HE		
14	4.5731E-007	IE-FI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
15	4.0098E-007	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO29F-HE
16	3.6156E-007	XCOM-AFZ-BSI4	06-BLINDAFWF-HE	IE-SI06B
		02-SW4A-B51F-HE		
17	3.5904E-007	06-BLINDAFWF-HE	IE-TX06B	08-FPSISO3CF-HE
18	2.4381E-007	XCOM-AFX-2WI4	XCOM-AFZ-BWI4	06--OC6----F-HE
		IE-WI06B	08-ISO-FS40F-HE	
19	2.4362E-007	XCOM-OCFI06B4	XCOM-AFX-2FI4	XCOM-AFZ-BFI4
		SL182	IE-FI06B	08-FPISO56-F-HE
20	2.3773E-007	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS18F-HE
21	2.2052E-007	XCOM-AFX-2TI4	XCOM-AFZ-BTI4	06--OC6----F-HE
		IE-TI06B	08-FPSISO56F-HE	
22	2.0859E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-FI06B	08-FPISO56-F-HE	

```
23  1.9184E-007   IE-WI06B         01-CMSIAC1B--PR  86-INSTRFCRF-HE
                  08-ISO-FS33F-HE
```

Table A-1 (continued)

Sensitivity Analysis of HEPs for Operator Actions With Less Than A 30-Minute Time Window Increased by 100%

24	1.4819E-007	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BPT--AFW1C-PS
25	1.4386E-007	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
26	1.3403E-007	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BPT--AFW1C-PS
27	1.2745E-007	XCOM-AFX-2CX4 IE-CX06B	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	06--OC6----F-HE
28	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
29	8.5293E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
30	7.9057E-008	05B-BYALOP-F-HE IE-SI06B	05B-FRACTDP-OFF 02-SW4A-B51F-HE	05B-MDPTD61F-HE
31	7.7461E-008	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PS
32	6.6168E-008	IE-CX06B 04-CWSTP13-F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
33	6.3733E-008	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
34	6.0495E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
35	5.2302E-008	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
36	5.1847E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-SWS--HE
37	5.1833E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
38	5.0517E-008	05B-BYALOP-F-HE IE-WX06B	05B-FRACTDP-OFF 08-ISO-FS2HF-HE	05B-MDPTD1CF-HE
39	4.9369E-008	XCOM-AFX-2FI4 IE-FI06B	XCOM-AFZ-BFI4 08-FPISO56-F-HE	06--OC6----F-HE
40	4.6894E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-SWS--HE
41	4.6592E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
42	4.4731E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
43	3.5867E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
44	3.0539E-008	IE-CX06B 04-CWSTP19-F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
45	3.0182E-008	IE-FI06B 08-FPISO45-F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
46	3.0006E-008	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PS
47	2.9951E-008	SL182 31-PM--CCW1B-TM	06--OC2----F-HE STBY-CCWPB	IE-TI06B 08-FPSISO29F-HE
48	2.7102E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE

		04-CWSTP22-F-HE		
49	2.4733E-008	XCOM-AFX-2WX4	XCOM-AFZ-BWX4	06--OC6----F-HE
		IE-WX06B	08-ISO-FS2HF-HE	

Table A-1 (continued)

Sensitivity Analysis of HEPs for Operator Actions With Less Than A 30-Minute Time Window Increased by 100%

50	1.9409E-008	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PR
		08-ISO-FS40F-HE		
51	1.8977E-008	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
52	1.8810E-008	IE-FI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
53	1.8764E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
54	1.8711E-008	XCOM-AFX-2SI4	XCOM-AFZ-BSI4	06--OC6----F-HE
		IE-SI06B	02-SW4A-B51F-HE	
55	1.8580E-008	XCOM-AFX-2TX4	06--OC6----F-HE	IE-TX06B
		08-FPSISO3CF-HE		
56	1.8040E-008	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
57	1.7757E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
58	1.7555E-008	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PR
		08-FPSISO56F-HE		
59	1.7484E-008	XCOM-AFZ-BWI4	IE-WI06B	05BMVI-MS102-FO
		08-ISO-FS40F-HE		
60	1.7376E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE
61	1.6883E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
62	1.6117E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
63	1.5813E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
64	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
65	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
66	1.5033E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
67	1.2964E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
68	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
69	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
70	1.1725E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
71	1.1372E-008	XCOM-AFZ-BSI4	IE-SI06B	05BPT--AFW1C-PS
		02-SW4A-B51F-HE		
72	1.1293E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
73	1.1251E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
74	1.0562E-008	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-TI06B

08-FPSISO29F-HE

Table A-1 (continued)

Sensitivity Analysis of HEPs for Operator Actions With Less Than A 30-Minute Time Window Increased by 100%

75	1.0562E-008	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-TI06B
		08-FPSISO29F-HE		
76	1.0498E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		
77	1.0441E-008	XCOM-OCTI06BB	38-BY-BRB101-OP	IE-TI06B
		STBY-CCWPB	08-FPSISO29F-HE	
78	1.0145E-008	XCOM-AFZ-BCX4	IE-CX06B	05BPT--AFW1C-PR
		04-CWSTP22-F-HE		
79	1.0010E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
80	9.8366E-009	05BPMSKPSCCF23	IE-TI06B	08-FPSISO29F-HE
81	9.3127E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO29-F-HE
82	9.1391E-009	XCOM-AFZ-BCX4	IE-CX06B	05BMVI-MS102-FO
		04-CWSTP22-F-HE		
83	9.1084E-009	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
84	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
85	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
86	8.8940E-009	IE-TI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
87	8.8940E-009	IE-TI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
88	8.8858E-009	IE-TI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
89	8.3260E-009	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP19-F-HE
90	8.3194E-009	IE-SI06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		02-SW4A-B29F-HE		
91	8.2288E-009	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
92	7.8907E-009	IE-WI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
93	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
94	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
95	6.7764E-009	XCOM-AFZ-BCX4	IE-CX06B	36--LHS-DIAG-HE
		04-CWSTP22-F-HE		
96	6.4722E-009	IE-CX06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
97	6.3722E-009	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-DIAG-HE
		08-ISO-FS40F-HE		
98	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE

STBY-SWPA1 STBY-SWPB1 IE-WI06B
08-ISO-FS18F-HE

Table A-1 (continued)

Sensitivity Analysis of HEPs for Operator Actions With Less Than A 30-Minute Time Window Increased by 100%

99	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
100	6.2340E-009	IE-TI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPSISO45F-HE		

Attachment B

Sensitivity Analysis of HEPs for Operator Actions
with Less than a One-Hour Time Window Increased by 100%

A sensitivity analysis was performed to investigate the impact of doubling the HEPs for operator actions with less than a one-hour time window. A separate directory was created, NEW SDI 1 HR 2X, for quantification of this sensitivity analysis. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity analysis is in the KNPP.BED file used for quantification. The changes to the KNPP.BED file are shown below:

Basic Event	Description	Base Case	<1hr X2
02-SW4A-B29F-HE	CLOSE SW-4A SW-4B DURING FLOOD - 29 MIN.	2.00E-02	4.00E-02
02-SW4A-B45F-HE	CLOSE SW-4A SW-4B DURING FLOOD - 45 MIN.	2.00E-02	4.00E-02
02-SW4A-B51F-HE	CLOSE SW-4A SW-4B DURING FLOOD - 51 MIN.	2.00E-02	4.00E-02
04-CWSTP13-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 13 MINUTES	2.60E-01	5.20E-01
04-CWSTP19-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 19 M INUTES	1.20E-01	2.40E-01
04-CWSTP22-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 22 M INUTES	1.20E-01	2.40E-01
04-CWSTP25-F-HE	TRIP CW PUMP DURINGFLOOD EVENT - 25 M INUTES	1.20E-01	2.40E-01
05B-MDPTD36F-HE	Start DT AFW Pump before loss of MD AFW Pump - 36 min.	4.70E-01	9.40E-01
05B-MDPTD49F-HE	Start TD AFW Pump before loss of MD AFW Pump - 49 min.	4.70E-01	9.40E-01
06--OC6----F-HE	FAIL TO COOLDOWN PER ES-1.2	9.20E-02	1.84E-01
08-FPISO45-F-HE	ISOL FIRE PUMP DURING FLOOD EVENT - 45 MINUTES	6.60E-02	1.32E-01
08-FPISO56-F-HE	ISOL FIRE PUMP DURING FLOOD EVENT - 56 MINUTES	2.40E-02	4.80E-02
08-FPSISO29F-HE	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 29 MIN.	4.50E-01	9.00E-01
08-FPSISO45F-HE	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 45 MIN.	3.90E-02	7.80E-02
08-FPSISO56F-HE	ISOLATE FIRE SPRINKLERS DURING FLOOD/MS EVENT - 56 MIN.	3.00E-02	6.00E-02

INTERNAL FLOODING – Quantification for Turbine Building Floods

Basic Event	Description	Base Case	<1hr X2
08-ISO-FS33F-HE	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 33 MIN	2.20E-01	4.40E-01
08-ISO-FS40F-HE	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 40 MIN	6.70E-02	1.34E-01
08-ISO-FS54F-HE	ISOLATE SPRINKLERS DURING FLOOD/FW EVENT IN 54 MIN.	3.00E-02	6.00E-02

The model was then quantified as described in Section 4.0 for the base case. KNPP.BED reset the Human Error Probabilities as shown above.

The cutsets for this sensitivity case are documented in Table B-1. The Core Damage Frequency if the HEPs for operator actions with less than a one-hour time window are increased by 100% is 7.531E-5.

Table B-1
Sensitivity Analysis of HEPs for Operator Actions with Less Than A 1-Hour Time Window
Increased by 100%

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============================================================================
WinNUPRA 3.0 Production                                Licensed to: KPS
CDFTBFLD.EQP                                           File created: 10-28-2005
============================================================================
   Equation File                                   = CDFTBFLD.EQN
   Basic Event Data file referenced                = FLOOD.BED
   Number of cut sets in equation                  = 23507
   Top event unavailability  (rare event)          = 7.531E-005
----------------------------------------------------------------------------
     1  2.7900E-005    IE-CI06B          04-CW-TRIP-F-HE
     2  8.5226E-006    XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                       08-FPSISO56F-HE
     3  7.2680E-006    XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                       08-ISO-FS40F-HE
     4  6.7338E-006    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                       IE-WI06B          08-ISO-FS40F-HE
     5  4.7280E-006    IE-CX06B          04-CWSTP25-F-HE
     6  1.9080E-006    XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                       08-FPISO56-F-HE
     7  1.8996E-006    XCOM-AFZ-BCX4     06-BLINDAFWF-HE   IE-CX06B
                       04-CWSTP22-F-HE
     8  1.8635E-006    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                       IE-TI06B          08-FPSISO56F-HE
     9  1.7600E-006    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD36F-HE
                       IE-CX06B          04-CWSTP22-F-HE
    10  1.4708E-006    IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                       08-FPSISO29F-HE
    11  8.8209E-007    XCOM-AFX-2TI4     XCOM-AFZ-BTI4     06--OC6----F-HE
                       IE-TI06B          08-FPSISO56F-HE
    12  8.7199E-007    IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                       08-ISO-FS18F-HE
    13  7.5223E-007    XCOM-AFX-2WI4     XCOM-AFZ-BWI4     06--OC6----F-HE
                       IE-WI06B          08-ISO-FS40F-HE
    14  7.2313E-007    XCOM-AFZ-BSI4     06-BLINDAFWF-HE   IE-SI06B
                       02-SW4A-B51F-HE
    15  6.4400E-007    IE-SI06B          02-SW4A-B66F-HE
    16  4.7794E-007    XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                       08-ISO-FS2HF-HE
    17  4.5731E-007    IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                       08-FPISO29-F-HE
    18  4.3788E-007    XCOM-OCFI06B4     XCOM-AFX-2FI4     XCOM-AFZ-BFI4
                       SL182             IE-FI06B          08-FPISO56-F-HE
    19  4.1719E-007    05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                       IE-FI06B          08-FPISO56-F-HE
    20  4.0098E-007    36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
    21  3.8367E-007    IE-WI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                       08-ISO-FS33F-HE
    22  3.5904E-007    06-BLINDAFWF-HE   IE-TX06B          08-FPSISO3CF-HE
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23	2.6806E-007	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PS
		08-FPSISO56F-HE		
24	2.3773E-007	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS18F-HE

Table B-1 (continued)
Sensitivity Analysis of HEPs for Operator Actions with Less Than A 1-Hour Time Window Increased by 100%

25	2.2860E-007	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BPT--AFW1C-PS
26	1.9748E-007	XCOM-AFX-2FI4 IE-FI06B	XCOM-AFZ-BFI4 08-FPISO56-F-HE	06--OC6----F-HE
27	1.9660E-007	XCOM-AFX-2CX4 IE-CX06B	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	06--OC6----F-HE
28	1.5811E-007	05B-BYALOP-F-HE IE-SI06B	05B-FRACTDP-OFF 02-SW4A-B51F-HE	05B-MDPTD61F-HE
29	1.4386E-007	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
30	1.2747E-007	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
31	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
32	1.0460E-007	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
33	9.3788E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-SWS--HE
34	9.3185E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
35	8.5293E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
36	7.9982E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-SWS--HE
37	7.4844E-008	XCOM-AFX-2SI4 IE-SI06B	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	06--OC6----F-HE
38	6.6168E-008	IE-CX06B 04-CWSTP13-F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
39	6.0495E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
40	6.0365E-008	IE-FI06B 08-FPISO45-F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
41	6.0012E-008	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PS
42	5.9747E-008	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PS
43	5.1833E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
44	5.0517E-008	05B-BYALOP-F-HE IE-WX06B	05B-FRACTDP-OFF 08-ISO-FS2HF-HE	05B-MDPTD1CF-HE
45	4.9467E-008	XCOM-AFX-2WX4 IE-WX06B	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	06--OC6----F-HE
46	4.4731E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
47	3.7529E-008	IE-WI06B 08-ISO-FS33F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
48	3.7161E-008	XCOM-AFX-2TX4 08-FPSISO3CF-HE	06--OC6----F-HE	IE-TX06B
49	3.5867E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE

50	3.5109E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BPT--AFW1C-PR
51	3.4752E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE

Table B-1 (continued)
Sensitivity Analysis of HEPs for Operator Actions with Less Than A 1-Hour Time Window Increased by 100%

52	3.1627E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
53	3.0539E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
54	2.9951E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE
55	2.9941E-008	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PR
		08-ISO-FS40F-HE		
56	2.6971E-008	XCOM-AFZ-BWI4	IE-WI06B	05BMVI-MS102-FO
		08-ISO-FS40F-HE		
57	2.3450E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
58	2.2745E-008	XCOM-AFZ-BSI4	IE-SI06B	05BPT--AFW1C-PS
		02-SW4A-B51F-HE		
59	2.0997E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		
60	2.0904E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE
		04-CWSTP22-F-HE		
61	1.9998E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
62	1.8977E-008	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
63	1.8810E-008	IE-FI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
64	1.8041E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD49F-HE
		IE-WI06B	05BPM--AFW1B-PR	08-ISO-FS33F-HE
65	1.8040E-008	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
66	1.7757E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
67	1.6883E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
68	1.6458E-008	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
69	1.6117E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
70	1.5781E-008	IE-WI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
71	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
72	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
73	1.5033E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
74	1.2468E-008	IE-TI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
75	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
76	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		

77	1.1527E-008	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-DIAG-HE
		08-FPSISO56F-HE		
78	1.1293E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
79	1.1251E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		

Table B-1 (continued)
Sensitivity Analysis of HEPs for Operator Actions with Less Than A 1-Hour Time Window Increased by 100%

80	1.0864E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BFAFWB-CAL-AE
81	1.0864E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BFAFWA-CAL-AE
82	1.0562E-008	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
83	1.0562E-008	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
84	1.0441E-008	XCOM-OCTI06BB STBY-CCWPB	38-BY-BRB101-OP 08-FPSISO29F-HE	IE-TI06B
85	1.0010E-008	SL182 31-PM--CCW1B-PR	06--OC2----F-HE 08-ISO-FS18F-HE	IE-WI06B
86	9.8366E-009	05BPMSKPSCCF23	IE-TI06B	08-FPSISO29F-HE
87	9.8299E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-DIAG-HE
88	9.7796E-009	XCOM-OCTI06B4 SL480	XCOM-AFX-2TI4 IE-TI06B	XCOM-AFZ-BTI4 08-FPSISO56F-HE
89	9.3127E-009	SL182 31-PM--CCW1B-TM	06--OC2----F-HE STBY-CCWPB	IE-FI06B 08-FPISO29-F-HE
90	9.2644E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BFAFWA-CAL-AE
91	9.2644E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BFAFWB-CAL-AE
92	9.1084E-009	05B-BYALOP-F-HE IE-TX06B	05B-FRACTDP-OFF 08-FPSISO3CF-HE	05B-MDPTD2HF-HE
93	9.0880E-009	IE-WX06B 08-ISO-FS97F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
94	9.0880E-009	IE-WX06B 08-ISO-FS55F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
95	8.8940E-009	IE-TI06B 08-FPSISO29F-HE	01-CMSKPRCCF12	86-INSTRRCRF-HE
96	8.8940E-009	IE-TI06B 08-FPSISO29F-HE	01-CMSKPRCCF23	86-INSTRRCRF-HE
97	8.8858E-009	IE-TI06B 08-FPSISO29F-HE	01-AV-SW420B-FO	86-INSTRRCRF-HE
98	8.3400E-009	XCOM-OCWI06B4 SL480	XCOM-AFX-2WI4 IE-WI06B	XCOM-AFZ-BWI4 08-ISO-FS40F-HE
99	8.3260E-009	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP19-F-HE
100	8.3194E-009	IE-SI06B 02-SW4A-B45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE

Attachment C

Sensitivity Analysis of HEPs for Unproceduralized Operator Actions
Increased by 100%

A sensitivity analysis was performed to investigate the impact of doubling the unproceduralized operator action HEPs. A separate directory was created, NEW SDI CASE UNPROC, for quantification of this sensitivity analysis. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity analysis is in the KNPP.BED file used for quantification. The changes to the KNPP.BED file are shown below:

Basic Event	Description	Base Case	No Procedure Case
04-CWSTP13-F-HE	TRIP CW PUMP DURING FLOOD EVENT - 13 MINUTES	2.60E-01	5.20E-01
04-CWSTP19-F-HE	TRIP CW PUMP DURING FLOOD EVENT - 19 MINUTES	1.20E-01	2.40E-01
04-CWSTP22-F-HE	TRIP CW PUMP DURING FLOOD EVENT - 22 MINUTES	1.20E-01	2.40E-01
04-CWSTP25-F-HE	TRIP CW PUMP DURING FLOOD EVENT - 25 MINUTES	1.20E-01	2.40E-01
05B-BYALOP-F-HE	FAIL TO BYPASS AFW ALOP PERMISSIVE LARGE FW BREAK	4.40E-01	8.80E-01
05B-MDPTD1CF-HE	Start TD AFW Pump before loss of MD AFW Pump - 108 min.	1.60E-01	3.20E-01
05B-MDPTD2HF-HE	Start TD AFW Pump before loss of MD AFW Pump - 2 Hr.	4.10E-02	8.20E-02
05B-MDPTD36F-HE	Start DT AFW Pump before loss of MD AFW Pump - 36 min.	4.70E-01	9.40E-01
05B-MDPTD49F-HE	Start TD AFW Pump before loss of MD AFW Pump - 49 min.	4.70E-01	9.40E-01
05B-MDPTD61F-HE	Start TD AFW Pump before loss of MD AFW Pump - 61 min.	3.10E-01	6.20E-01
06-BLINDAFWF-HE	Operator fails to feed S/G without Level indication	6.40E-01	1.00E+00
08-FPISO45-F-HE	ISOL FIRE PUMP DURING FLOOD EVENT - 45 MINUTES	6.60E-02	1.32E-01
08-FPISO56-F-HE	ISOL FIRE PUMP DURING FLOOD EVENT - 56 MINUTES	2.40E-02	4.80E-02

The model was then quantified as described in Section 4.0 for the base case. KNPP.BED reset the Human Error Probabilities to those shown above.

The cutsets for this sensitivity case are documented in Table C-1. The Core Damage Frequency if the unproceduralized operator action HEPs are increased by 100% is 6.476E-5.

Table C-1

Sensitivity Analysis of HEPs for Unproceduralized Operator Action
Increased by 100%

```
=============================================================================
WinNUPRA 3.0 Production                                  Licensed to: KPS
CDFTBFLD.EQP                                             File created: 10-28-2005
=============================================================================
   Equation File                                   = CDFTBFLD.EQN
   Basic Event Data file referenced                = FLOOD.BED
   Number of cut sets in equation                  = 21911
   Top event unavailability  (rare event)          = 6.476E-005
-----------------------------------------------------------------------------
     1  2.7900E-005   IE-CI06B          04-CW-TRIP-F-HE
     2  6.7338E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                      IE-WI06B          08-ISO-FS40F-HE
     3  4.7280E-006   IE-CX06B          04-CWSTP25-F-HE
     4  3.8630E-006   XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                      08-FPSISO56F-HE
     5  3.7270E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-TI06B          08-FPSISO56F-HE
     6  3.5199E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD36F-HE
                      IE-CX06B          04-CWSTP22-F-HE
     7  2.3112E-006   XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                      08-ISO-FS40F-HE
     8  1.7296E-006   XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                      08-FPISO56-F-HE
     9  1.6688E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-FI06B          08-FPISO56-F-HE
    10  1.2081E-006   XCOM-AFZ-BCX4     06-BLINDAFWF-HE   IE-CX06B
                      04-CWSTP22-F-HE
    11  8.7199E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
    12  7.3538E-007   IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
    13  6.4400E-007   IE-SI06B          02-SW4A-B66F-HE
    14  5.9523E-007   XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                      08-ISO-FS2HF-HE
    15  5.2457E-007   XCOM-AFZ-BTX4     06-BLINDAFWF-HE   IE-TX06B
                      08-FPSISO3CF-HE
    16  4.5731E-007   IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
    17  3.2777E-007   XCOM-AFZ-BSI4     06-BLINDAFWF-HE   IE-SI06B
                      02-SW4A-B51F-HE
    18  3.1623E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-SI06B          02-SW4A-B51F-HE
    19  2.3773E-007   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS18F-HE
    20  2.0207E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD1CF-HE
                      IE-WX06B          08-ISO-FS2HF-HE
    21  2.0049E-007   36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
    22  1.9184E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
```

		08-ISO-FS33F-HE		
23	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
24	9.3185E-008	05B-FRACTDP-OFF	05B-MDPTD49F-HE	IE-WI06B
		05BPM--AFW1B-PR	08-ISO-FS18F-HE	

Table C-1

Sensitivity Analysis of HEPs for Unproceduralized Operator Action
Increased by 100%

25	8.5293E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
26	7.7762E-008	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PS
		08-FPSISO56F-HE		
27	7.1930E-008	IE-TI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
28	6.6168E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
29	6.3733E-008	IE-TI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
30	6.0365E-008	IE-FI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
31	5.2302E-008	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
32	5.1833E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-TI06B
		05BPM--AFW1B-PR	08-FPSISO29F-HE	
33	4.6524E-008	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PS
		08-ISO-FS40F-HE		
34	4.4731E-008	IE-FI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
35	3.6434E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
36	3.5867E-008	IE-WI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
37	3.4818E-008	XCOM-AFZ-BFI4	IE-FI06B	05BPT--AFW1C-PS
		08-FPISO56-F-HE		
38	3.2234E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
39	3.0539E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
40	3.0248E-008	IE-TI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
41	2.7207E-008	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-SWS--HE
		08-FPSISO56F-HE		
42	2.4319E-008	XCOM-AFZ-BCX4	IE-CX06B	05BPT--AFW1C-PS
		04-CWSTP22-F-HE		
43	1.8810E-008	IE-FI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
44	1.8764E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
45	1.8041E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD49F-HE
		IE-WI06B	05BPM--AFW1B-PR	08-ISO-FS33F-HE
46	1.8040E-008	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
47	1.7757E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
48	1.7376E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE
49	1.6458E-008	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
50	1.6278E-008	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-SWS--HE

		08-ISO-FS40F-HE		
51	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
52	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
53	1.4975E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE

Table C-1

Sensitivity Analysis of HEPs for Unproceduralized Operator Action
Increased by 100%

54	1.2182E-008	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05B-CST-SWS--HE
55	1.1982E-008	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	IE-WX06B	05BPT--AFW1C-PS
56	1.1251E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSKPRCCF123	86-INSTRRCRF-HE
57	1.0560E-008	XCOM-AFZ-BTX4 08-FPSISO3CF-HE	IE-TX06B	05BPT--AFW1C-PS
58	1.0185E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BPT--AFW1C-PR
59	1.0010E-008	SL182 31-PM--CCW1B-PR	06--OC2----F-HE 08-ISO-FS18F-HE	IE-WI06B
60	9.4883E-009	IE-TI06B 08-FPSISO29F-HE	01-CMSKPRCCF123	86-INSTRRCRF-HE
61	9.3127E-009	SL182 31-PM--CCW1B-TM	06--OC2----F-HE STBY-CCWPB	IE-FI06B 08-FPISO29-F-HE
62	9.1746E-009	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BMVI-MS102-FO
63	9.0880E-009	IE-WX06B 08-ISO-FS97F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
64	9.0880E-009	IE-WX06B 08-ISO-FS55F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
65	8.5086E-009	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05B-CST-SWS--HE
66	8.4414E-009	SL182 31-PM--CCW1B-PR	06--OC2----F-HE 08-FPSISO29F-HE	IE-TI06B
67	8.3260E-009	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP19-F-HE
68	7.8907E-009	IE-WI06B 08-ISO-FS33F-HE	01-CMSIAC1B--PS	86-INSTRFCRF-HE
69	7.0710E-009	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD36F-HE 04-CWSTP13-F-HE	IE-CX06B
70	6.9986E-009	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
71	6.9986E-009	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
72	6.8028E-009	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	36--LHS-DIAG-HE
73	6.5980E-009	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	IE-SI06B	05BPT--AFW1C-PS
74	6.4722E-009	IE-CX06B 04-CWSTP13-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
75	6.2619E-009	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
76	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE

		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
77	6.2340E-009	IE-TI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPSISO45F-HE		

Table C-1

Sensitivity Analysis of HEPs for Unproceduralized Operator Action
Increased by 100%

78	6.1902E-009	XCOM-OCWI06BB STBY-CCWPB	38-BY-BRB101-OP 08-ISO-FS18F-HE	IE-WI06B
79	6.0935E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BPT--AFW1C-PR
80	5.9046E-009	IE-FI06B 08-FPISO45-F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
81	5.9022E-009	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
82	5.9022E-009	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-TI06B
83	5.9005E-009	IE-FI06B 08-FPISO29-F-HE	01-CMSKPRCCF123	86-INSTRRCRF-HE
84	5.8320E-009	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS18F-HE
85	5.4890E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BMVI-MS102-FO
86	5.2809E-009	XCOM-OCTI06BB STBY-SWPA2 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
87	5.2809E-009	XCOM-OCTI06BB STBY-SWPA1 08-FPSISO29F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-TI06B
88	5.2731E-009	IE-WI06B 08-ISO-FS18F-HE	01-CMSKPRCCF23	86-INSTRRCRF-HE
89	5.2731E-009	IE-WI06B 08-ISO-FS18F-HE	01-CMSKPRCCF12	86-INSTRRCRF-HE
90	5.2682E-009	IE-WI06B 08-ISO-FS18F-HE	01-AV-SW420B-FO	86-INSTRRCRF-HE
91	5.2494E-009	SL182 31-PM--CCW1B-PR	06--OC2----F-HE 08-FPISO29-F-HE	IE-FI06B
92	5.2204E-009	XCOM-OCTI06BB STBY-CCWPB	38-BY-BRB101-OP 08-FPSISO29F-HE	IE-TI06B
93	4.9183E-009	05BPMSKPSCCF23	IE-TI06B	08-FPSISO29F-HE
94	4.5603E-009	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PR
95	4.4470E-009	IE-TI06B 08-FPSISO29F-HE	01-CMSKPRCCF23	86-INSTRRCRF-HE
96	4.4470E-009	IE-TI06B 08-FPSISO29F-HE	01-CMSKPRCCF12	86-INSTRRCRF-HE
97	4.4429E-009	IE-TI06B 08-FPSISO29F-HE	01-AV-SW420B-FO	86-INSTRRCRF-HE
98	4.1922E-009	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	IE-WX06B	05B-CST-SWS--HE
99	4.1597E-009	IE-SI06B 02-SW4A-B29F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
100	4.1597E-009	IE-SI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE

02-SW4A-B45F-HE

Attachment D

Sensitivity Analysis of High Energy Line Break (HELB) Frequencies
Increased by 100%

A sensitivity analysis was performed to investigate the impact of increasing the high energy line break frequencies by a factor of two. A separate directory was created, NEW SDI HELB 2X, for quantification of this sensitivity. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity analysis for the increased HELB line break is changes to the FLDINIT.BED file. The initiating event frequencies were changed as follows:

	Base Case Initiator Frequency	HELB Case Initiator Frequency
TI (Large Main Steam Break)	2.53E-4	5.06E-4
TX (Moderate Main Steam)	1.37E-5	3.74E-5
WI (Large Feedwater Break)	1.35E-4	2.70E-4
WX (Moderate Feedwater)	4.69E-5	9.38E-5

The model was then quantified as described in Section 4.0 for the base case. FLDINIT.BED reset the initiating event frequencies to those shown above.

The cutsets for this sensitivity case are documented in Table D-1. The Core Damage Frequency if the high energy line break frequencies are increased by 100% is 6.919E-5.

Table D-1

Sensitivity Analyses for High Energy Line Break Frequencies Increased by 100%

```
============================================================================
WinNUPRA 3.0 Production                          Licensed to: KPS
CDFTBFLD.EQP                                     File created: 10-28-2005
============================================================================
   Equation File                                = CDFTBFLD.EQN
   Basic Event Data file referenced             = FLOOD.BED
   Number of cut sets in equation               = 28581
   Top event unavailability  (rare event)       = 6.919E-005
----------------------------------------------------------------------------
     1  2.7900E-005   IE-CI06B          04-CW-TRIP-F-HE
     2  9.4228E-006   XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                      08-ISO-FS40F-HE
     3  8.5226E-006   XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                      08-FPSISO56F-HE
     4  3.3669E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                      IE-WI06B          08-ISO-FS40F-HE
     5  2.3640E-006   IE-CX06B          04-CWSTP25-F-HE
     6  1.8635E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-TI06B          08-FPSISO56F-HE
     7  1.7440E-006   IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
     8  1.4708E-006   IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
     9  1.2314E-006   XCOM-AFZ-BCX4     06-BLINDAFWF-HE   IE-CX06B
                      04-CWSTP22-F-HE
    10  9.5588E-007   XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                      08-ISO-FS2HF-HE
    11  9.5399E-007   XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                      08-FPISO56-F-HE
    12  7.1808E-007   06-BLINDAFWF-HE   IE-TX06B          08-FPSISO3CF-HE
    13  6.4400E-007   IE-SI06B          02-SW4A-B66F-HE
    14  4.8763E-007   XCOM-AFX-2WI4     XCOM-AFZ-BWI4     06--OC6----F-HE
                      IE-WI06B          08-ISO-FS40F-HE
    15  4.7547E-007   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS18F-HE
    16  4.5731E-007   IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
    17  4.4104E-007   XCOM-AFX-2TI4     XCOM-AFZ-BTI4     06--OC6----F-HE
                      IE-TI06B          08-FPSISO56F-HE
    18  4.3999E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD36F-HE
                      IE-CX06B          04-CWSTP22-F-HE
    19  4.0098E-007   36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
    20  3.8367E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
                      08-ISO-FS33F-HE
    21  3.6156E-007   XCOM-AFZ-BSI4     06-BLINDAFWF-HE   IE-SI06B
                      02-SW4A-B51F-HE
    22  2.9638E-007   XCOM-AFZ-BWI4     IE-WI06B          05BPT--AFW1C-PS
                      08-ISO-FS40F-HE
    23  2.6806E-007   XCOM-AFZ-BTI4     IE-TI06B          05BPT--AFW1C-PS
                      08-FPSISO56F-HE
```

24	2.4362E-007	XCOM-OCFI06B4	XCOM-AFX-2FI4	XCOM-AFZ-BFI4
		SL182	IE-FI06B	08-FPISO56-F-HE

Table D-1 (continued)

Sensitivity Analyses for High Energy Line Break Frequencies Increased by 100%

25	2.0859E-007	05B-BYALOP-F-HE IE-FI06B	05B-FRACTDP-OFF 08-FPISO56-F-HE	05B-MDPTD61F-HE
26	1.7059E-007	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
27	1.4386E-007	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
28	1.2747E-007	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
29	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
30	1.0460E-007	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
31	1.0369E-007	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-SWS--HE
32	1.0103E-007	05B-BYALOP-F-HE IE-WX06B	05B-FRACTDP-OFF 08-ISO-FS2HF-HE	05B-MDPTD1CF-HE
33	9.3788E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-SWS--HE
34	9.3185E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
35	7.9057E-008	05B-BYALOP-F-HE IE-SI06B	05B-FRACTDP-OFF 02-SW4A-B51F-HE	05B-MDPTD61F-HE
36	7.1734E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
37	6.3723E-008	XCOM-AFX-2CX4 IE-CX06B	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	06--OC6----F-HE
38	6.0495E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
39	5.1833E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
40	4.9467E-008	XCOM-AFX-2WX4 IE-WX06B	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	06--OC6----F-HE
41	4.9369E-008	XCOM-AFX-2FI4 IE-FI06B	XCOM-AFZ-BFI4 08-FPISO56-F-HE	06--OC6----F-HE
42	4.4731E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
43	3.8818E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BPT--AFW1C-PR
44	3.8730E-008	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PS
45	3.7529E-008	IE-WI06B 08-ISO-FS33F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
46	3.7161E-008	XCOM-AFX-2TX4 08-FPSISO3CF-HE	06--OC6----F-HE	IE-TX06B
47	3.5514E-008	SL182 31-PM--CCW1B-TM	06--OC2----F-HE STBY-CCWPB	IE-WI06B 08-ISO-FS18F-HE
48	3.5109E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BPT--AFW1C-PR
49	3.4967E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05BMVI-MS102-FO
50	3.4752E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE

```
51  3.3084E-008    IE-CX06B          01-CMSIAC1B--PR  86-INSTRRCRF-HE
                   04-CWSTP13-F-HE
```

Table D-1 (continued)

Sensitivity Analyses for High Energy Line Break Frequencies Increased by 100%

52	3.1627E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
53	3.0182E-008	IE-FI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
54	3.0065E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
55	3.0006E-008	XCOM-AFZ-BFI4	IE-FI06B	05BPT--AFW1C-PS
		08-FPISO56-F-HE		
56	2.9951E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE
57	2.5927E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
58	2.3450E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
59	2.2586E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
60	2.2502E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
61	2.0019E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
62	1.8977E-008	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
63	1.8810E-008	IE-FI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
64	1.8711E-008	XCOM-AFX-2SI4	XCOM-AFZ-BSI4	06--OC6----F-HE
		IE-SI06B	02-SW4A-B51F-HE	
65	1.8217E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
66	1.8176E-008	IE-WX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
67	1.8176E-008	IE-WX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
68	1.6883E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
69	1.6117E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
70	1.5781E-008	IE-WI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
71	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
72	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
73	1.5269E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
74	1.3997E-008	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
75	1.3997E-008	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
76	1.3551E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE
		04-CWSTP22-F-HE		

77	1.2744E-008	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-DIAG-HE
		08-ISO-FS40F-HE		

Table D-1 (continued)

Sensitivity Analyses for High Energy Line Break Frequencies Increased by 100%

78	1.2524E-008	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
79	1.2524E-008	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
80	1.2468E-008	IE-TI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
81	1.2380E-008	XCOM-OCWI06BB	38-BY-BRB101-OP	IE-WI06B
		STBY-CCWPB	08-ISO-FS18F-HE	
82	1.2032E-008	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		SL480	IE-WI06B	08-ISO-FS40F-HE
83	1.2011E-008	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWB-CAL-AE
		08-ISO-FS40F-HE		
84	1.2011E-008	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWA-CAL-AE
		08-ISO-FS40F-HE		
85	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
86	1.1804E-008	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
87	1.1664E-008	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS18F-HE
88	1.1527E-008	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-DIAG-HE
		08-FPSISO56F-HE		
89	1.1372E-008	XCOM-AFZ-BSI4	IE-SI06B	05BPT--AFW1C-PS
		02-SW4A-B51F-HE		
90	1.0882E-008	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		SL480	IE-TI06B	08-FPSISO56F-HE
91	1.0864E-008	XCOM-AFZ-BTI4	IE-TI06B	05BFAFWA-CAL-AE
		08-FPSISO56F-HE		
92	1.0864E-008	XCOM-AFZ-BTI4	IE-TI06B	05BFAFWB-CAL-AE
		08-FPSISO56F-HE		
93	1.0562E-008	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-TI06B
		08-FPSISO29F-HE		
94	1.0562E-008	XCOM-OCTI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-TI06B
		08-FPSISO29F-HE		
95	1.0546E-008	IE-WI06B	01-CMSKPRCCF23	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
96	1.0546E-008	IE-WI06B	01-CMSKPRCCF12	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
97	1.0536E-008	IE-WI06B	01-AV-SW420B-FO	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
98	1.0519E-008	XCOM-AFZ-BWX4	IE-WX06B	05B-CST-SWS--HE
		08-ISO-FS2HF-HE		
99	1.0498E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		

100	1.0441E-008	XCOM-OCTI06BB	38-BY-BRB101-OP	IE-TI06B
		STBY-CCWPB	08-FPSISO29F-HE	

Attachment E

Sensitivity Analysis of Circulating Water Expansion Joint
Rupture Frequency Increased by 100%

A sensitivity analysis was performed to investigate the impact of doubling the circulating water expansion joint rupture frequencies. A separate directory was created, NEW SDI CI06B 2X, for quantification of this sensitivity analysis. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity case is the increase in the circulating water initiating event frequencies used for quantification. FLDINIT.BED reset the initiating event frequencies for circulating water breaks as shown below:

	Base Case Initiator Frequency	Expansion Joint X2 Case
CI (Large Circ Water Break)	2.79E-5	4.27E-5
CX (Moderate Circ Water)	1.97E-5	3.45E-5

The total frequency of large breaks in the circulating system inlet lines for the base case is the sum of the frequency of expansion joint ruptures and the frequency of large pipe ruptures, or,

$F_{CWIN} = F_{CWINExp} + F_{CWINPipe}$.

F_{CWIN} = 1.48E-05 per year + 1.31E-05 per year

F_{CWIN} = 2.79E-05 per year.

The total frequency of large breaks in the circulating system inlet lines for this sensitivity is the sum of the frequency of two times the expansion joint ruptures and the frequency of large pipe ruptures, or,

$F_{CWIN} = 2 * F_{CWINExp} + F_{CWINPipe}$.

F_{CWIN} = 2 * 1.48E-05 per year + 1.31E-05 per year

F_{CWIN} = 4.27E-05 per year.

The total frequency of moderate breaks in the circulating system outlet lines for the base case is the sum of the frequency of expansion joint ruptures and the frequency of moderate pipe ruptures,

or,

$F_{CWOUT} = F_{CWOUTExp} + F_{CWOUTPipe}$.

F_{CWIN} = 1.48E-05 per year + 4.87E-06 per year

F_{CWIN} = 1.97E-05 per year.

The total frequency of moderate breaks in the circulating system outlet lines for the sensitivity analysis is the sum of the frequency of two times the expansion joint ruptures and the frequency of moderate pipe ruptures, or,

$F_{CWOUT} = 2 * F_{CWOUTExp} + F_{CWOUTPipe}$.

F_{CWIN} = 2 * 1.48E-05 per year + 4.87E-06 per year

F_{CWIN} = 3.45E-05 per year.

The cutsets for this sensitivity case are documented in Table E-1. The Core Damage Frequency if the circulating water expansion joint rupture frequencies are increased by 100% is 7.042E-5.

Table E-1

Sensitivity Analysis of Circulating Water Expansion Joint Rupture
Frequency Increased by 100%

```
=============================================================================
WinNUPRA 3.0 Production                               Licensed to: KPS
CDFTBFLD.EQP                                          File created: 10-28-2005
=============================================================================
   Equation File                                = CDFTBFLD.EQN
   Basic Event Data file referenced             = FLOOD.BED
   Number of cut sets in equation               = 24150
   Top event unavailability  (rare event)       = 7.042E-005
-----------------------------------------------------------------------------
    1  4.2700E-005   IE-CI06B          04-CW-TRIP-F-HE
    2  4.7114E-006   XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                     08-ISO-FS40F-HE
    3  4.2613E-006   XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                     08-FPSISO56F-HE
    4  4.1400E-006   IE-CX06B          04-CWSTP25-F-HE
    5  2.1565E-006   XCOM-AFZ-BCX4     06-BLINDAFWF-HE   IE-CX06B
                     04-CWSTP22-F-HE
    6  1.6835E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                     IE-WI06B          08-ISO-FS40F-HE
    7  9.5399E-007   XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                     08-FPISO56-F-HE
    8  9.3175E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                     IE-TI06B          08-FPSISO56F-HE
    9  8.7199E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                     08-ISO-FS18F-HE
   10  7.7054E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD36F-HE
                     IE-CX06B          04-CWSTP22-F-HE
   11  7.3538E-007   IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                     08-FPSISO29F-HE
   12  6.4400E-007   IE-SI06B          02-SW4A-B66F-HE
   13  4.7794E-007   XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                     08-ISO-FS2HF-HE
   14  4.5731E-007   IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                     08-FPISO29-F-HE
   15  3.6156E-007   XCOM-AFZ-BSI4     06-BLINDAFWF-HE   IE-SI06B
                     02-SW4A-B51F-HE
   16  3.5904E-007   06-BLINDAFWF-HE   IE-TX06B          08-FPSISO3CF-HE
   17  2.4381E-007   XCOM-AFX-2WI4     XCOM-AFZ-BWI4     06--OC6----F-HE
                     IE-WI06B          08-ISO-FS40F-HE
   18  2.4362E-007   XCOM-OCFI06B4     XCOM-AFX-2FI4     XCOM-AFZ-BFI4
                     SL182             IE-FI06B          08-FPISO56-F-HE
   19  2.3773E-007   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS18F-HE
   20  2.2052E-007   XCOM-AFX-2TI4     XCOM-AFZ-BTI4     06--OC6----F-HE
                     IE-TI06B          08-FPSISO56F-HE
   21  2.0859E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                     IE-FI06B          08-FPISO56-F-HE
   22  2.0049E-007   36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
```

23	1.9184E-007	IE-WI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
24	1.4819E-007	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PS
		08-ISO-FS40F-HE		

Table E-1

Sensitivity Analysis of Circulating Water Expansion Joint Rupture
Frequency Increased by 100%

25	1.3403E-007	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PS
		08-FPSISO56F-HE		
26	1.2468E-007	36--LHS-DIAG-HE	IE-FI06B	08-FPISO29-F-HE
27	1.1160E-007	XCOM-AFX-2CX4	XCOM-AFZ-BCX4	06--OC6----F-HE
		IE-CX06B	04-CWSTP22-F-HE	
28	8.5293E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
29	7.9057E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-SI06B	02-SW4A-B51F-HE	
30	7.1930E-008	IE-TI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
31	6.7827E-008	XCOM-AFZ-BCX4	IE-CX06B	05BPT--AFW1C-PS
		04-CWSTP22-F-HE		
32	6.3733E-008	IE-TI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
33	5.7939E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
34	5.2302E-008	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
35	5.1847E-008	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-SWS--HE
		08-ISO-FS40F-HE		
36	5.0517E-008	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD1CF-HE
		IE-WX06B	08-ISO-FS2HF-HE	
37	4.9369E-008	XCOM-AFX-2FI4	XCOM-AFZ-BFI4	06--OC6----F-HE
		IE-FI06B	08-FPISO56-F-HE	
38	4.6894E-008	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-SWS--HE
		08-FPSISO56F-HE		
39	4.6592E-008	05B-FRACTDP-OFF	05B-MDPTD49F-HE	IE-WI06B
		05BPM--AFW1B-PR	08-ISO-FS18F-HE	
40	4.4731E-008	IE-FI06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
41	3.5867E-008	IE-WI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
42	3.0248E-008	IE-TI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
43	3.0182E-008	IE-FI06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-FPISO45-F-HE		
44	3.0006E-008	XCOM-AFZ-BFI4	IE-FI06B	05BPT--AFW1C-PS
		08-FPISO56-F-HE		
45	2.6741E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
46	2.5917E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-TI06B
		05BPM--AFW1B-PR	08-FPSISO29F-HE	
47	2.4733E-008	XCOM-AFX-2WX4	XCOM-AFZ-BWX4	06--OC6----F-HE
		IE-WX06B	08-ISO-FS2HF-HE	
48	2.3731E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE
		04-CWSTP22-F-HE		
49	1.9409E-008	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PR

		08-ISO-FS40F-HE		
50	1.8810E-008	IE-FI06B	01-CMSIAC1B--PS	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
51	1.8764E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		

Table E-1

Sensitivity Analysis of Circulating Water Expansion Joint Rupture
Frequency Increased by 100%

52	1.8711E-008	XCOM-AFX-2SI4	XCOM-AFZ-BSI4	06--OC6----F-HE
		IE-SI06B	02-SW4A-B51F-HE	
53	1.8580E-008	XCOM-AFX-2TX4	06--OC6----F-HE	IE-TX06B
		08-FPSISO3CF-HE		
54	1.7757E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
55	1.7555E-008	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PR
		08-FPSISO56F-HE		
56	1.7484E-008	XCOM-AFZ-BWI4	IE-WI06B	05BMVI-MS102-FO
		08-ISO-FS40F-HE		
57	1.7376E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE
58	1.6117E-008	05B-FRACTDP-OFF	05B-MDPTD61F-HE	IE-FI06B
		05BPM--AFW1B-PR	08-FPISO29-F-HE	
59	1.5813E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
60	1.5796E-008	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
61	1.5321E-008	02-AV-SW4B---FC	IE-SI06B	
62	1.5321E-008	02-AV-SW4A---FC	IE-SI06B	
63	1.5033E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
64	1.4975E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE
65	1.2964E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
66	1.1725E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
67	1.1372E-008	XCOM-AFZ-BSI4	IE-SI06B	05BPT--AFW1C-PS
		02-SW4A-B51F-HE		
68	1.1293E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
69	1.1251E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
70	1.0498E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		
71	1.0010E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
72	9.4883E-009	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
73	9.3127E-009	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO29-F-HE
74	9.1084E-009	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
75	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE
		08-ISO-FS55F-HE		
76	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
77	8.8837E-009	XCOM-AFZ-BCX4	IE-CX06B	05BPT--AFW1C-PR
		04-CWSTP22-F-HE		

78	8.4414E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	
79	8.2288E-009	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
80	8.0025E-009	XCOM-AFZ-BCX4	IE-CX06B	05BMVI-MS102-FO
		04-CWSTP22-F-HE		

Table E-1

Sensitivity Analysis of Circulating Water Expansion Joint Rupture Frequency Increased by 100%

81	7.8907E-009	IE-WI06B	01-CMSIAC1B--PS	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
82	7.2905E-009	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP19-F-HE
83	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
84	6.9986E-009	XCOM-OCWI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-WI06B
		08-ISO-FS18F-HE		
85	6.3722E-009	XCOM-AFZ-BWI4	IE-WI06B	05B-CST-DIAG-HE
		08-ISO-FS40F-HE		
86	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
87	6.2619E-009	XCOM-OCWI06BB	02-PM-SW1B1--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB1	IE-WI06B
		08-ISO-FS18F-HE		
88	6.2340E-009	IE-TI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-FPSISO45F-HE		
89	6.1902E-009	XCOM-OCWI06BB	38-BY-BRB101-OP	IE-WI06B
		STBY-CCWPB	08-ISO-FS18F-HE	
90	6.0159E-009	XCOM-OCWI06B4	XCOM-AFX-2WI4	XCOM-AFZ-BWI4
		SL480	IE-WI06B	08-ISO-FS40F-HE
91	6.0055E-009	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWB-CAL-AE
		08-ISO-FS40F-HE		
92	6.0055E-009	XCOM-AFZ-BWI4	IE-WI06B	05BFAFWA-CAL-AE
		08-ISO-FS40F-HE		
93	5.9336E-009	XCOM-AFZ-BCX4	IE-CX06B	36--LHS-DIAG-HE
		04-CWSTP22-F-HE		
94	5.9022E-009	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA1	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
95	5.9022E-009	XCOM-OCTI06BB	02-PM-SW1B2--TM	16-BATCLG--F-HE
		STBY-SWPA2	STBY-SWPB2	IE-TI06B
		08-FPSISO29F-HE		
96	5.9005E-009	IE-FI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
97	5.8320E-009	05BPMSKPSCCF23	IE-WI06B	08-ISO-FS18F-HE
98	5.7634E-009	XCOM-AFZ-BTI4	IE-TI06B	05B-CST-DIAG-HE
		08-FPSISO56F-HE		
99	5.6672E-009	IE-CX06B	01-CMSIAC1B--TM	86-INSTRRCRF-HE
		04-CWSTP13-F-HE		
100	5.4411E-009	XCOM-OCTI06B4	XCOM-AFX-2TI4	XCOM-AFZ-BTI4
		SL480	IE-TI06B	08-FPSISO56F-HE

Attachment F

Sensitivity Analysis of Random Pipe Break Frequencies
Increased by 100%

A sensitivity analysis was performed to investigate the impact of doubling the random pipe break frequencies. A separate directory was created, NEW SDI RANDOM BREAKS 2X, for quantification of this sensitivity analysis. The batch quantification file, IE-FLOOD1.IN, was used to perform all of the quantification steps needed to calculate the CDF. The only difference between the base case and the sensitivity case is the values were changed for initiating events in the FLDINIT.BED file as shown below:

	Base Case Initiator Frequency	Random Pipe Break X2 Case
SI (Large Service Water Break)	3.22E-5	6.44E-5
CI (Large Circ Water Break)	2.79E-5	4.10E-5
CX (Moderate Circ Water)	1.97E-5	2.45E-5
FI (Large Fire Protection Break)	7.08E-5	2.45E-5

The Large Service Water Break and Large Fire Protection Break frequencies could be doubled since their initiating event frequency was based solely on piping failures. However, the Large and Moderate Circulating Water Break initiating event frequencies are based on pipe breaks and circulating water expansion joint ruptures.

The total frequency of large breaks in the circulating system inlet lines for the base case is the sum of the frequency of expansion joint ruptures and the frequency of large pipe ruptures, or,

$$F_{CWIN} = F_{CWINExp} + F_{CWINPipe}.$$

$$F_{CWIN} = 1.48E\text{-}05 \text{ per year} + 1.31E\text{-}05 \text{ per year}$$

$$\mathbf{F_{CWIN} = 2.79E\text{-}05 \text{ per year.}}$$

The total frequency of large breaks in the circulating system inlet lines for this sensitivity is the sum of the frequency of expansion joint ruptures and double the frequency of large pipe ruptures, or,

$$F_{CWIN} = F_{CWINExp} + 2 * F_{CWINPipe}.$$

$$F_{CWIN} = 1.48E\text{-}05 \text{ per year} + 2 * 1.31E\text{-}05 \text{ per year}$$

F_{CWIN} = 4.10E-05 per year.

The total frequency of moderate breaks in the circulating system outlet lines for the base case is the sum of the frequency of expansion joint ruptures and the frequency of moderate pipe ruptures, or,

$F_{CWOUT} = F_{CWOUTExp} + F_{CWOUTPipe}$.

F_{CWIN} = 1.48E-05 per year + 4.87E-06 per year

F_{CWIN} = 1.97E-05 per year.

The total frequency of moderate breaks in the circulating system outlet lines for the sensitivity analysis is the sum of the frequency of expansion joint ruptures and double the frequency of moderate pipe ruptures, or,

$F_{CWOUT} = F_{CWOUTExp} + 2 * F_{CWOUTPipe}$.

F_{CWIN} = 1.48E-05 per year + 2 * 4.87E-06 per year

F_{CWIN} = 2.45E-05 per year.

The cutsets for this sensitivity case are documented in Table F-1. The Core Damage Frequency if the random pipe break frequencies are increased by 100% is 7.006E-5.

INTERNAL FLOODING – Quantification for Turbine Building Floods

Table F-1

Sensitivity Analysis for Random Pipe Break Frequencies Increased by 100%

```
===========================================================================
WinNUPRA 3.0 Production                                  Licensed to: KPS
CDFTBFLD.EQP                                       File created: 10-28-2005
===========================================================================
   Equation File                             = CDFTBFLD.EQN
   Basic Event Data file referenced          = FLOOD.BED
   Number of cut sets in equation            = 25582
   Top event unavailability  (rare event)    = 7.006E-005
---------------------------------------------------------------------------
     1  4.1000E-005   IE-CI06B          04-CW-TRIP-F-HE
     2  4.7114E-006   XCOM-AFZ-BWI4     06-BLINDAFWF-HE   IE-WI06B
                      08-ISO-FS40F-HE
     3  4.2613E-006   XCOM-AFZ-BTI4     06-BLINDAFWF-HE   IE-TI06B
                      08-FPSISO56F-HE
     4  2.9400E-006   IE-CX06B          04-CWSTP25-F-HE
     5  1.9134E-006   XCOM-AFZ-BFI4     06-BLINDAFWF-HE   IE-FI06B
                      08-FPISO56-F-HE
     6  1.6835E-006   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD49F-HE
                      IE-WI06B          08-ISO-FS40F-HE
     7  1.5314E-006   XCOM-AFZ-BCX4     06-BLINDAFWF-HE   IE-CX06B
                      04-CWSTP22-F-HE
     8  1.2880E-006   IE-SI06B          02-SW4A-B66F-HE
     9  9.3175E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-TI06B          08-FPSISO56F-HE
    10  9.1720E-007   IE-FI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPISO29-F-HE
    11  8.7199E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-ISO-FS18F-HE
    12  7.3538E-007   IE-TI06B          01-CMSIAC1B--PR   86-INSTRRCRF-HE
                      08-FPSISO29F-HE
    13  7.2313E-007   XCOM-AFZ-BSI4     06-BLINDAFWF-HE   IE-SI06B
                      02-SW4A-B51F-HE
    14  5.4719E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD36F-HE
                      IE-CX06B          04-CWSTP22-F-HE
    15  4.8863E-007   XCOM-OCFI06B4     XCOM-AFX-2FI4     XCOM-AFZ-BFI4
                      SL182             IE-FI06B          08-FPISO56-F-HE
    16  4.7794E-007   XCOM-AFZ-BWX4     06-BLINDAFWF-HE   IE-WX06B
                      08-ISO-FS2HF-HE
    17  4.1837E-007   05B-BYALOP-F-HE   05B-FRACTDP-OFF   05B-MDPTD61F-HE
                      IE-FI06B          08-FPISO56-F-HE
    18  3.5904E-007   06-BLINDAFWF-HE   IE-TX06B          08-FPSISO3CF-HE
    19  2.5006E-007   36--LHS-DIAG-HE   IE-FI06B          08-FPISO29-F-HE
    20  2.4381E-007   XCOM-AFX-2WI4     XCOM-AFZ-BWI4     06--OC6----F-HE
                      IE-WI06B          08-ISO-FS40F-HE
    21  2.3773E-007   36--LHS-DIAG-HE   IE-WI06B          08-ISO-FS18F-HE
    22  2.2052E-007   XCOM-AFX-2TI4     XCOM-AFZ-BTI4     06--OC6----F-HE
                      IE-TI06B          08-FPSISO56F-HE
    23  2.0049E-007   36--LHS-DIAG-HE   IE-TI06B          08-FPSISO29F-HE
    24  1.9184E-007   IE-WI06B          01-CMSIAC1B--PR   86-INSTRFCRF-HE
```

		08-ISO-FS33F-HE		
25	1.5811E-007	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD61F-HE
		IE-SI06B	02-SW4A-B51F-HE	
26	1.4819E-007	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PS
		08-ISO-FS40F-HE		

Table F-1

Sensitivity Analysis for Random Pipe Break Frequencies Increased by 100%

27	1.3403E-007	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05BPT--AFW1C-PS
28	9.9017E-008	XCOM-AFX-2FI4 IE-FI06B	XCOM-AFZ-BFI4 08-FPISO56-F-HE	06--OC6----F-HE
29	8.9716E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
30	8.5293E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
31	7.9250E-008	XCOM-AFX-2CX4 IE-CX06B	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	06--OC6----F-HE
32	7.1930E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--TM	86-INSTRRCRF-HE
33	6.3733E-008	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
34	6.0535E-008	IE-FI06B 08-FPISO45-F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
35	6.0181E-008	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PS
36	5.2302E-008	36--LHS-DIAG-HE	IE-WI06B	08-ISO-FS33F-HE
37	5.1847E-008	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-SWS--HE
38	5.0517E-008	05B-BYALOP-F-HE IE-WX06B	05B-FRACTDP-OFF 08-ISO-FS2HF-HE	05B-MDPTD1CF-HE
39	4.8167E-008	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PS
40	4.6894E-008	XCOM-AFZ-BTI4 08-FPSISO56F-HE	IE-TI06B	05B-CST-SWS--HE
41	4.6592E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD49F-HE 08-ISO-FS18F-HE	IE-WI06B
42	4.1145E-008	IE-CX06B 04-CWSTP13-F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
43	3.7727E-008	IE-FI06B 08-FPISO29-F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
44	3.7422E-008	XCOM-AFX-2SI4 IE-SI06B	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	06--OC6----F-HE
45	3.5867E-008	IE-WI06B 08-ISO-FS18F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
46	3.2325E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPISO29-F-HE	IE-FI06B
47	3.0642E-008	02-AV-SW4B---FC	IE-SI06B	
48	3.0642E-008	02-AV-SW4A---FC	IE-SI06B	
49	3.0248E-008	IE-TI06B 08-FPSISO29F-HE	01-CMSIAC1B--PS	86-INSTRRCRF-HE
50	2.5917E-008	05B-FRACTDP-OFF 05BPM--AFW1B-PR	05B-MDPTD61F-HE 08-FPSISO29F-HE	IE-TI06B
51	2.4733E-008	XCOM-AFX-2WX4 IE-WX06B	XCOM-AFZ-BWX4 08-ISO-FS2HF-HE	06--OC6----F-HE
52	2.2745E-008	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	IE-SI06B	05BPT--AFW1C-PS

Table F-1

Sensitivity Analysis for Random Pipe Break Frequencies Increased by 100%

53	2.1056E-008	XCOM-AFZ-BFI4	IE-FI06B	05B-CST-SWS--HE
		08-FPISO56-F-HE		
54	1.9409E-008	XCOM-AFZ-BWI4	IE-WI06B	05BPT--AFW1C-PR
		08-ISO-FS40F-HE		
55	1.8990E-008	IE-CX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		04-CWSTP19-F-HE		
56	1.8764E-008	IE-WI06B	01-CMSIAC1B--TM	86-INSTRFCRF-HE
		08-ISO-FS33F-HE		
57	1.8678E-008	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPISO29-F-HE
58	1.8580E-008	XCOM-AFX-2TX4	06--OC6----F-HE	IE-TX06B
		08-FPSISO3CF-HE		
59	1.7757E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-ISO-FS18F-HE
60	1.7555E-008	XCOM-AFZ-BTI4	IE-TI06B	05BPT--AFW1C-PR
		08-FPSISO56F-HE		
61	1.7484E-008	XCOM-AFZ-BWI4	IE-WI06B	05BMVI-MS102-FO
		08-ISO-FS40F-HE		
62	1.7376E-008	36--LHS-DIAG-HE	IE-TI06B	08-FPSISO45F-HE
63	1.6853E-008	XCOM-AFZ-BCX4	IE-CX06B	05B-CST-SWS--HE
		04-CWSTP22-F-HE		
64	1.6504E-008	36--LHS-DIAG-HE	IE-FI06B	08-FPISO45-F-HE
65	1.5813E-008	XCOM-AFZ-BTI4	IE-TI06B	05BMVI-MS102-FO
		08-FPSISO56F-HE		
66	1.5033E-008	XCOM-AFZ-BWX4	IE-WX06B	05BPT--AFW1C-PS
		08-ISO-FS2HF-HE		
67	1.4975E-008	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-TM	STBY-CCWPB	08-FPSISO29F-HE
68	1.2964E-008	XCOM-AFZ-BWI4	IE-WI06B	36--LHS-DIAG-HE
		08-ISO-FS40F-HE		
69	1.1834E-008	IE-FI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPISO29-F-HE		
70	1.1725E-008	XCOM-AFZ-BTI4	IE-TI06B	36--LHS-DIAG-HE
		08-FPSISO56F-HE		
71	1.1293E-008	IE-TX06B	05BPT--AFW1C-PS	08-FPSISO3CF-HE
72	1.1251E-008	IE-WI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-ISO-FS18F-HE		
73	1.1218E-008	IE-CX06B	36--LHS-DIAG-HE	04-CWSTP13-F-HE
74	1.0529E-008	SL182	06--OC2----F-HE	IE-FI06B
		31-PM--CCW1B-PR	08-FPISO29-F-HE	
75	1.0010E-008	SL182	06--OC2----F-HE	IE-WI06B
		31-PM--CCW1B-PR	08-ISO-FS18F-HE	
76	9.4883E-009	IE-TI06B	01-CMSKPRCCF123	86-INSTRRCRF-HE
		08-FPSISO29F-HE		
77	9.1084E-009	05B-BYALOP-F-HE	05B-FRACTDP-OFF	05B-MDPTD2HF-HE
		IE-TX06B	08-FPSISO3CF-HE	
78	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRFCRF-HE
		08-ISO-FS97F-HE		
79	9.0880E-009	IE-WX06B	01-CMSIAC1B--PR	86-INSTRRCRF-HE

		08-ISO-FS55F-HE		
80	8.4414E-009	SL182	06--OC2----F-HE	IE-TI06B
		31-PM--CCW1B-PR	08-FPSISO29F-HE	

Table F-1

Sensitivity Analysis for Random Pipe Break Frequencies Increased by 100%

81	8.3194E-009	IE-SI06B 02-SW4A-B29F-HE	01-CMSIAC1B--PR	86-INSTRRCRF-HE
82	8.3194E-009	IE-SI06B 02-SW4A-B45F-HE	01-CMSIAC1B--PR	86-INSTRFCRF-HE
83	7.9578E-009	XCOM-AFZ-BSI4 02-SW4A-B51F-HE	IE-SI06B	05B-CST-SWS--HE
84	7.8907E-009	IE-WI06B 08-ISO-FS33F-HE	01-CMSIAC1B--PS	86-INSTRFCRF-HE
85	7.8822E-009	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BPT--AFW1C-PR
86	7.3615E-009	XCOM-OCFI06BB STBY-SWPA2 08-FPISO29-F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-FI06B
87	7.3615E-009	XCOM-OCFI06BB STBY-SWPA1 08-FPISO29-F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-FI06B
88	7.1004E-009	XCOM-AFZ-BFI4 08-FPISO56-F-HE	IE-FI06B	05BMVI-MS102-FO
89	6.9986E-009	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
90	6.9986E-009	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B2--TM STBY-SWPB2	16-BATCLG--F-HE IE-WI06B
91	6.5866E-009	XCOM-OCFI06BB STBY-SWPA2 08-FPISO29-F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-FI06B
92	6.5866E-009	XCOM-OCFI06BB STBY-SWPA1 08-FPISO29-F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-FI06B
93	6.5111E-009	XCOM-OCFI06BB STBY-CCWPB	38-BY-BRB101-OP 08-FPISO29-F-HE	IE-FI06B
94	6.3722E-009	XCOM-AFZ-BWI4 08-ISO-FS40F-HE	IE-WI06B	05B-CST-DIAG-HE
95	6.3087E-009	XCOM-AFZ-BCX4 04-CWSTP22-F-HE	IE-CX06B	05BPT--AFW1C-PR
96	6.2619E-009	XCOM-OCWI06BB STBY-SWPA2 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
97	6.2619E-009	XCOM-OCWI06BB STBY-SWPA1 08-ISO-FS18F-HE	02-PM-SW1B1--TM STBY-SWPB1	16-BATCLG--F-HE IE-WI06B
98	6.2340E-009	IE-TI06B 08-FPSISO45F-HE	01-CMSIAC1B--TM	86-INSTRFCRF-HE
99	6.1902E-009	XCOM-OCWI06BB STBY-CCWPB	38-BY-BRB101-OP 08-ISO-FS18F-HE	IE-WI06B
100	6.1344E-009	05BPMSKPSCCF23	IE-FI06B	08-FPISO29-F-HE

Appendix F

Seismic Analysis

Seismic Analysis

Prepared by: Edward D. Coen (signature) Edward D. Coen
Signature Print Name

10/28/05
Date

Reviewed by: David Moore by telephone EDC David L Moore
Signature Print Name

10/28/05
Date

1.0 DESCRIPTION

This analysis provides an evaluation of the potential risk from turbine building floods initiated by seismic events. The objective is to support the Significance Determination Process (SDP) associated with the turbine building flooding issue. It concerns the seismic initiator only.

The sections of this evaluation are organized as follows:

1. Introduction
2. Methodology
3. Seismic Hazard
4. Fragilities of Equipment and Structures
5. Plant and Systems Model
6. Quantification
7. Sensitivity Analyses

2.0 METHODOLOGY

This evaluation uses seismic probabilistic safety assessment (SPSA) methods to determine the potential core damage frequency from seismic initiated turbine building floods. The major steps in this evaluation are:

- Development of the seismic hazard
- Development of the fragilities of equipment and structures
- Development of event tree and fault tree models (or logic equations) for the plant systems, and development of human error probabilities (HEPs) including potential seismic stresses
- Quantification of the core damage frequency (CDF) using the above information

In addition, sensitivity analyses or qualitative assessments are performed to evaluate the impacts of uncertainties and conservatisms in the seismic models.

3.0 SEISMIC HAZARD

The size of a seismic event can be measured by the peak level of acceleration of the ground at the site, usually measured in units of "g." The seismic hazard for the site is expressed as the frequency of exceedance of the earthquake peak ground accelerations (pga). The mean seismic hazard, which incorporates the uncertainties of the seismic hazard parameters, is used for this evaluation, as permitted in NUREG-1407 (NRC, 1991). The most recent Kewaunee site seismic hazards were calculated by EPRI (EPRI, 1989) and by LLNL (NUREG-1488, NRC, 1994). For this SPSA, the EPRI mean seismic hazard, provided in Table 3-1, is used as the baseline. The LLNL mean seismic hazard, provided in Table 3-2, is used for a sensitivity study. The two mean hazard curves are compared in Figure 3-1. Further documentation of the methods and results are provided in the above references.

Table 3-1 EPRI Seismic Hazard

PGA (g)	Exceedance Frequency
0.011	2.10E-03
0.027	1.30E-03
0.110	1.10E-04
0.142	8.12E-05
0.221	3.80E-05
0.265	2.84E-05
0.327	1.87E-05
0.499	5.90E-06
0.555	4.41E-06
0.633	2.94E-06
0.846	9.60E-07
0.931	6.50E-07
1.120	2.70E-07
1.280	1.66E-07
1.590	6.20E-08

Table 3-2 LLNL Seismic Hazard

PGA (g)	Exceedance Frequency
0.050	3.10E-04
0.051	3.04E-04
0.077	1.78E-04
0.153	6.42E-05
0.255	2.75E-05
0.306	1.98E-05
0.408	1.14E-05
0.510	7.21E-06
0.663	4.04E-06
0.816	2.47E-06
1.020	1.41E-06
1.200	8.60E-07
1.400	4.96E-07
1.600	2.86E-07

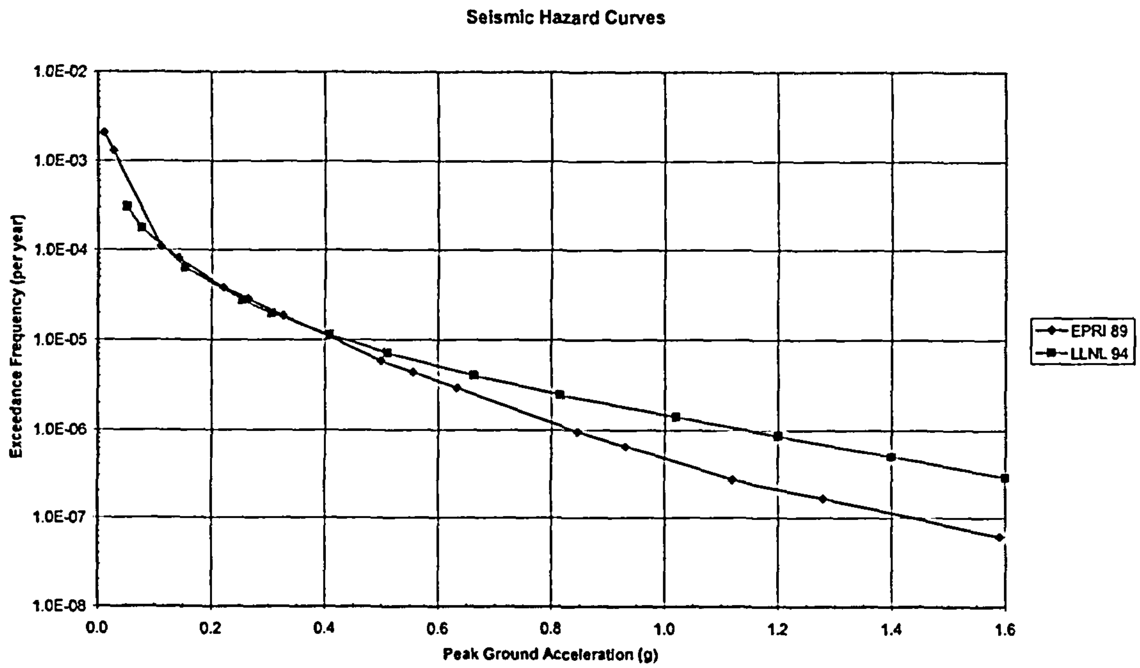


Figure 3-1 Comparison of EPRI and LLNL Seismic Hazard Curves

4.0 FRAGILITIES OF EQUIPMENT, COMPONENTS AND STRUCTURES

As equipment, components or structures are subjected to increasing levels of seismic ground motion, there is an increased probability of their failure. The fragility of equipment (or a component or structure) provides a mathematical model of the probability of failure of the equipment when subjected to increasing levels of seismic peak ground acceleration. This fragility is expressed as a median acceleration level (A_m), or median capacity, expressed in units of "g," and an associated uncertainty estimator (β_c) that describes the level of uncertainty in estimating the median capacity.

For this SDP, the seismic fragilities were calculated by Stevenson & Associates (Stevenson & Associates, 2005). The systems (potential flood sources) evaluated are:

- Circulating Water (CW) - including Turbine Building Cooling and Water Box Priming/Venting
- Condensate (CD) - including Condenser Make-Up/Dump and AFW Pump Supply
- Feedwater (FW)
- Fire Protection - Water System (FP)
- Heater & Moisture Separator Drain Piping (HD)
- Service Water (SW)
- Service Water Pre-Treatment (SWPT)
- Steam Generator Blowdown (SGB)
- Steam Generator Blowdown Treatment (SGBT)
- Water Treatment (MUP) - including Demineralized Water to/from the Condensate Storage Tanks, supply piping to the Caustic & Sulfuric Acid systems, and Anion, Cation, & Mixed Bed exchangers, and the potable water system

Only the portions of these systems within the following plant areas are evaluated:

- Turbine Building, elevations 586', 606', 626'
- Administration Building, elevation 586' (Diesel Generator Rooms)
- Auxiliary Building, south of column line 4 on elevations 586', 606', 626', and south of column line 3 on elevation 642'
- Tank Storage Building, elevation 606', which houses the Condensate Storage Tanks and the Reactor Makeup Water Storage Tanks

These plant areas are essentially all of the power block on the Turbine Building side of the SV (Special Ventilation) boundary. It was assumed that a system rupture inside the SV boundary would not result in significant flooding in the Turbine Building.

4.1 Seismic Fragilities Methodology

The general method for developing the seismic fragility values is:

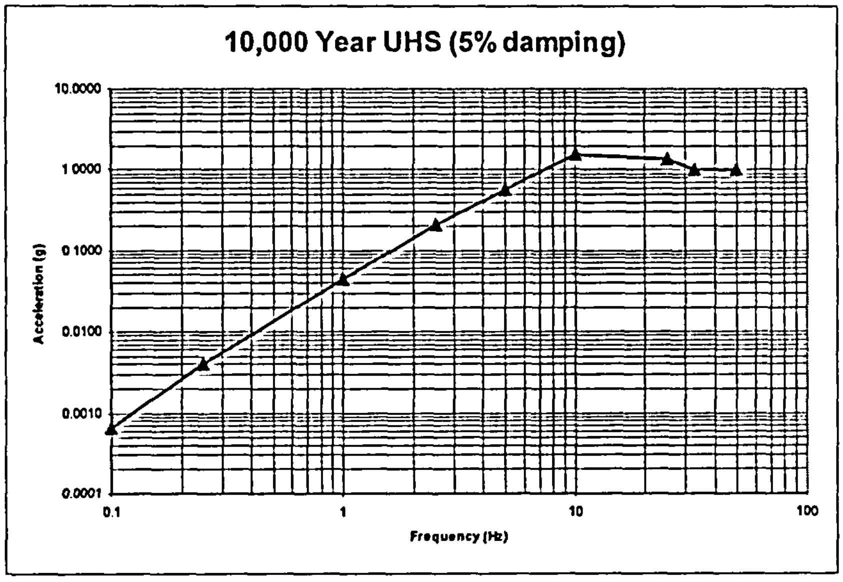
- Determine the portion of the subject system that is within the plant areas listed above using plant flow diagrams and walkdowns. Seismically qualified portions are screened since they have a high seismic capacity, and would not contribute to the flooding risk.
- Organize the non-seismically qualified piping on the flow diagrams into segments. Each pipe segment is identified using the number of the first valve on the segment.
- Walk down each pipe segment to identify any conditions that would result in a reduced seismic capacity, such as:
  - An unusual geometry that would concentrate large inertial loads in a local area
  - Branch pipes with stiff lateral supports connected to run pipes with flexible lateral supports
  - Dead weight supports that are vulnerable to lateral loads, such as short threaded rods with fixed end conditions, beam clamps, vertical stanchions where the pipe could move laterally and fall off, and poorly detailed or poorly constructed supports
  - Non-ductile components such as cast iron valves or fittings, threaded fittings, or victaulic couplings
  - Field-fabricated fittings that could result in high stress concentrations
  - Potential seismic interaction hazards such as unanchored equipment or masonry block walls
- Walk down each item of equipment, and either screen it based on a high seismic capacity, or identify the equipment as requiring further evaluation. The walkdown included consideration of any seismic interaction hazards such as masonry block walls.
- Establish median seismic capacities, and associated uncertainty estimates, based on the guidance provided in EPRI NP-6041 (EPRI, 1991) and EPRI TR-103959 (EPRI, 1994), using one of the following approaches:
  - For equipment and masonry walls that could be screened using EPRI NP-6041, the resulting HCLPF (High Confidence Low Probability of Failure) was converted to a median capacity. For instance, all concrete and steel structures of interest were screened.
  - For non-screened equipment and block walls, a HCLPF capacity using CDFM (Conservative Deterministic Failure Methodology) criteria was calculated, then converted to a median capacity. The composite variability (beta coefficient) was developed on a generic basis, and determined to be 0.4 for all equipment and block walls.
  - For all piping segments, median capacities were directly calculated based on establishing median capacity evaluation criteria by applying median properties to all relevant parameters, such as material properties, ductility, load combinations, and strength factors. Detailed piping models were developed for critical piping such as fire protection and service water. The composite variability (beta coefficient) was developed on a generic basis, and determined to be 0.5 for all piping segments.

Note that the determination of the fragility for a piping segment includes consideration of the pipe/support fragility, the fragility of attached equipment, and the impact on fragility parameters due to any seismic interaction hazards.

More detail on the calculation of fragilities is contained in the fragilities report (Stevenson & Associates, 2005).

4.2 Seismic Demand

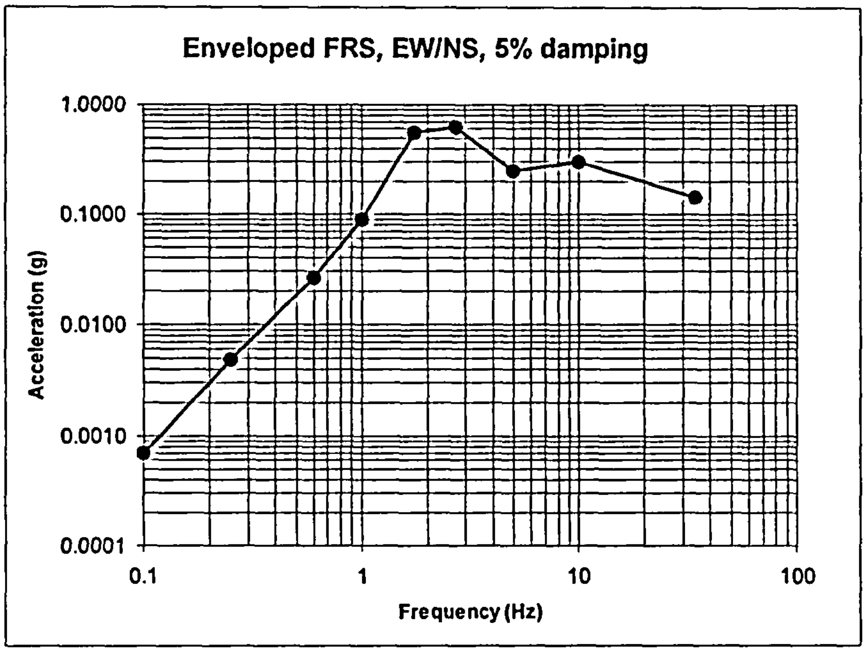
The ground response spectral shape is the Kewaunee median (50% non-exceedance probability) EPRI uniform hazard spectrum (UHS) corresponding to the 10,000 year return period as published in EPRI NP-6395-D (EPRI, 1989). The shape is shown below normalized to a peak ground acceleration (pga) of 1g.



Freq (Hz)	Acc. (g)
0.10	0.000660
0.25	0.00412
1.00	0.0440
2.50	0.208
5.00	0.581
10.00	1.55
25.00	1.39
33.00	1.00
50.00	1.00

Since rod hung piping systems can have frequencies less than 1 Hz, the low frequency portion of the spectral shape was established by linearly extrapolating (on a log-log basis) from 1 Hz down to 0.25 Hz, and assuming the region below 0.25 Hz to be constant displacement. The low frequency content of this ground spectrum is small. For a 1g pga, the constant displacement value is 0.64". This will result in relatively high capacities for low frequency components such as rod hung piping systems.

The floor response spectrum (FRS) corresponding to the above ground response spectrum (GRS) was calculated using the Blume structural model (Blume, 1971), which was used to develop the original design basis FRS. The model response is dominated by soil modes; as a result, the FRS do not vary greatly between elevations or as a function of direction. This allows, without adding undue conservatism, the FRS at all elevations evaluated to be represented by the envelope of the individual FRS. That single FRS is shown below.



Freq (Hz)	Acc. (g)
0.1	0.000705
0.25	0.00484
0.60	0.0262
1.00	0.0904
1.75	0.554
2.70	0.632
5.00	0.246
10.00	0.304
34.00	0.143

The Blume model did not consider any vertical soil springs or vertical building flexibility. For simplicity, 2/3 of the above horizontal FRS is conservatively used as the vertical FRS.

The condensate storage tanks (CSTs) and reactor makeup water storage tanks (RMSTs) are directly founded on compacted fill. As such, they are not evaluated based on the above FRS, rather the seismic accelerations determined from a detailed soil-structure interaction (SSI) analysis are used.

4.3 Seismic Fragility Results and Screening

The fragility analysis was very extensive, with reviews of 91 equipment and tank items, 12 masonry block walls, and 566 piping segments. Therefore, a probabilistic screening criterion was developed to screen out those items that could not contribute significantly to the overall seismic flooding CDF. Based on guidance in the ANS Standard for External Events PRA Methodology (ANS, 2003), a criterion of <1E-07/year potential frequency was selected as the screening frequency. That is, if a component has a seismic failure frequency of less than 1E-7/y, then it cannot contribute more than 1E-7/y to the overall core damage frequency. In fact, this is conservative, since most of the component failures would not directly cause core damage (that is, one or more additional component failures or operator errors would be required for core damage to occur). Therefore, their contribution could be much less than 1E-7/y. Using the EPRI seismic hazard curve presented in Section 3, the following median capacities (A_m) and uncertainty estimators (β_c) corresponding to less than 1E-07/y were calculated:

Equipment, tanks, and block walls: $A_m = 1.9g$ $\beta_c = 0.4$ Frequency = 8.76E-08/y

Piping segments: $A_m = 2.2g$ $\beta_c = 0.5$ Frequency = 9.93E-08/y

The difference in the median capacity screening values is due to the impact of the beta uncertainty estimators. For the same median capacity (A_m), there is an increase in frequency with higher uncertainty (β_c).

In nuclear plants, experience has shown that most of the equipment, block walls, and piping segments have high seismic capacity due to safety margins and conservative design and installation criteria. For KPS, most of the investigated equipment, block walls, and piping segments were screened from further analysis based on their high seismic capacity. As mentioned before, all of the relevant structures, including the Turbine Building, were screened.

The equipment, block walls, and piping segments that were not screened using the 1E-07/y criterion are listed in Table 4-1 and Attachment 2. Table 4-1 includes all components that are included with seismic failures in the seismic flooding model and quantification. Attachment 2 lists components that would not contribute to seismic flooding risk, and provides the reason. For example, the piping segment may have insignificant (or no) flow due to its small size, or due to the loss of offsite power (LOSP). If the component is a small tank, its volume may not be significant compared to other flooding sources. The components in Attachment 2 are not in the seismic model since they would not impact the results.

Table 4-1 provides a summary table of the 29 components whose seismic failures are included in the seismic flooding model. The component descriptions and fragilities are detailed in the fragilities report (Stevenson & Associates, 2005). Volumes of tanks, hotwell, and main condenser are given in Attachments 3 and 6. Flows are calculated using the following formula:

$$Q = \frac{7.48 * 60}{12} \; \frac{\pi D^2}{4} \; \sqrt{\frac{2gP}{\rho}}$$

Where: Q is the volumetric flow rate in gallons/min

7.48 *60/12 is the conversion factor between gallons and cubic feet, between seconds and minutes, and between inches and feet

D is the break diameter in inches

g is the gravitational constant = 32.17 ft/sec^2

P is the pressure in psig

ρ is the density in lbm/ft^3 = 62.22 for 80°F water

The break diameter is assumed to be the nominal diameter of the piping, and conservatively does not include the reduction in area due to the pipe wall thickness. The piping pressure for fire protection (FP) and service water (SW) are from the System Descriptions (SD 08, Rev 2, Fire Protection System (FP), 5/23/2002; SD 02, Rev 3, Service Water System (SW), 3/10/2004).

As seen in Table 4-1, only 3 components have median seismic capacities less than 1.0g:

- FP335 (A_m = 0.42g): This is a 2" fire protection branch line from the main header in the Turbine Building to the hydrogen cooler wet system. Its failure would result in a flow of 1,336gpm into the Turbine Building.

- RMST (A_m = 0.54g): These are the two Reactor Make-up Water Storage Tanks, located in the Tank Storage Building. Each tank has a capacity of 40,000 gal. Failures of the two tanks are correlated as a single failure, since they are similarly designed, constructed, and located.

- CST (A_m = 0.67g): These are the two Condensate Storage Tanks, located in the Tank Storage Building. Each tank has a capacity of 75,000 gal, and is about 93% full on average (Kewaunee Evaluation X10068), for an expected volume of 70,000 gal each. Failures of the two CSTs are correlated as a single failure. When conservative in the quantitative analysis, failure of both CSTs and both RMSTs are correlated as well.

Note that it was conservatively assumed that the entire contents of the RMSTs and CSTs would drain into the basement of the Turbine Building (and Aux Building lower area). To reach the Turbine Building basement, this water would either drain into the piping trench in the Tank Storage Building, and then break through a marinite fire barrier to spill into the Turbine Building basement, or would fail a fire door (that opens inward into the Tank Storage Building from the Aux Building) or a masonry block wall (with a screened A_m = 2.9g), and then spill down a stairwell into the basement. Since there is also a door on the west side of the Tank Storage Building that opens outward into the yard area (and would therefore be expected to fail before the door that opens inward), a significant amount of water could be routed away from the Turbine Building basement. This potential diversion of water away from the Turbine Building flooding scenarios was neglected, and could be a major conservatism in the overall seismic flooding analysis.

Of the remaining 26 components, about one-half have median capacities greater than 1.5g, and would not be expected to contribute significantly to seismic flooding risk, but are still included in the flooding model. For piping segments, only fire protection, service water (including the supply to the service water pre-treatment system), and the condensate piping at the pump expansion joints are included in the list of significant flooding sources. All other piping systems were determined to be insignificant to flooding risk, either due to high seismic capacity, or low potential flow rates. In particular, the feedwater piping and equipment was determined to have high seismic capacity, and could be screened out of the seismic flooding analysis. Note that several piping segments are grouped together and correlated as single failures, based on similar design and location. These correlations are indicated in Table 4-1, and the combined flows are used for the analysis.

There are other piping segments where some correlation could be postulated, but was not assumed since that correlation would result in reduced risk. One example is piping segments SW2800, SW2820, and SW2810 (items 4, 5, and 6 on Table 4-1). Since they are connected, the failure of one or all three would release the same flow. If correlated, there would only be one failure event in the seismic model. By leaving them uncorrelated, it provides 3 separate failure events that are assumed to be independent, and thus increases the seismic flooding CDF. A

second example where correlation would reduce risk is the piping segments SW2501AB and SW2500 (items 16 and 21 in Table 4-1). These segments are the supply and discharge for the exciter air cooler, and failures of either or both result in the same flow. Rather than correlate them to one failure, it is conservative to include them as two independent failures.

Failure of the condensate pump piping expansion joints will drain the hotwell of the main condensers, resulting in a release of 48,000 gal (see Attachment 3). However, there would be no other flow from the condensate system since offsite power to the condensate pumps is failed, and there are check valves to prevent backflow through the pumps. Offsite power would be lost before the failure of the condensate piping expansion joints since the generic seismic capacity of offsite power is about $A_m = 0.3g$, which is much smaller than the 2.2g for the expansion joints.

For tanks, in addition to the RMSTs and CSTs discussed above, the following assumptions were made:

- SGBT-HMT ($A_m = 1.41g$): These 4 tanks each have a capacity of 10,000 gal, and are located in the Aux Building, but could drain into the Turbine Building. It was assumed that failure of all 4 of these tanks is correlated, resulting in a total spill volume of 40,000 gal.

- MAIN-COND ($A_m = 1.87g$): These two condensers have a combined hotwell capacity of 48,000 gal (above the Turbine Building basement floor 586' elevation) (see Attachment 3). The critical failure mode of the condensers is movement, which is then assumed to fail the condensers and drain the hotwell, as well as failing attached lines. In particular, it is assumed that the Circulating Water (CW) expansion joints would fail, draining the contents of the condenser tubes, which is equivalent to an additional 42,000 gal (see Attachment 3). In addition, it is assumed that the various steam dump lines from the Moisture Separator Reheaters (MSR) and other equipment fail at the normally closed valve, thus releasing steam into the basement, and initiating full flow of the FP sprinklers (6000gpm). Failure of the two condensers is correlated as a single failure. Note that offsite power would be lost before the condensers or CW expansion joints fail, since the generic seismic capacity of offsite power is about $A_m = 0.3g$, which is much smaller than the 1.87g for the condensers. Therefore the CW pumps would not have power.

- MSR ($A_m = 1.87g$): The failure of the Moisture Separator Reheaters is assumed to result in steam releases from the MSRs and connected steam piping that actuates sprinklers, and results in the maximum FP flow of 6000gpm. This may be conservative depending on the actual location of the failure, since the MSRs and piping connections are on the operating deck of the Turbine Building, and a steam release at that elevation would not cause actuation of the sprinklers. However, it is conservatively assumed that there are steam piping failures at lower elevations, resulting in sprinkler actuation. There is very little water released from failure of the MSRs, which primarily contain steam.

The equipment, tanks, and piping segments discussed above and listed in Table 4-1 are then used to develop the seismic plant and systems model.

Table 4-1 Components and Fragilities Included in Seismic Flooding Model

	Label	Description	Am (g)	Bc	Volume (gal)	Flow (gpm)	Notes	Flow Diag	Pres (psi)	Dia (in)	Density	Flow Calc
1	FP335	Branch to Hydrogen cooler wet system	0.42	0.5	0	1,336		OPERM-208	125	2	62.22	1336
2	RMST	Reactor Make-up Water Storage Tanks	0.54	0.4	80,000	0	Two tanks with 40,000 gal each					
3	CST	Condensate Storage Tanks	0.67	0.4	140,000	0	Two tanks with 75,000 gal each, 93% full as historical average					
4	SW2800	3" supply from SW	1.07	0.5	0	3,006		OPERM-394	125	3	62.22	3006
5	SW2820	3" supply from SW to flocculator (includes downstream lines)	1.07	0.5	0	3,006	downstream from SW2800	OPERM-394	125	3	62.22	3006
6	SW2810	3" supply from SW to waste sludge pumps	1.07	0.5	0	3,006	downstream from SW2800	OPERM-394	125	3	62.22	3006
7	FP320	Supply to Aux Bldg wet systems	1.08	0.5	0	3,006		OPERM-208	125	3	62.22	3006
8	SW2900	Alt supply to branch fed by SW5200	1.26	0.5	0	5,377	double flow since could come from both sides of break, break anywhere else would be less flow	OPERM-202-3	100	3	62.22	5377
9	FP276	Sub-branch to FP276 DV	1.28	0.5	0	6,000	run out flow of fire protection system	OPERM-208	125	6	62.22	12023
10	FP341-123	Sub-branches to HS on TB floor, 10,15	1.31	0.5	0	2,087	correlated 3 lines, but fed by single 2.5" branch	OPERM-208	125	2.5	62.22	2087
11	FP370	Header to FP370 HS supply	1.31	0.5	0	2,087		OPERM-208	125	2.5	62.22	2087
12	FP331	Deluge station by waste neutralizing tank	1.31	0.5	0	2,087		OPERM-208	125	2.5	62.22	2087
13	SW2200	Supply to Anal Instr Panel Refrig Unit	1.37	0.5	0	1,195		OPERM-202-3	100	2	62.22	1195
14	FP201	10" Fire Protection Header in TB	1.38	0.5	0	6,000	run out flow of fire protection system	OPERM-208				
15	SGBT-HMT	SGBT Hold-up & Monitor Tanks	1.41	0.4	40,000	0						
16	SW2501AB	Disch from Exciter Air Cooler	1.53	0.5	0	2,688	correlated 2 lines, max 3" flow, do not need to correlate with supply lines since total flow would be the same.	OPERM-202-3	100	3	62.22	2688
17	FP280	Branch to HS 8,14,20	1.67	0.5	0	2,087		OPERM-208	125	2.5	62.22	2087

	Label	Description	Am (g)	Bc	Volume (gal)	Flow (gpm)	Notes	Flow Diag	Pres (psi)	Dia (in)	Density	Flow Calc
18	FP250	Branch to HS 3,12,18	1.71	0.5	0	2,087		OPERM-208	125	2.5	62.22	2087
19	FP275	Branch to FP277 & 279 and TSC	1.76	0.5	0	6,000	run out flow of fire protection system (Note that this header could also fail several discharge lines from fan coils, but the flow would be 195gpm, which is not significant. See OPERM-606 in Attachment 2)	OPERM-208	125	8	62.22	21373
20	SW1801AB	Bypass branch on supply to Turbine Oil Coolers	1.8	0.5	0	9,558	correlated 2 lines	OPERM-202-3	100	4	62.22	9558
21	SW2500	Supply to Exciter Air Cooler	1.8	0.5	0	2,688	do not need to correlate with discharge lines, since total flow would be the same	OPERM-202-3	100	3	62.22	2688
22	MAIN-COND	Main Condensers	1.87	0.4	90,000	6,000	*assumed to cause sprinkler actuation of 6000gpm* *no flow from CW or CD due to LOSP* volume based on CW (42,000 gal) and normal hot well above 586' elevation (48,000 gal), see Attachment 3					
23	MSR	Moisture Separators Reheaters	1.87	0.4	0	6,000	assumed to cause sprinkler actuation of 6000gpm no significant water volume (mostly steam)					
24	FP275-1	Sub-branch to TSC	1.93	0.5	0	5,343		OPERM-208	125	4	62.22	5343
25	FP270	Branch to FP270 deluge valve	1.97	0.5	0	2,087		OPERM-208	125	2.5	62.22	2087
26	FP380A	Branch to FP282A DV	2.02	0.5	0	6,000	run out flow of fire protection system	OPERM-208	125	6	62.22	12023
27	FP345	Branch to FP347, 349, & TSC	2.03	0.5	0	6,000	run out flow of fire protection system	OPERM-208	125	8	62.22	21373
28	COND-PP-EJ	Supply to Cond Pumps	2.2	0.5	48,000	0	correlated 2 lines no flow due to LOSP volume based on hot well above 586' elevation, see Attachment 3	OPERM-204	0	0	62.22	0
29	FP321-1	Maint Bldg wet system (A2)	2.2	0.5	0	3,006	correlated 2 lines, max of 3" flow from header, do not need to correlate with header since same total flow	OPERM-208	125	3	62.22	3006

5.0 SEISMIC FLOODING PLANT AND SYSTEMS MODEL

The plant and systems model consists of the event trees, fault trees (or cut set equations), and basic events that represent the initiator seismic flooding events, and the plant response to potential flooding of the Turbine Building basement. This includes basic events for seismic failures, random equipment failures, and human errors.

5.1 Success Criteria

For seismic induced floods, success is defined as prevention of core damage by:

- Isolation of the flooding event before releasing 260,000 gal of water into the Turbine Building basement (and Aux Building low area)

AND

- Successful operation of AFW for decay heat removal

AND

- Successful operation of SI for reactor coolant makeup

AND

- Either successful boration and RCS cooldown to reduce flow from an RCP seal LOCA, OR occurrence of only a small RCP seal LOCA

AND

- Successful operation of support systems such as electrical power

AND

- Successful completion of required operator actions

The mission time is the traditional 24 hours, by which time additional resources can be mobilized to maintain plant stability.

Extensive details on these success criteria are included in the internal flooding analysis (see Appendices A, B, C, and D). Specific issues associated with the seismic flooding analysis are discussed below.

The volume of 260,000 gal for the flood is selected based on two Gothic computer runs (MPR, 2005). These runs showed that the 4kv switchgear Bus 6 and required loads on the associated 480v buses would not be failed by an instantaneous spill of 240,000 gal, but the 480v buses would just barely be failed by an instantaneous spill of 275,000 gal. The AFW turbine driven pump (TDP), B train AFW motor driven pump (MDP), and B train DG and auxiliaries would also not be impacted. The selection of 260,000 gal is conservative since:

- Based on more recent electrical evaluations, the switchgear can withstand higher flooding before failure, so the spill volume of 260,000 is conservative.

- The spill is assumed to be almost instantaneous, which is conservative for the dynamic Gothic models

5.2 Seismic Flooding Event Trees

Two event trees are used to delineate the potential accident sequences. The first event tree describes the potential flooding sources and combinations, and the potential for flood isolation. The second event tree, used only when flooding is successfully isolated before reaching the 260,000 g limit, describes the potential random success and failures of equipment and operator actions that are used to prevent core damage after the flooding. Figure 5-1 provides the seismic flooding event tree. There are 7 top events, other than the seismic initiator:

- HCE: High seismic capacity equipment
  Success of this event indicates that the main condenser, condensate pump piping expansion joints, and SGBT Hold-up and Monitor Tanks did not fail due to the seismic event. Failure indicates that one or more of these components failed. Since these components have relatively high seismic capacity, if they failed it was conservatively assumed that the CSTs and RMSTs would also be failed. This leads to a flood that exceeds 260,000 gal, and was assumed to lead directly to core damage.

- CST: Condensate Storage Tanks
  Success of this event indicates that the CSTs did not fail. Failure is conservatively assumed to fail both the CSTs and the RMSTs. Although the combined volume (220,000 gal) is less than the failure criterion of 260,000 gal, the CST failure is assumed to result in failure of the AFW pumps, due to the old pump discharge flow trip configuration. This is further assumed to result in core damage due to loss of decay heat removal. Note that this is conservative for several reasons. As mentioned previously, the failure was assumed to be instantaneous, giving no significant time for operators to stop the AFW pumps and switch to the SW for pump suction. Second, feed and bleed was assumed not to be successful, since the RWST would eventually empty, and recirculation switchover was assumed to not be available.

- RMST: Reactor Make-up Water Storage Tanks
  Success of this event indicates that the RMSTs do not fail. Failure is assumed to spill the maximum contents of both tanks almost instantaneously (80,000 gal total). Note that the CSTs do not fail in the associated event tree sequences, so AFW can be available. Unless additional flooding occurs, due to piping failure, this relatively small volume does not fail significant equipment, and can be easily mitigated.

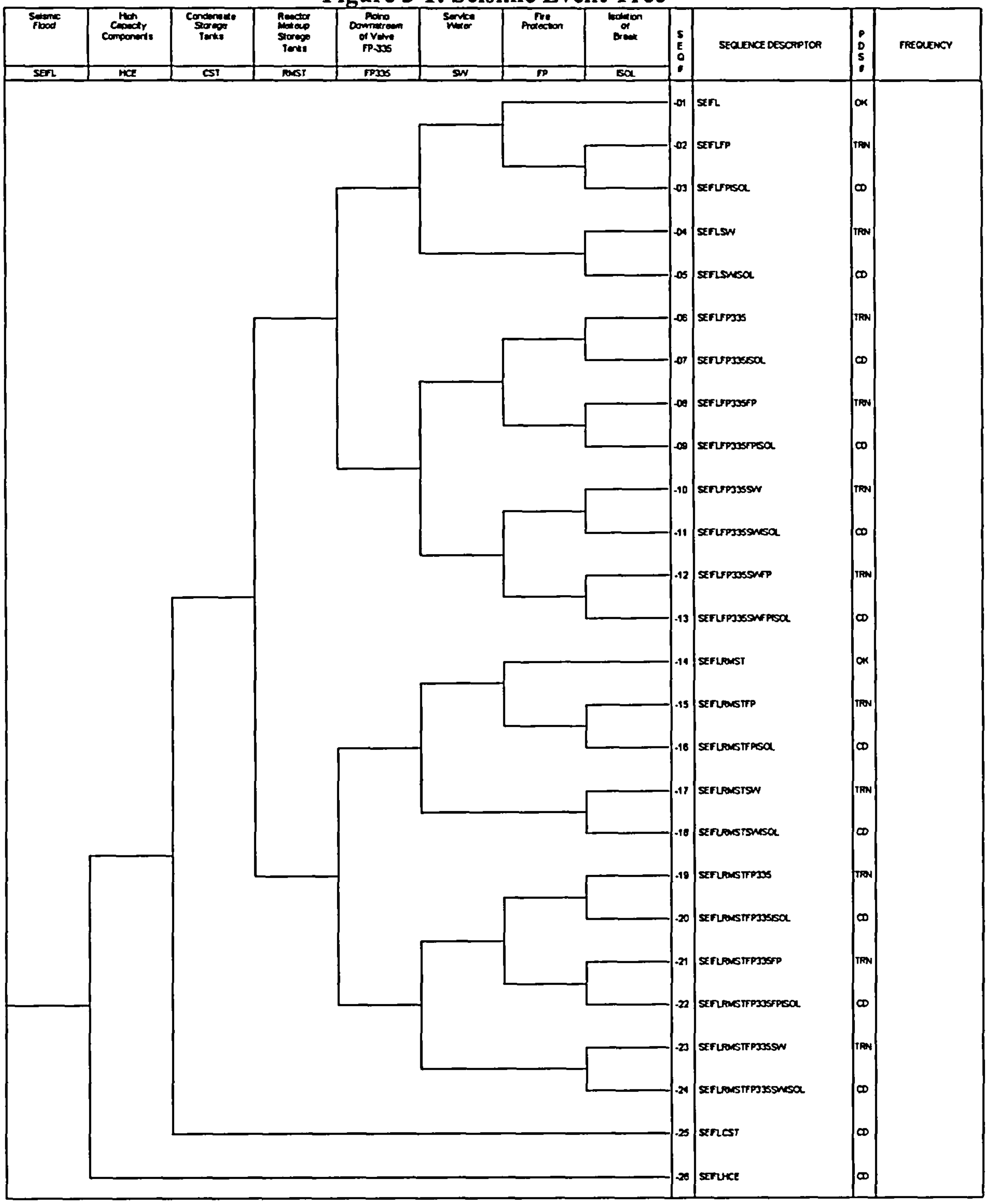
- FP335: Piping Downstream of Fire Protection Branch 335
  This one FP piping branch has a relatively low seismic capacity (A_m = 0.42g), and is therefore treated separately in the event tree. Failure results in a flood of 1,336gpm from this 2" diameter pipe. By itself, or with failure of the RMSTs, there is greater than 2 hours for isolation of this piping break by closing the FP header valves. It was conservatively assumed that this branch could not be isolated by the branch isolation valve (FP335) in the Turbine Building.

- SW: Service Water Piping
  Success of this event indicates that none of the SW piping segments failed due to the seismic event. Failure results in flooding from about 1200gpm to 10,000gpm, depending on the piping segment. The piping segments, seismic capacities, and flows are given in Table 4-1. Depending on the size of the piping failure, and the potential failure of previous event tree branches (ie, the RMST and/or FP335) the time for isolation can vary before reaching the 260,000 gal limit. This time impacts the potential for successful isolation. In addition to single failures of SW piping segments, multiple piping failures can occur. In these cases, the flow is the combined flow of all broken piping segments. The event heading nodal equations include single and multiple failures when appropriate.

- FP: Fire Protection Piping
  This event heading covers the remainder of FP piping segments, excluding FP335, which is a single event discussed above. As with the SW piping, the potential flow depends on the segment that fails. However, since the runout flow of the FP system (with both FP pumps operating) is limited to 6000gpm, the potential flow is constrained. Multiple segments can fail, and are included when appropriate. In addition, this event heading includes the potential failure of the moisture separator reheaters (MSR). As discussed in section 4.3, the MSRs do not directly contribute to the flood, since they contain mostly steam and very little water. However, depending on the location of breaks in attached steam piping, it may be possible to set off the fire sprinklers. Conservatively, it was assumed that failure of any MSR would actuate the sprinklers and result in the maximum FP runout flow of 6000gpm.

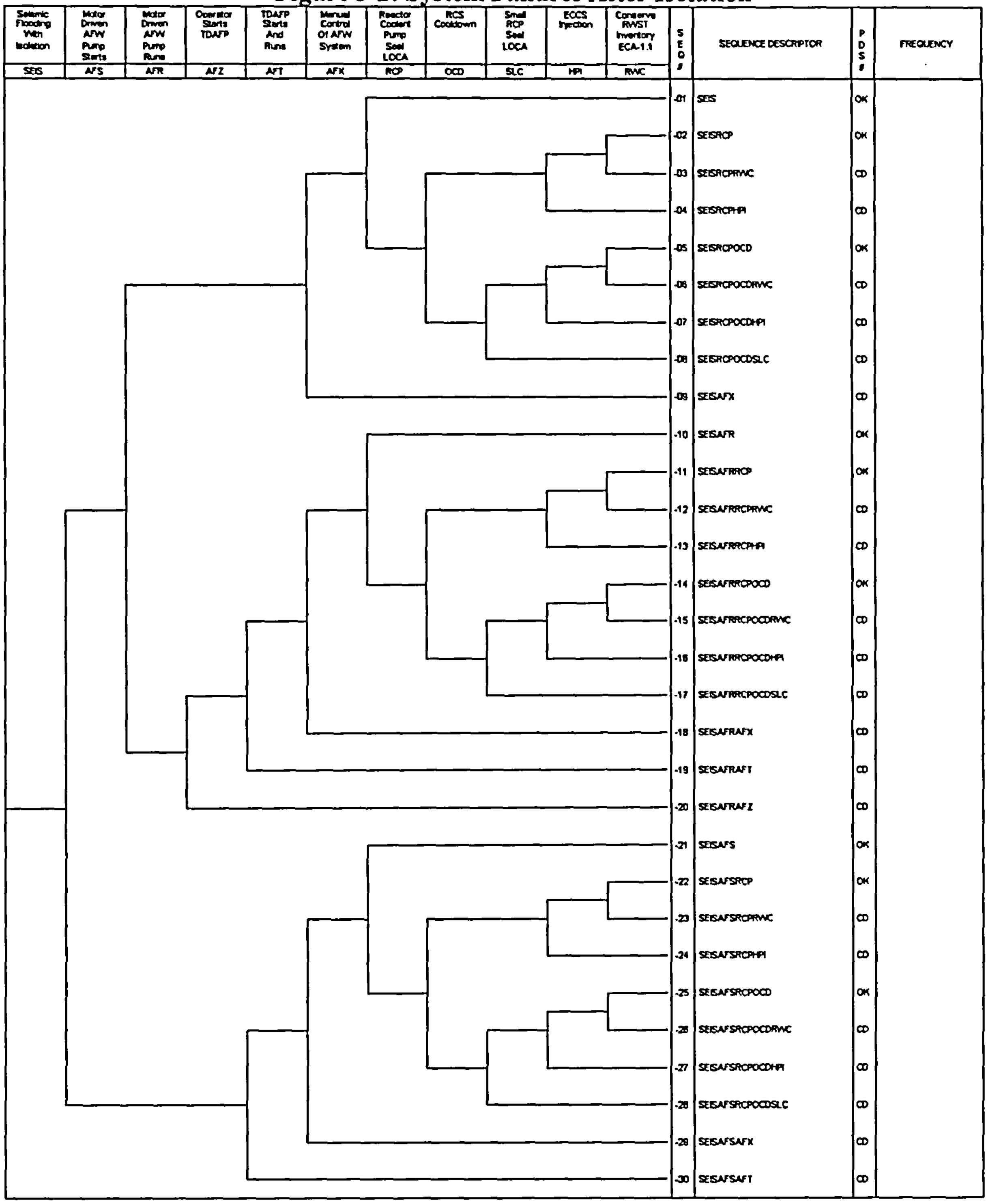
- ISOL: Isolation of Break
  Success of this event indicates that the operators have isolated the break(s). The time for isolation depends on the number of breaks, the flow from each broken piping segment, and any other seismic failures, such as the RMSTs. The operator actions, timing, and other factors are discussed below, and described in detail in Attachment 1. Since the timing varies from one sequence to another, the operator actions were grouped, and the minimum time of each group was used for the evaluation. That is, the individual piping segment may have 86 minutes for action, but it is grouped in with the other piping failures that have 57 minutes for action. The grouping was always conservative.

Figure 5-1: Seismic Event Tree



J:\Appdata\winnupra\New SDP\ETS\SEIFL.EVT 10/27/2005 17:12:06 WinNUPRA 3.0 Production
Quantification Date TOTAL CMF = 0.00E+000
Licensed to: Kewaunee

Figure 5-2: System Failures After Isolation



J:\AppData\winnupra\New SD\ETS\SEIS.EVT 10/27/2005 17:13:12 WinNUPRA 3.0 Production
Quantification Date: TOTAL CMF = 0.00E+000
Licensed to: Kewaunee

5.3 Nodal Equations

To quantify the seismic flooding event tree, nodal equations were developed for each branch of the event tree. Note that both success and failure equations were developed for each branch as appropriate. Table 5-1 provides a description of each sequence of the seismic flooding event tree, the successes and failures, and provides the grouping of the operator isolation actions used for that sequence. The isolation grouping time is shown in parentheses. Note that a "\" represents a success. In the "Status" column, TRN represents a transfer to the flooding mitigation event tree, and CD represents core damage.

Table 5-1 Seismic Flooding Sequences and Nodal Equations

Seq #	Successes and Failures	Status	Description	Isolation Times (min)
1	no significant failures	OK		
2	\RMST * \FP335 * \SW * \ISOL	TRN	Successful isolation of FP piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	3000gpm: 86m (*ISOL-FP-57*) 6000gpm: 43m (*ISOL-FP-40*)
3	\RMST * \FP335 * \SW * ISOL	CD	Failure of operators to isolate FP piping failure, resulting in flood failing electric power.	
4	\RMST * \FP335 * SW * \ISOL	TRN	Successful isolation of SW piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	3000gpm: 86m 6000gpm: 43m 10,000gpm: 26m (*ISOL-SW-26*)
5	\RMST * \FP335 * ISOL	CD	Failure of operators to isolate SW piping failure, resulting in flood failing electric power.	
6	\RMST * FP335 * \SW * \FP * \ISOL	TRN	Successful isolation of FP335 piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	1336gpm: 194m (*ISOL-FP-57*)
7	\RMST * FP335 * \SW * \FP * ISOL	CD	Failure of operators to isolate FP335 piping failure, resulting in flood failing electric power.	
8	\RMST * FP335 * \SW * FP * \ISOL	TRN	Successful isolation of FP piping failure, with CST available. In addition to FP335, multiple FP lines may fail, but max flow is limited to 6000gpm. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	4500gpm: 57m (*ISOL-FP-57*) 6000gpm: 43m (*ISOL-FP-40*)
9	\RMST * FP335 * \SW * ISOL	CD	Failure of operators to isolate FP piping failure, resulting in flood failing electric power.	

Seq #	Successes and Failures	Status	Description	Isolation Times (min)
10	\RMST * FP335 * SW * \ISOL	TRN	Successful isolation of both FP335 and SW piping failure, with CST available. In addition to FP335, multiple SW lines may fail. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	4500gpm: 57m (*ISOL-SF-57*) 7500gpm: 34m (*ISOL-SF-34*)
11	\RMST * FP335 * ISOL	CD	Failure of operators to isolate FP or SW piping failure, resulting in flood failing electric power.	
12	\RMST * FP335 * SW * FP * \ISOL	TRN	Successful isolation of both FP and SW piping failure, with CST available. In addition to FP335, multiple SW and\or FP lines may fail. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	4500gpm: 57m (*ISOL-SF-57*) 7500gpm: 34m (*ISOL-SF-34*)
13	\RMST * FP335 * ISOL	CD	Failure of operators to isolate FP or SW piping failure, resulting in flood failing electric power.	
14	\CST * RMST	OK	CST does not fail. 80,000 gal from RMSTs will cause only minor flooding with no significant losses.	
15	\CST * RMST * \FP335 * \SW * FP * \ISOL	TRN	Successful isolation of FP piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	80,000 gal + 3000gpm: 60m (*ISOL-FP-57*) 6000gpm: 30m
16	\CST * RMST * \FP335 * \SW * ISOL	CD	Failure of operators to isolate FP piping failure, resulting in flood failing electric power.	(*ISOL-FP-30*)
17	\CST * RMST * \FP335 * SW * \ISOL	TRN	Successful isolation of SW piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	80,000 gal + 6000gpm: 30m (*ISOL-SW-26*)
18	\CST * RMST * \FP335 * ISOL	CD	Failure of operators to isolate SW piping failure, resulting in flood failing electric power.	

Seq #	Successes and Failures	Status	Description	Isolation Times (min)
19	\CST * RMST * FP335 * \SW * \FP * \ISOL	TRN	Successful isolation of FP335 piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	80,000 gal + 1336gpm: 134m (*ISOL-FP-57*)
20	\CST * RMST * FP335 * \SW * \FP * ISOL	CD	Failure of operators to isolate FP335 piping failure, resulting in flood failing electric power.	
21	\CST * RMST * FP335 * \SW * FP * \ISOL	TRN	Successful isolation of FP piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	80,000 gal + 4500gpm: 40m (*ISOL-FP-40*) 6000gpm: 30m
22	\CST * RMST * FP335 * \SW * ISOL	CD	Failure of operators to isolate FP piping failure, resulting in flood failing electric power.	(*ISOL-FP-30*)
23	\CST * RMST * FP335 * SW * \ISOL	TRN	Successful isolation of FP335 and SW piping failure, with CST available. Transfer to flooding mitigation event tree to ensure no large SL, successful AFW and primary cooldown. Alignment of AFW to SW NOT required.	80,000 gal + 4500gpm: 40m (*ISOL-SF-40*)
24	\CST * RMST * FP335 * ISOL	CD	Failure of operators to isolate FP335 or SW piping failure, resulting in flood failing electric power.	
25	CST	CD	CST fails, and RMST conservatively assumed to fail as well, dumping 220,000 gal into Turbine Building. Since AFW pumps were not automatically stopped in these CST failure scenarios, they are assumed to fail. Feed and bleed is assumed to fail at recirculation switchover, resulting in core damage.	not applicable
26	HCE	CD	Conservatively assumed failure of high seismic capacity components (that is, main condenser, condensate pump expansion joints, or SGBT Hold-up and Monitor Tanks) would also fail CSTs and RMSTs, and directly result in core damage.	not applicable

Table 5-2 Seismic Flooding Event Tree Nodal Equations

Node	Description	Equation	Notes
HCE	High Seismic Capacity Equipment	MAIN-COND + COND-PP-EJ + SGBT-HMT	
CST	Condensate Storage Tanks	CST	
RMST	Reactor Make-up Water Storage Tank	RMST	
FP335	Fire Protection Piping 335	FP335	
SW	Service Water Piping	SW2800 + SW2820 + SW2810 + SW2900 + SW2200 + SW2501AB + SW1801AB + SW2500	Multiple failures only required in sequences 9 and 13, based on calculation of frequency.
FP	Fire Protection Piping	FP320 + FP276 + FP341-123 + FP370 + FP331 + FP201 + FP280 + FP250 + FP275 + FP275-1 + FP270 + FP380A + FP345 + FP321-1 + MSR	Multiple failures only required in sequences 11 and 13, based on calculation of frequency.
ISOL	Isolation of Piping		
	Seq 3	FP320 * ISOL-FP-57 + FP276 * ISOL-FP-40 + FP341-123 * ISOL-FP-57 + FP370 * ISOL-FP-57 + FP331 * ISOL-FP-57 + FP201 * ISOL-FP-40 + FP280 * ISOL-FP-57 + FP250 * ISOL-FP-57 + FP275 * ISOL-FP-40 + FP275-1 * ISOL-FP-40 + FP270 * ISOL-FP-57 + FP380A * ISOL-FP-40 + FP345 * ISOL-FP-40 + FP321-1 * ISOL-FP-57 + MSR * ISOL-FP-40	Since ISOL equation includes FP piping failures, remove FP equation from 3. Use this ISOL equation failure for Seq 3.
	Seq 5	SW2800 * ISOL-SW-26 + SW2820 * ISOL-SW-26 + SW2810 * ISOL-SW-26 + SW2900 * ISOL-SW-26 + SW2200 * ISOL-SW-26 + SW2501AB * ISOL-SW-26 + SW1801AB * ISOL-SW-26 + SW2500 * ISOL-SW-26	Since ISOL equation includes SW piping failures, remove SW equation from Seq 5. Use this ISOL equation failure for Seq 5.
	Seq 7, 20	ISOL-FP-57	Conservatively used for all FP isolations with times 57 minutes or greater.

Node	Description	Equation	Notes
Seq 9		FP320 * ISOL-FP-57 + FP276 * ISOL-FP-40 + FP341-123 * ISOL-FP-57 + FP370 * ISOL-FP-57 + FP331 * ISOL-FP-57 + FP201 * ISOL-FP-40 + FP280 * ISOL-FP-57 + FP250 * ISOL-FP-57 + FP275 * ISOL-FP-40 + FP275-1 * ISOL-FP-40 + FP270 * ISOL-FP-57 + FP380A * ISOL-FP-40 + FP345 * ISOL-FP-40 + FP321-1 * ISOL-FP-57 + MSR * ISOL-FP-40 + FP320 * ISOL-FP-40 * FP341-123 + FP370 * ISOL-FP-40 * FP341-123 + FP331 * ISOL-FP-40 * FP341-123 + FP280 * ISOL-FP-40 * FP341-123 + FP250 * ISOL-FP-40 * FP341-123 + FP270 * ISOL-FP-40 * FP341-123 + FP321-1 * ISOL-FP-40 * FP341-123 + FP320 * ISOL-FP-40 * FP370 + FP331 * ISOL-FP-40 * FP370 + FP280 * ISOL-FP-40 * FP370 + FP250 * ISOL-FP-40 * FP370 + FP270 * ISOL-FP-40 * FP370 + FP321-1 * ISOL-FP-40 * FP370 + FP320 * ISOL-FP-40 * FP331 + FP280 * ISOL-FP-40 * FP331 + FP250 * ISOL-FP-40 * FP331 + FP270 * ISOL-FP-40 * FP331 + FP321-1 * ISOL-FP-40 * FP331 + FP280 * ISOL-FP-40 * FP320 + FP250 * ISOL-FP-40 * FP320 + FP270 * ISOL-FP-40 * FP320 + FP321-1 * ISOL-FP-40 * FP320	Since ISOL equation includes FP piping failures, remove FP equation from Seq 9. Use this ISOL equation failure for Seq 9. This equation includes multiple FP piping failures. Combinations with two components greater than 1.5g are screened out, since they are not significant to CDF. Also, combinations with one component delivering runout flow (6000gpm) are screened out, since the flow with the one component was already maximum. Also, combinations with one component downstream of another are screened out, since the flow would not be increased by the second failure.
Seq 11		SW2800 * ISOL-SF-57 + SW2820 * ISOL-SF-57 + SW2810 * ISOL-SF-57 + SW2900 * ISOL-SF-34 + SW2200 * ISOL-SF-57 + SW2501AB * ISOL-SF-57 + SW1801AB + SW2500 * ISOL-SF-57 + SW2900 * SW2820 + SW2200 * ISOL-SF-34 * SW2820 + SW2501AB * ISOL-SF-34 * SW2820 + SW2500 * ISOL-SF-34 * SW2820 + SW2900 * SW2810 + SW2200 * ISOL-SF-34 * SW2810 + SW2501AB * ISOL-SF-34 * SW2810 + SW2500 * ISOL-SF-34 * SW2810 + SW2800 * SW2900 + SW2200 * SW2900 + SW2501AB * SW2900 + SW2500 * SW2900 + SW2800 * ISOL-SF-34 * SW2200 + SW2501AB * ISOL-SF-34 * SW2200 + SW2500 * ISOL-SF-34 * SW2200 + SW2501AB * ISOL-SF-34 * SW2800 + SW2500 * ISOL-SF-34 * SW2800	Since ISOL equation includes SW piping failures, remove SW equation from Seq 11. Use this ISOL equation failure for Seq 11. This equation includes multiple SW piping failures. Combinations with two components greater than 1.5g are screened out, since they are not significant to CDF. Also, if individual piping failures cannot be isolated in the time available (ie, SW1801AB), then further combinations with this piping failure are screened out since they would be non-minimal.

Node	Description	Equation	Notes
Seq 13		SW2800 * ISOL-SF-34 * FP320 + SW2820 * ISOL-SF-34 * FP320 + SW2810 * ISOL-SF-34 * FP320 + SW2900 * FP320 + SW2200 * ISOL-SF-34 * FP320 + SW2501AB * ISOL-SF-34 * FP320 + SW2500 * ISOL-SF-34 * FP320 + SW2800 * FP276 + SW2820 * FP276 + SW2810 * FP276 + SW2900 * FP276 + SW2200 * ISOL-SF-34 * FP276 + SW2501AB * FP276 + SW2500 * FP276 + SW2800 * ISOL-SF-34 * FP341-123 + SW2820 * ISOL-SF-34 * FP341-123 + SW2810 * ISOL-SF-34 * FP341-123 + SW2900 * FP341-123 + SW2200 * ISOL-SF-57 * FP341-123 + SW2501AB * ISOL-SF-34 * FP341-123 + SW2500 * ISOL-SF-34 * FP341-123 + SW2800 * ISOL-SF-34 * FP370 + SW2820 * ISOL-SF-34 * FP370 + SW2810 * ISOL-SF-34 * FP370 + SW2900 * FP370 + SW2200 * ISOL-SF-57 * FP370 + SW2501AB * ISOL-SF-34 * FP370 + SW2500 * ISOL-SF-34 * FP370 + SW2800 * ISOL-SF-34 * FP331 + SW2820 * ISOL-SF-34 * FP331 + SW2810 * ISOL-SF-34 * FP331 + SW2900 * FP331 + SW2200 * ISOL-SF-57 * FP331 + SW2501AB * ISOL-SF-34 * FP331 + SW2500 * ISOL-SF-34 * FP331 + SW2800 * FP201 + SW2820 * FP201 + SW2810 * FP201 + SW2900 * FP201 + SW2200 * ISOL-SF-34 * FP201 + SW2501AB * FP201 + SW2500 * FP201 + SW2800 * ISOL-SF-34 * FP280 + SW2820 * ISOL-SF-34 * FP280 + SW2810 * ISOL-SF-34 * FP280 + SW2900 * FP280 + SW2200 * ISOL-SF-57 * FP280 + SW2800 * ISOL-SF-34 * FP250 + SW2820 * ISOL-SF-34 * FP250 + SW2810 * ISOL-SF-34 * FP250 + SW2900 * FP250 + SW2200 * ISOL-SF-57 * FP250 + SW2800 * FP275 + SW2820 * FP275 + SW2810 * FP275 + SW2900 * FP275 + SW2200 * ISOL-SF-34 * FP275 + SW2800 * FP275-1 + SW2820 * FP275-1 + SW2810 * FP275-1 + SW2900 * FP275-1 + SW2200 * ISOL-SF-34 * FP275-1 + SW2800 * ISOL-SF-34 * FP270 + SW2820 * ISOL-SF-34 * FP270 + SW2810 * ISOL-SF-34 * FP270 + SW2900 * FP270 + SW2200 * ISOL-SF-57 * FP270 + SW2800 * FP380A + SW2820 * FP380A + SW2810 * FP380A + SW2900 * FP380A + SW2200 * ISOL-SF-34 * FP380A + SW2800 * FP345 + SW2820 * FP345 + SW2810 * FP345 + SW2900 * FP345 + SW2200 * ISOL-SF-34 * FP345 + SW2800 * ISOL-SF-34 * FP321-1 + SW2820 * ISOL-SF-34 * FP321-1 + SW2810 * ISOL-SF-34 * FP321-1 + SW2900 * FP321-1 + SW2200 * ISOL-SF-34 * FP321-1 + SW2800 * MSR + SW2820 * MSR + SW2810 * MSR + SW2900 * MSR + SW2200 * ISOL-SF-34 * MSR	Since ISOL equation includes SW and FP piping failures, remove SW and FP equations from Seq 13. Use this ISOL equation failure for Seq 13. This equation consists of combinations of SW and FP piping failures. Combinations with two components greater than 1.5g are screened out, since they are not significant to CDF. Also, if individual piping failures cannot be isolated in the time available (ie, SW1801AB), then further combinations with this piping failure are screened out since they would be non-minimal.
Seq 16		FP320 * ISOL-FP-57 + FP276 * ISOL-FP-30 + FP341-123 * ISOL-FP-57 + FP370 * ISOL-FP-57 + FP331 * ISOL-FP-57 + FP201 * ISOL-FP-30 + FP280 * ISOL-FP-57 + FP250 * ISOL-FP-57 + FP275 * ISOL-FP-30 + FP275-1 * ISOL-FP-30 + FP270 * ISOL-FP-57 + FP380A * ISOL-FP-30 + FP345 * ISOL-FP-30 + FP321-1 * ISOL-FP-57 + MSR * ISOL-FP-30	Since ISOL equation includes FP piping failures, remove FP equation from Seq 16. Use this ISOL equation failure for Seq 16.
Seq 18		SW2800 * ISOL-SW-26 + SW2820 * ISOL-SW-26 + SW2810 * ISOL-SW-26 + SW2900 * ISOL-SW-26 + SW2200 * ISOL-SW-26 + SW2501AB * ISOL-SW-26 + SW1801AB + SW2500 * ISOL-SW-26	Since ISOL equation includes SW piping failures, remove SW equation from Seq 17 and 18. Use this ISOL equation failure for Seq 18. Change ISOL terms to success for Seq 17.
Seq 22		FP320 * ISOL-FP-40 + FP276 * ISOL-FP-30 + FP341-123 * ISOL-FP-40 + FP370 * ISOL-FP-40 + FP331 * ISOL-FP-40 + FP201 * ISOL-FP-30 + FP280 * ISOL-FP-40 + FP250 * ISOL-FP-40 + FP275 * ISOL-FP-30 + FP275-1 * ISOL-FP-30 + FP270 * ISOL-FP-40 + FP380A * ISOL-FP-30 + FP345 * ISOL-FP-30 + FP321-1 * ISOL-FP-40 + MSR * ISOL-FP-30	Since ISOL equation includes FP piping failures, remove FP equation from Seq 22. Use this ISOL equation failure for Seq 22.
Seq 24		SW2800 * ISOL-SF-40 + SW2820 * ISOL-SF-40 + SW2810 * ISOL-SF-40 + SW2900 + SW2200 * ISOL-SF-40 + SW2501AB * ISOL-SF-40 + SW1801AB + SW2500 * ISOL-SF-40	Since ISOL equation includes SW piping failures, remove SW equation from Seq 24. Use this ISOL equation failure for Seq 24.

The nodal equations are given in Table 5-2. If there is inadequate time for operator action in a cut set, then the "ISOL" action does not appear in the nodal equation. A side calculation was performed to determine the potential impact of independent multiple failures of piping segments. It was determined that the impact to most sequences would be less than 1E-08/y. However, there was some potential for independent multiple piping segment failures to impact sequences 9, 11, and 13, so the nodal equations for these sequences include multiple piping failures. Correlated piping failures were included in the basic events in all sequences.

Success nodal equations were directly developed by the quantification software, SHIP (Benjamin, 1996). However, in the case of the ISOL success, a separate calculation was made to determine the exact average value of isolation success for each sequence. These separate SHIP calculations are included in Attachment 4.

The second event tree, used only when flooding is successfully isolated before reaching the 260,000 gal limit, describes the potential random success and failures of equipment and operator actions that are used to prevent core damage after the flooding. Figure 5-2 provides this flooding mitigation event tree. The structure and event tree headings are directly taken from the internal turbine building flooding analysis (KPS, 2005), which provides a detailed discussion of the events. However, the operator actions used for this event tree are revised to reflect the stress from a seismic event.

5.4 Human Reliability

The human error probabilities (HEPs) for the operator actions were calculated to specifically include the stress from a seismic event. Table 5-3 lists the operator actions included in the seismic flooding analysis. These actions are discussed in detail in Attachment 1.

Table 5-3 Human Error Probabilities

Event ID	Description	Probability
08-FPISO57-F-HE	Operator fails to isolate FP within 57 minutes	3.10E-02
08-FPISO40-F-HE	Operator fails to isolate FP within 40 minutes	5.90E-02
08-FPISO30-F-HE	Operator fails to isolate FP within 30 minutes	4.90E-01
02-SW4A-B--FSHE	Operator fails to isolate SW within 26 minutes	2.50E-02
SX-SWFP-57-F-HE	Operator fails to isolate SW and FP within 57 minutes	5.60E-02
SX-SWFP-40-F-HE	Operator fails to isolate SW and FP within 40 minutes	1.50E-01
SX-SWFP-34-F-HE	Operator fails to isolate SW and FP within 34 minutes	3.00E-01
27A-ORR----FSHE	Limit SI and Refill RWST (no cooldown) – Seismic Flood	1.00E-02

The isolation actions for the FP system are taken in the pump house. After the seismic event, the crew in the control room will have three cues to identify the Turbine Building flooding. First, the operator will have indication that the FP pumps have started, but no indication of a fire, and the aux operator will be sent to determine the status. Second, the procedures for a seismic event

(KPS, 2004) direct the crew to check all of the safety systems. Again, the aux operator will be sent to safeguards alley to verify proper start and operation of the equipment. Third, the crew will be in a loss of offsite power event, and will send the aux operator to the DG rooms to check their proper operation. The aux operator must determine that the flooding is due to the FP system, and contact the main control room for further instructions. The control room must send the aux operator to the pump house to isolate two manual valves. It was conservatively assumed that this operator action outside the control room would not be successful if there was less than 30 minutes after the seismic event. .

Isolation of the SW piping can be completed in the control room, since power and air are available. The two valves that isolate the non-essential turbine building SW are air-operated, with air accumulators, and fail as is. Although a large SW break may give an alarm, this was not credited. Instead, the cues of the seismic event and the LOSP discussed above will guide the aux operator to identify the SW flooding as he checks the safety equipment. The control room would then initiate the SW isolation. Although more time may be available, a time of 26 minutes was used as the minimum time necessary to identify and isolate a SW break.

If both SW and FP piping breaks occurred, then both had to be successfully isolated.

The other operator actions are similar to those described for the internal flooding events (Attachment 3 of Appendix C)

6.0 QUANTIFICATION

The seismic risk is analyzed with the Seismic Hazard Integration Package (SHIP, Benjamin, 1996) computer code. This code integrates the seismic hazard curve for the site with the success and failure nodal equations for each seismic flooding event tree sequence (Figure 5-1). The following SHIP evaluations were performed, and are included in Attachment 4:

- Seiflood.BAS: This is the quantification of the 24 event tree sequences for the seismic flooding event tree, using the EPRI seismic hazard curve discussed in section 3.
- Seiflsuc.BAS: This side quantification was used in the calculation to determine the exact success probabilities for \ISOL.

The nodal equations in cut set form are also given in Attachment 4.

The seismic flood mitigation event tree (Figure 5-2) is quantified, and used for each of the transferred event tree sequences that have successful isolation of the piping break. Since the events in the mitigation event tree are independent of the seismic flooding event tree, it is only quantified once.

The resulting CDF for all seismic flooding sequences is 6.6E-06/year. Table 6-1 lists each of the flooding sequences, and their CDF contribution. As can be seen, sequence 25 (SEIFLD25) is the dominant sequence, contributing about 4.0E-6/y to seismic flooding CDF. This sequence is failure of the CSTs, with assumed failure of the AFW pumps, assumed failure of feed and bleed, and eventual core damage. This sequence represents about 60% of the seismic flooding CDF.

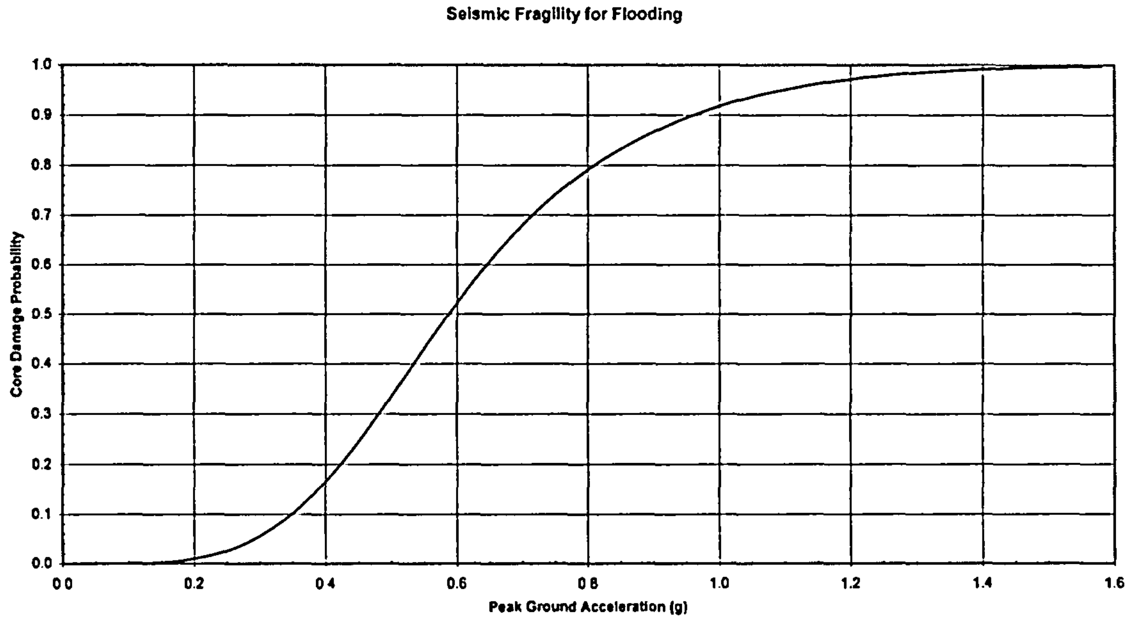
Table 6-1 Seismic Flooding Sequences and CDF

No.	Sequence Name	Sequence Risk	% of Total
1	SEIFLD25	3.97E-06	60.35
2	SEIFLD06	8.36E-07	12.71
3	SEIFLD26	4.90E-07	7.44
4	SEIFLD07	2.80E-07	4.26
5	SEIFLD19	1.37E-07	2.09
6	SEIFLD24	1.23E-07	1.88
7	SEIFLD13	1.10E-07	1.68
8	SEIFLD22	7.98E-08	1.21
9	SEIFLD11	6.94E-08	1.06
10	SEIFLD23	6.67E-08	1.01
11	SEIFLD04	6.62E-08	1.01
12	SEIFLD10	4.71E-08	.72
13	SEIFLD20	4.60E-08	.70
14	SEIFLD02	4.28E-08	.65
15	SEIFLD08	4.16E-08	.63
16	SEIFLD16	3.14E-08	.48
17	SEIFLD17	2.83E-08	.43
18	SEIFLD21	2.72E-08	.41
19	SEIFLD09	1.99E-08	.30
20	SEIFLD03	1.83E-08	.28
21	SEIFLD05	1.78E-08	.27
22	SEIFLD15	1.38E-08	.21
23	SEIFLD18	7.62E-09	.12
24	SEIFLD12	7.08E-09	.11
	Sum:	6.58E-06	100.00

The second most important contributor is sequence 6 (SEIFLD06), contributing about 8.4E-7/y to seismic flooding CDF. This sequence is failure of FP335 piping segment, success of all other equipment and piping segments, and success of isolation. However, the mitigation fails, resulting in core damage. This sequence contributes about 13% of the seismic flooding CDF. The only other sequence contributing more than 5% to the seismic flooding CDF is the failure of one of the high seismic capacity equipment items. The dominant contributor is failure of the SGBT hold-up and monitor tanks, with assumed failure of the CSTs and RMSTs.

Figure 6-1 shows the seismic fragility of the plant, i.e., the conditional probability of core damage due to seismic flooding as a function of peak ground acceleration. For instance, given a seismic event of 0.588 g pga, there is a 0.5 probability that core damage would occur due to seismic flooding. Although not directly shown on the plant fragility plot, there would have been a very low probability of core damage due to a design basis earthquake and flooding.

Figure 6-1 Plant Seismic Flooding Fragility



7.0 SENSITIVITY ANALYSES

Three sensitivity analyses were performed for the seismic flooding evaluation:

- Using LLNL seismic hazard curve (NUREG-1488, 1994) (SeifLLNL.BAS)
- Increasing operator isolation that must occur in less than 60 minutes by a factor of 2 (HEP30.BAS)
- Increasing skill-of-the-craft operator actions by a factor of 2 (HEPSOC.BAS)

Each of these sensitivity studies is discussed below. The SHIP output files (in parentheses above) are in Attachment 5.

7.1 Seismic Flooding Using the LLNL Seismic Hazard Curve

For this sensitivity study, the LLNL hazard estimate from NUREG-1488 was substituted for the baseline EPRI seismic hazard curve. The LLNL curve was extended, by log-linear extrapolation, to 1.6g so the range of pga values considered would be consistent with the base case. The models and fragility parameters (median capacities, composite variabilities) for equipment, tanks and pipe segments remain the same as the baseline. It should be noted that the fragility calculations have used the EPRI seismic ground and floor response spectrum information as described in section 4.2; the LLNL spectral shape is somewhat higher. Use of the same fragility parameters is considered acceptable for this sensitivity study.

The results demonstrated that there is little difference whether the LLNL or EPRI hazard curve is used, since they are very similar. The total seismic flooding CDF with the LLNL hazard curve is 7.3E-06/year. The ranking and contribution of the individual sequences was very similar.

7.2 Sensitivity of Operator Action HEPs

Table 7-1 presents a comparison of the seismic flooding baseline CDF, and the results of increasing the HEPs by a factor of 2 for the three sensitivity cases described above.

Table 7-1 Comparison of Sensitivity Studies

Case	Description	CDF
Baseline	Seismic flooding baseline (section 6)	6.58E-06/y
LLNL	LLNL Seismic Hazard Curve Used	7.32E-06/y
<30 min	Increase HEPs with less than 60 minutes for performance by factor of 2	6.60E-06/y
SOC	Increase HEPs using skill-of-the-craft for performance by factor of 2	7.20E-06/y

As can be seen, there is very little increase in seismic flooding CDF due to increased operator action HEPs. For the skill-of-the-craft actions (which are all of the FP piping isolations), there is about a 9% increase above the baseline CDF.

REFERENCES

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(NRC, 1991) NUREG-1407, Procedural and Submittal Guidance for the IPEEE for Severe Accident Vulnerabilities, June 1991.

(EPRI, 1989) EPRI NP-6395-D, Probabilistic Seismic Hazard at Nuclear Plant Sites in the Central and Eastern United States: Resolution of the Charleston Earthquake Issue, April 1989.

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(MPR, 2005) MPR Calculation 064-0515-LYS-01, "Evaluation of Flooding Levels for Various PRA Cases," Revision 0.

(Benjamin, 1996) SHIP, Seismic Hazard Integration Package, Jack R. Benjamin and Associates, Inc., Version 1.02, 7/2/96.

Appendix F

Seismic Analysis

Attachment 1 – HEPs

HEPs

Prepared by: *[signature]* George E Baldwin
Signature — Print Name

10/26/05
Date

Reviewed by: *[signature]* JEFFREY T. STAFFORD
Signature — Print Name

10-28-05
Date

HEP	02-SW4AB22-F-HE		HEP Description	Close SW-4A & SW-4B During Flood/Seismic Event - 22 min.
Revision Date	10/20/2005		Evaluator	GE Baldwin
Operation Reviewer			Reviewer	
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03		
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.			
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header			
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • Seismic event was initiating event.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 12 minutes. The allowed time is 22 minutes.			
Success Criteria	Affected SW header is isolated.			
References Used	A-SW-02			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			
Execution Assumptions	None			
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.			

02-SW4AB22-F-HE, Close SW-4A & SW-4B During Flood/Seismic Event - 22 min.

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 1: 02-SW4AB22-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	4.2e-02
P_{exe}	8.7e-03	8.7e-03
Total HEP		5.0e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme stress due to plant conditions during seismic event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

- \- **None**
- X - **Classroom** Frequency:
- X - **Simulator** Frequency:

Degree of Clarity of Cues & Indications:

- X - **Very Good**
- \- **Average**
- \- **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
- \- **Local Control Panels**
- \- **Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

	-	**Skills**
X	-	**Rule**
	-	**Knowledge**

Complexity of Response

Cognitive			Execution		
X	-	Complex		-	Complex
	-	Simple	X	-	Simple

Environment:

Lighting			Heat/Humidity		
X	-	Normal	X	-	Normal
	-	Emergency		-	Hot / Humid
	-	Portable		-	Cold

Radiation			Atmosphere		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	Accessibility
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
	-	**Pump house**	
	-	**Switchyard**	

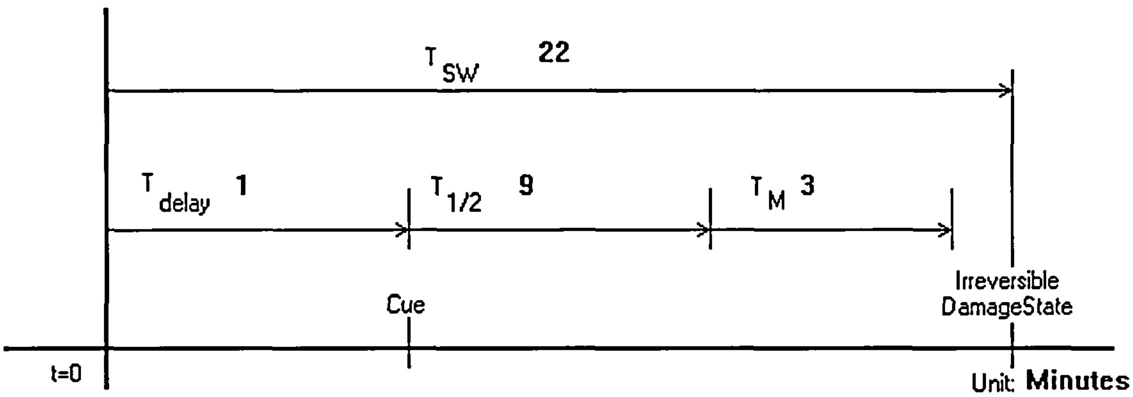
Stress:

	-	**Optimum (Low)**
	-	**Moderate**
X	-	**Extreme (High)**

Cognitive

02-SW4AB22-F-HE

Cue:
47033-P, Miscellaneous Sump Level High,and 47023-K, Seismic Trouble, alarms
Additional SW Alarms based on event



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 9.00 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 4.2e-02

Execution Unrecovered

02-SW4AB22-F-HE

Table 2: 02-SW4AB22-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	E	5	1.3E-3	20-12	3	E	5		8.7e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4AB22-F-HE

Table 3: 02-SW4AB22-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	8.7e-03				
		Total Unrecovered:	8.7e-03			Total Recovered:	8.7e-03

HEP	08-FPISO30-F-HE	HEP Description	Isol Fire Pump during Seismic Flood Event -30 minutes
Revision Date	10/18/2005	Evaluator	GE Baldwin
Operations Review		Reviewer	
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. Addition plant walk downs conducted in April, 2005 and simulator observation 9/29/05.	
Scenario	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO is directed to isolate the Fire Pumps.		
Assumptions for the Event	The following assumptions are made: • No major obstacles present to prevent close to normal transits. • Operator has used alternate path to Safeguard Alley • Fire header break has occurred requiring isolation in 30 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report fire header rupture. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 30 minutes.		
Success Criteria	Rupture isolated in time to prevent a loss of TD AFW pump.		
References Used	ARP 47033-P, ARP 47054-L, ARP 47023-K, E-0-05		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		

Execution Recovery Assumptions	None

08-FPISO30-F-HE, Isol Fire Pump during Seismic Flood Event -30 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 4: 08-FPISO30-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	N/A	4.6e-01
P_{exe}	2.6e-02	2.6e-02
Total HEP		4.9e-01
Error Factor		1

HFE Scenario Description:
Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
ARP 47023-K, Seismic Trouble
E-0-05, Response To Natural Events

Training:

- None
- Classroom

X - Simulator Frequency: .5

Degree of Clarity of Cues & Indications:

- Very Good

X - Average

- Poor

Human-Machine Interface:

- Control Room Panels
- Local Control Panels

X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills

X - Rule

- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	- Complex
- Simple	X - Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- Control Room Front Panels	
- Control Room Back Panels	
- Hot Shutdown Panels	
- Auxiliary Building	
- Electrical Building	
- Containment	
X - Pump house	Accessible
- Switchyard	

Stress:

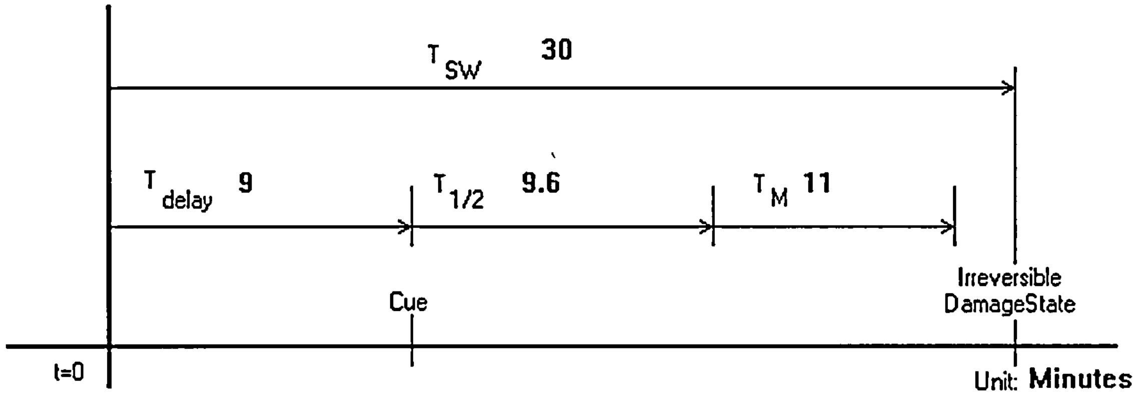
- Optimum (Low)
- Moderate

X - Extreme (High)

Cognitive

08-FPISO30-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 0.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 4.6e-01

Execution Unrecovered

08-FPISO30-F-HE

Table 5: 08-FPISO30-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO30-F-HE

Table 6: 08-FPISO30-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	1.3e-02				
2		Close FP-2B	1.3e-02				
		Total Unrecovered:	2.6e-02			Total Recovered:	2.6e-02

HEP	08-FPISO40-F-HE		HEP Description	Isol Fire Pump during Seismic Flood Event - 40 minutes
Revision Date	10/18/2005		Evaluator	GE Baldwin
Operations Review			Reviewer	
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. Addition plant walk downs conducted in April, 2005 and simulator observation 9/29/05.		
Scenario	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.			
Event Description	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO is directed to isolate the Fire Pumps.			
Assumptions for the Event	The following assumptions are made: • No major obstacles present to prevent close to normal transits. • Operator has used alternate path to Safeguard Alley • Fire header break has occurred requiring isolation in 40 minutes.			
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report fire header rupture. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 40 minutes.			
Success Criteria	Rupture isolated in time to prevent a loss of TD AFW pump.			
References Used	ARP 47033-P, ARP 47054-L, ARP 47023-K, E-0-05			
Cognitive Assumption	It is assumed proper place keeping is used.			
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.			
Execution Assumptions	None			

Execution Recovery Assumptions	None

08-FPISO40-F-HE, Isol Fire Pump during Seismic Flood Event -40 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 7: 08-FPISO40-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	3.3e-02
P_{exe}	2.6e-02	2.6e-02
Total HEP		5.9e-02
Error Factor		5

HFE Scenario Description:
Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Moderate due to single failure with potential subsequent damage. Limited by lack of knowledge of full consequence of flood event.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
ARP 47023-K, Seismic Trouble
E-0-05, Response To Natural Events

Training:

- **None**
- **Classroom**
- X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**
- X - **Average**
- **Poor**

Human-Machine Interface:

- **Control Room Panels**
- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools	**Parts**	**Clothing**
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive	**Execution**
X - Complex	- Complex
- *Simple*	X - *Simple*

Environment:

Lighting	**Heat/Humidity**
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold
Radiation	**Atmosphere**
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
- ***Control Room Front Panels***	
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
- ***Auxiliary Building***	
- **Electrical Building**	
- **Containment**	
X - **Pump house**	Accessible
- **Switchyard**	

Stress:

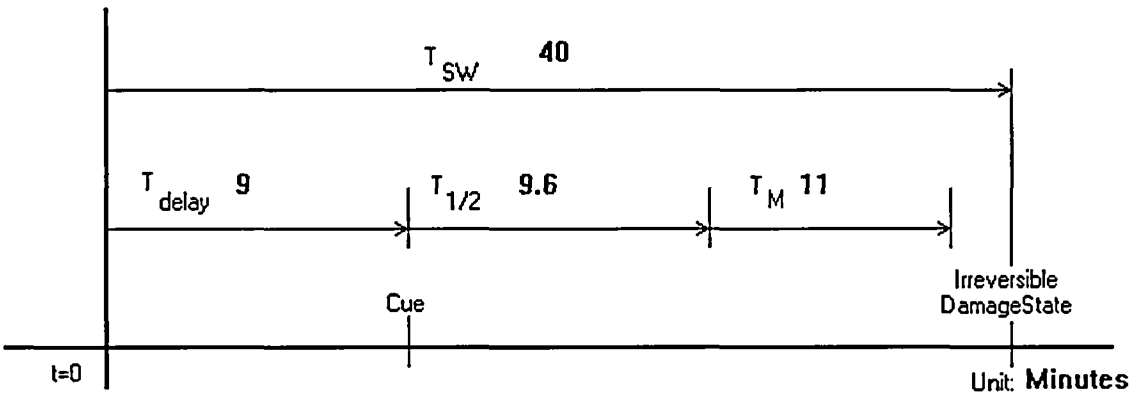
- **Optimum (Low)**
- **Moderate**

X - **Extreme (High)**

Cognitive

08-FPISO40-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 10.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes	X	Yes		Low
X	Rule		No		No	X	High

Sigma: 4.0e-01

HEP: 3.3e-02

Execution Unrecovered

08-FPISO40-F-HE

Table 8: 08-FPISO40-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO40-F-HE

Table 9: 08-FPISO40-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	1.3e-02				
2		Close FP-2B	1.3e-02				
		Total Unrecovered:	2.6e-02			Total Recovered:	2.6e-02

HEP	08-FPISO57-F-HE	HEP Description	Isol Fire Pump during Seismic Flood Event -57 minutes
Revision Date	10/18/2005	Evaluator	GE Baldwin
Operations Review		Reviewer	
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. Addition plant walk downs conducted in April, 2005 and simulator observation 9/29/05.	
Scenario	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.		
Event Description	Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing. The NAO is directed to isolate the Fire Pumps.		
Assumptions for the Event	The following assumptions are made: • No major obstacles present to prevent close to normal transits. • Operator has used alternate path to Safeguard Alley • Fire header break has occurred requiring isolation in 57 minutes.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report fire header rupture. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 57 minutes.		
Success Criteria	Rupture isolated in time to prevent a loss of TD AFW pump.		
References Used	ARP 47033-P, ARP 47054-L, ARP 47023-K, E-0-05		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		

Execution Recovery Assumptions	None

08-FPISO57-F-HE, Isol Fire Pump during Seismic Flood Event -57 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	CDBTM/THERP

Table 10: 08-FPISO57-F-HE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	6.0e-03	4.5e-03
P_{exe}	2.6e-02	2.6e-02
Total HEP		3.1e-02
Error Factor		5

HFE Scenario Description:
A seismic event occurs. Fire Header ruptures flooding the Turbine Building Basement causing 47054-L, Fire Pump Abnormal, and 47033-P, Miscellaneous Sump Level High to actuate. The NAO proceeds to the Turbine Building Basement to investigate and discovers water levels increasing.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme due to seismic event with damage and potential subsequent damage.

Procedure and step governing HI:
ARP 47033-P, Miscellaneous Sump Level High
ARP 47054-L, Fire Pump Abnormal
ARP 47023-K, Seismic Trouble
E-0-05, Response To Natural Events

Training:

- **None**
- **Classroom**

X - **Simulator** Frequency: .5

Degree of Clarity of Cues & Indications:

- **Very Good**

X - **Average**

- **Poor**

Human-Machine Interface:

- **Control Room Panels**

- **Local Control Panels**

X - **Local Equipment**

Special Requirements:

Tools		**Parts**		**Clothing**	
	Required		Required		Required
	Adequate		Adequate		Adequate
	Available		Available		Available

Type of Response:

- **Skills**

X - **Rule**

- **Knowledge**

Complexity of Response

Cognitive		**Execution**	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		**Heat/Humidity**	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold

Radiation		**Atmosphere**	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	**Accessibility**
	- **Control Room Front Panels**	
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	With Difficulty
	- **Switchyard**	

Stress:

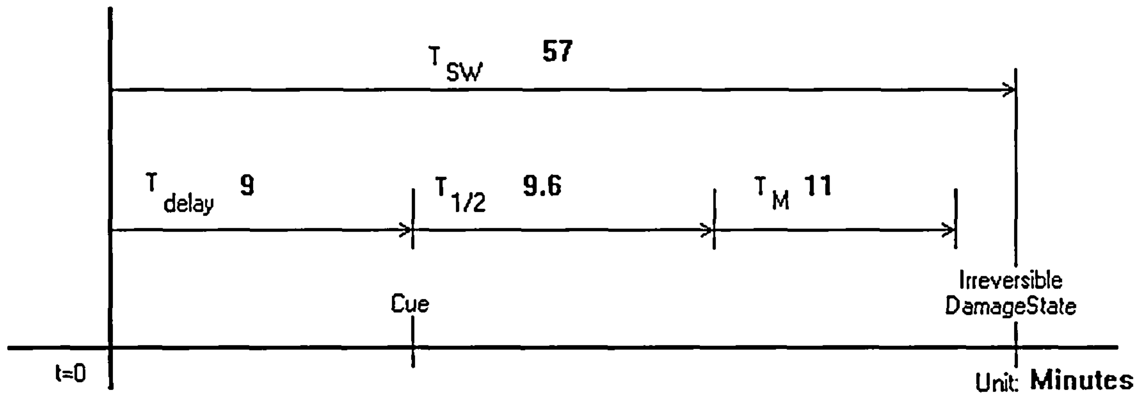
- **Optimum (Low)**
- **Moderate**

X - **Extreme (High)**

Cognitive Unrecovered

08-FPISO57-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Operator interviews and Simulator observation

Duration of time window available for action (TW): 27.40 Minutes

Table 11: 08-FPISO57-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	a	neg.
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	l	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		6.0e-03

Cognitive Recovery

08-FPISO57-F-HE

Table 12: 08-FPISO57-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
									Sum of Pc_a through Pc_h = Initial Pc =		4.5e-03

Recovery Factors Identified:
Star process is iused.

Execution Unrecovered

08-FPISO57-F-HE

Table 13: 08-FPISO57-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

08-FPISO57-F-HE

Table 14: 08-FPISO57-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Close FP-2A	1.3e-02				
2		Close FP-2B	1.3e-02				
		Total Unrecovered:	2.6e-02			Total Recovered:	2.6e-02

HEP	SX-SWFP-22-F-HE	HEP Description	Isolate SW and Fire Water Rupture -22 minutes
Revision Date	10/21/2005	Evaluator	GE Baldwin
Operations Reviewer		Review	
Operations Input	I: Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. S: Operator walk down on 4/28/05		
Scenario	Seismic event occurs- Fire Water and Service Water Rupture		
Event Description	Seismic event occurs- Fire Water and Service Water Rupture. The NAO is directed to investigate/monitor equipment after the actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms. The Operator take appropriate actions via procedure.		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • NAO is in the Turbine Building.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report Fire and Service Water header ruptures. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The control room operators would isolate Turbine Building Service Water Header simultaneously thus the Fire Header timing is dominant. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 22 minutes. This action is unsuccessful.		
Success Criteria	Flooding is stopped in 22 minutes.		
References Used	E-0-05		
Cognitive Assumption	Assumes operators will immediately isolate identified rupture.		
Cognitive Recovery Assumptions	None		
Execution Assumptions	None		

Execution Recovery Assumptions	None

SX-SWFP-22-F-HE, Isolate SW and Fire Water Rupture -22 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 15: SX-SWFP-22-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	1.0e+00
P_{exe}	3.9e-02	3.9e-02
Total HEP		1.0e+00
Error Factor		1

HFE Scenario Description:
Seismic event occurs- Fire Water and Service Water Rupture

Related Human Interactions:
none

Performance Shaping Factors:
High Stress due to multiple failures and a seismic event

Procedure and step governing HI:
E-0-05, Response To Natural Events, steps 2-7

Training:

- None
- Classroom

X - Simulator Frequency:

Degree of Clarity of Cues & Indications:

- Very Good

X - Average

- Poor

Human-Machine Interface:

X - Control Room Panels

X - Local Control Panels

- Local Equipment

Special Requirements:

Tools	Parts	Clothing

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

- Skills
- X - Rule
- Knowledge

Complexity of Response

Cognitive		Execution	
X	Complex	X	Complex
	Simple		Simple

Environment:

Lighting		Heat/Humidity	
X	Normal		Normal
	Emergency		Hot / Humid
	Portable	X	Cold

Radiation		Atmosphere	
X	Background	X	Normal
	Green		Steam
	Yellow		Smoke
	Red		Respirator required

Equipment Accessibility:

	Location	Accessibility
X	Control Room Front Panels	Accessible
	Control Room Back Panels	
	Hot Shutdown Panels	
	Auxiliary Building	
	Electrical Building	
	Containment	
X	Pump house	Accessible
	Switchyard	

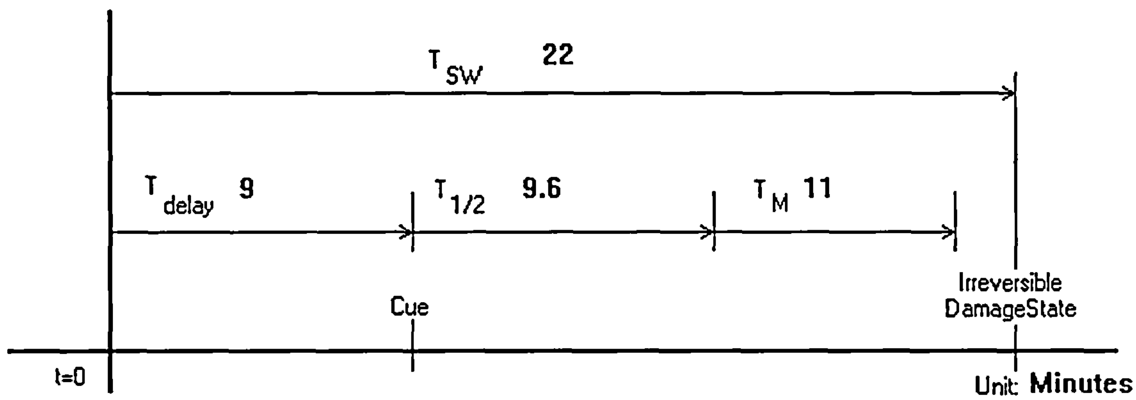
Stress:

- Optimum (Low)
- Moderate
- X - Extreme (High)

Cognitive

SX-SWFP-22-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Simulator observation, interviews and plant walkdowns.

Duration of time window available for action (TW): -7.60 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes		Yes		Low
X	Rule		No	X	No	X	High

Sigma: 6.0e-01

HEP: 1.0e+00

Execution Recovery

SX-SWFP-22-F-HE

Table 17: SX-SWFP-22-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Isolate Turbine Header	1.3e-02				
2		Close FP-2A	1.3e-02				
3		Close FP-2B	1.3e-02				
		Total Unrecovered:	3.9e-02			Total Recovered:	3.9e-02

HEP	SX-SWFP-34-F-HE	HEP Description	Isolate SW and Fire Water Rupture -34 minutes
Revision Date	10/21/2005	Evaluator	GE Baldwin
Operations Reviewer		Review	
Operations Input	I: Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. S: Operator walk down on 4/28/05		
Scenario	Seismic event occurs- Fire Water and Service Water Rupture		
Event Description	Seismic event occurs- Fire Water and Service Water Rupture. The NAO is directed to investigate/monitor equipment after the actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms. The Operator take appropriate actions via procedure.		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • NAO is in the Turbine Building.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report Fire and Service Water header ruptures. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The control room operators would isolate Turbine Building Service Water Header simultaneously thus the Fire Header timing is dominant. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 34 minutes.		
Success Criteria	Flooding is stopped in 34 minutes.		
References Used	E-0-05		
Cognitive Assumption	Assumes operators will immediately isolate identified rupture.		
Cognitive Recovery Assumptions	None		
Execution Assumptions	None		

Execution Recovery Assumptions	None

SX-SWFP-34-F-HE, Isolate SW and Fire Water Rupture -34 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 18: SX-SWFP-34-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	2.6e-01
P_{exe}	3.9e-02	3.9e-02
Total HEP		3.0e-01
Error Factor		1

HFE Scenario Description:
Seismic event occurs- Fire Water and Service Water Rupture

Related Human Interactions:
none

Performance Shaping Factors:
High Stress due to multiple failures and a seismic event

Procedure and step governing HI:
E-0-05, Response To Natural Events, steps 2-7

Training:

- None
- Classroom

X - Simulator Frequency:

Degree of Clarity of Cues & Indications:

- Very Good

X - Average

- Poor

Human-Machine Interface:

X - Control Room Panels

X - Local Control Panels

- Local Equipment

Special Requirements:

Tools	Parts	Clothing

Execution Unrecovered

SX-SWFP-22-F-HE

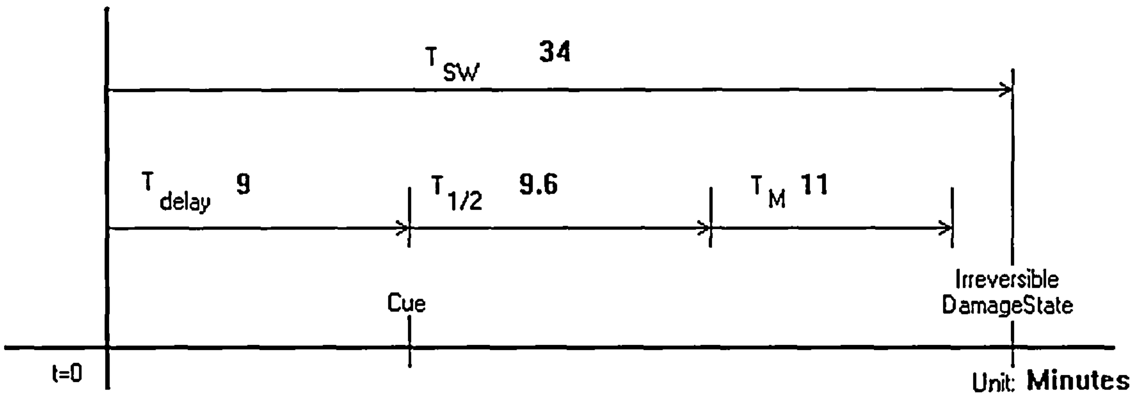
Table 16: SX-SWFP-22-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-12	3	E	5		1.3e-02
Actions: Isolate Turbine Header						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
3	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Cognitive

SX-SWFP-34-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Simulator observation, interviews and plant walkdowns.

Duration of time window available for action (TW): 4.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes		Yes		Low
X	Rule		No	X	No	X	High

Sigma: 6.0e-01

HEP: 2.6e-01

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

	-	**Skills**
X	-	**Rule**
	-	**Knowledge**

Complexity of Response

Cognitive			**Execution**		
X	-	Complex	X	-	Complex
	-	Simple		-	Simple

Environment:

Lighting			**Heat/Humidity**		
X	-	Normal		-	Normal
	-	Emergency		-	Hot / Humid
	-	Portable	X	-	Cold

Radiation			**Atmosphere**		
X	-	Background	X	-	Normal
	-	Green		-	Steam
	-	Yellow		-	Smoke
	-	Red		-	Respirator required

Equipment Accessibility:

		Location	**Accessibility**
X	-	**Control Room Front Panels**	Accessible
	-	**Control Room Back Panels**	
	-	**Hot Shutdown Panels**	
	-	**Auxiliary Building**	
	-	**Electrical Building**	
	-	**Containment**	
X	-	**Pump house**	Accessible
	-	**Switchyard**	

Stress:

	-	**Optimum (Low)**
	-	**Moderate**
X	-	**Extreme (High)**

Execution Recovery Assumptions	None

SX-SWFP-40-F-HE, Isolate SW and Fire Water Rupture -40 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	HCR/ORE/THERP

Table 21: SX-SWFP-40-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	N/A	1.1e-01
P_{exe}	3.9e-02	3.9e-02
Total HEP		1.5e-01
Error Factor		1

HFE Scenario Description:
Seismic event occurs - Fire Water and Service Water Rupture

Related Human Interactions:
none

Performance Shaping Factors:
High Stress due to multiple failures and a seismic event

Procedure and step governing HI:
E-0-05, Response To Natural Events, steps 2-7

Training:

- None
- Classroom
- X - Simulator   Frequency:

Degree of Clarity of Cues & Indications:

- Very Good
- X - Average
- Poor

Human-Machine Interface:

- X - Control Room Panels
- X - Local Control Panels
- Local Equipment

Special Requirements:

Tools	Parts	Clothing

Execution Unrecovered

SX-SWFP-34-F-HE

Table 19: SX-SWFP-34-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-12	3	E	5		1.3e-02
Actions: Isolate Turbine Header						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
3	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

SX-SWFP-34-F-HE

Table 20: SX-SWFP-34-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Isolate Turbine Header	1.3e-02				
2		Close FP-2A	1.3e-02				
3		Close FP-2B	1.3e-02				
		Total Unrecovered:	3.9e-02			Total Recovered:	3.9e-02

HEP	SX-SWFP-40-F-HE	HEP Description	Isolate SW and Fire Water Rupture - 40 minutes
Revision Date	10/21/2005	Evaluator	GE Baldwin
Operations Reviewer		Review	
Operations Input	I: Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. S: Operator walk down on 4/28/05		
Scenario	*Seismic event occurs- Fire Water and Service Water Rupture*		
Event Description	Seismic event occurs- Fire Water and Service Water Rupture. The NAO is directed to investigate/monitor equipment after the actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms. The Operator take appropriate actions via procedure.		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • NAO is in the Turbine Building.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report Fire and Service Water header ruptures. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The control room operators would isolate Turbine Building Service Water Header simultaneously thus the Fire Header timing is dominant. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 40 minutes.		
Success Criteria	Flooding is stopped in 40 minutes.		
References Used	E-0-05		
Cognitive Assumption	Assumes operators will immediately isolate identified rupture.		
Cognitive Recovery Assumptions	None		
Execution Assumptions	None		

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

-   - **Skills**
- X - **Rule**
-   - **Knowledge**

Complexity of Response

Cognitive	Execution
X - Complex	X - Complex
- Simple	- Simple

Environment:

Lighting	Heat/Humidity
X - Normal	- Normal
- Emergency	- Hot / Humid
- Portable	X - Cold

Radiation	Atmosphere
X - Background	X - Normal
- Green	- Steam
- Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	Accessible
	- **Switchyard**	

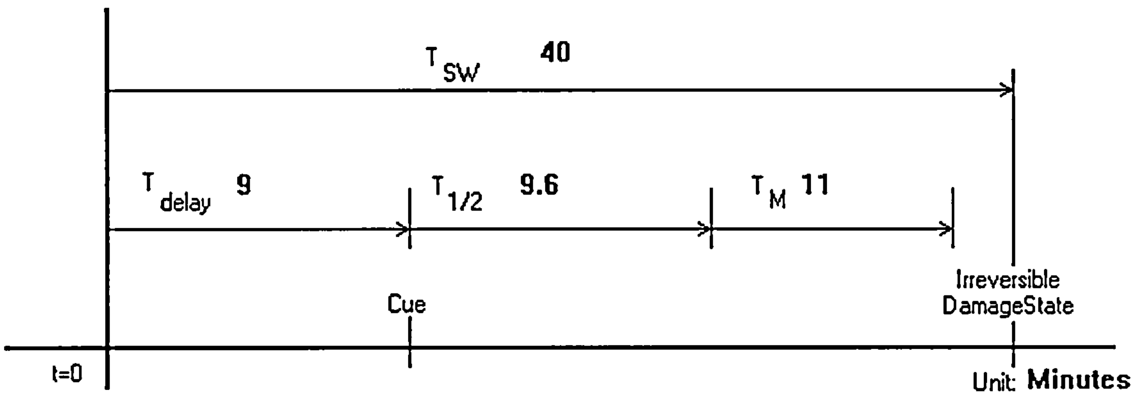
Stress:

-   - **Optimum (Low)**
-   - **Moderate**
- X - **Extreme (High)**

Cognitive

SX-SWFP-40-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Simulator observation, interviews and plant walkdowns.

Duration of time window available for action (TW): 10.40 Minutes

Sigma Decision Tree

	Skill vs. Rule		Procedures		Training		Stress
	Skill	X	Yes		Yes		Low
X	Rule		No	X	No	X	High

Sigma: 6.0e-01

HEP: 1.1e-01

Execution Unrecovered

SX-SWFP-40-F-HE

Table 22: SX-SWFP-40-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-12	3	E	5		1.3e-02
Actions: Isolate Turbine Header						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
3	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

SX-SWFP-40-F-HE

Table 23: SX-SWFP-40-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Isolate Turbine Header	1.3e-02				
2		Close FP-2A	1.3e-02				
3		Close FP-2B	1.3e-02				
		Total Unrecovered:	3.9e-02			Total Recovered:	3.9e-02

HEP	SX-SWFP-57-F-HE	HEP Description	Isolate SW and Fire Water Rupture -57 minutes
Revision Date	10/21/2005	Evaluator	GE Baldwin
Operations Reviewer		Review	
Operations Input	I / S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03. Operator walk down on 4/28/05	
Scenario	Seismic event occurs- Fire Water and Service Water Rupture		
Event Description	Seismic event occurs- Fire Water and Service Water Rupture. The NAO is directed to investigate/monitor equipment after the actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms. The Operator take appropriate actions via procedure.		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • NAO is in the Turbine Building.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. At approximately 5-9 minutes into the event (after immediate actions for Reactor trip) the Shift Manager (SM) will divide crew to deal with the two events – Plant trip and Seismic event. The SM would dispatch the NAO to evaluate the plant conditions and approximately 4 minutes later the NAO would report Fire and Service Water header ruptures. The SM would identify the isolation and direct the isolation of the fire header in approximately 5 minutes. The control room operators would isolate Turbine Building Service Water Header simultaneously thus the Fire Header timing is dominant. The NAO would complete the isolation in approximately 11 minutes. The total time would be 29 minutes of the allowed 57 minutes.		
Success Criteria	Flooding is stopped in 57 minutes.		
References Used	E-0-05		
Cognitive Assumption	Assumes operators will immediately isolate identified rupture.		
Cognitive Recovery Assumptions	None		
Execution Assumptions	None		

Execution Recovery Assumptions	None

SX-SWFP-57-F-HE, Isolate SW and Fire Water Rupture -57 minutes

Basic Event Summary

Analyst:	GE Baldwin
Rev. Date:	10/20/05
Cognitive Method:	CDBTM/THERP

Table 24: SX-SWFP-57-F-HE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.7e-02	1.7e-02
P_{exe}	3.9e-02	3.9e-02
Total HEP		5.6e-02
Error Factor		5

HFE Scenario Description:
Seismic event occurs- Fire Water and Service Water Rupture

Related Human Interactions:
none

Performance Shaping Factors:
High Stress due to multiple failures and a seismic event

Procedure and step governing HI:
E-0-05, Response To Natural Events, steps 2-7

Training:

- None
- Classroom
X - Simulator Frequency:

Degree of Clarity of Cues & Indications:

- Very Good
X - Average
- Poor

Human-Machine Interface:

X - Control Room Panels
X - Local Control Panels
- Local Equipment

Special Requirements:

Tools	Parts	Clothing

Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
- X - **Rule**
- Knowledge

Complexity of Response

Cognitive		Execution	
X	- Complex	X	- Complex
	- Simple		- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal		- Normal
	- Emergency		- Hot / Humid
	- Portable	X	- Cold
Radiation		**Atmosphere**	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
X	- **Pump house**	Accessible
	- **Switchyard**	

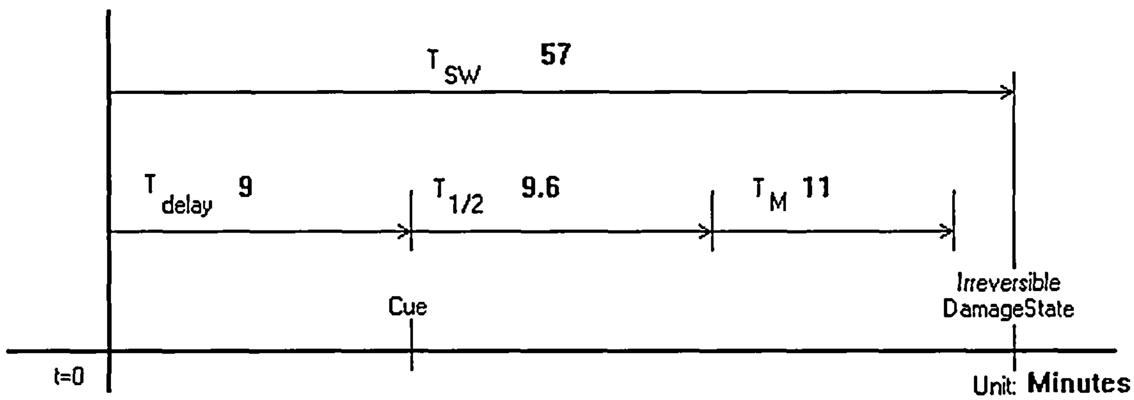
Stress:

- Optimum (Low)
- Moderate
- X - **Extreme (High)**

Cognitive Unrecovered

SX-SWFP-57-F-HE

Cue:
Actuation of 47054-L, Fire Pump Abnormal, 47033-P, Miscellaneous Sump Level High and 47023-K, Seismic Trouble, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Simulator observation, interviews and plant walkdowns.

Duration of time window available for action (TW): 27.40 Minutes

Table 25: SX-SWFP-57-F-HE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	b	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	j	1.0e-03
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.7e-02

Cognitive Recovery

SX-SWFP-57-F-HE

Table 26: SX-SWFP-57-F-HE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	1.0e-03	-	-	-	-	-	NC	-	1.0		1.0e-03
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.7e-02

Recovery Factors identified:

Execution Unrecovered

SX-SWFP-57-F-HE

Table 27: SX-SWFP-57-F-HE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
1	1.3E-3	20-7	1	E	5	1.3E-3	20-12	3	E	5		1.3e-02
Actions: Isolate Turbine Header						Comments:						
2	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2A						Comments:						
3	1.3E-3	20-7	1	E	5	1.3E-3	20-13	1	E	5		1.3e-02
Actions: Close FP-2B						Comments:						

Execution Recovery

SX-SWFP-57-F-HE

Table 28: SX-SWFP-57-F-HE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
1		Isolate Turbine Header	1.3e-02				
2		Close FP-2A	1.3e-02				
3		Close FP-2B	1.3e-02				
		Total Unrecovered:	3.9e-02			Total Recovered:	3.9e-02

HEP	02-SW4A-B--FSHE	HEP Description	Operator Fails to Close SW-4A & SW-4B During Flood/Seismic Event
Revision Date	10/20/2005	Evaluator	GE Baldwin
Operation Reviewer		Reviewer	
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03	
Scenario	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.		
Event Description	A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure. Operators enter A-SW-02 and determine a rupture in Turbine Building header. The operators isolate the affected header		
Assumptions for the Event	The following assumptions are made: • All automatic actions occur except as noted. • Seismic event was initiating event.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Most times in this analysis is based on the A-SW-02 interview conducted 10/14/02 however some time was adjusted using the average response time. Based on these times it is estimated the operator will close SW-4A(B) in approximately 12 minutes. The allowed time is 29 minutes.		
Success Criteria	Affected SW header is isolated.		
References Used	A-SW-02		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	It is assumed STAR self-checking is used.		
Execution Assumptions	None		
Execution Recovery Assumptions	Operator will review the procedure when pressure does not return to >86 psig.		

02-SW4A-B--FSHE, Close SW-4A & SW-4B During Flood/Seismic Event

Basic Event Summary

Analyst:	G Baldwin
Rev. Date:	10/20/05
Cognitive Method:	CDBTM/THERP

Table 29: 02-SW4A-B--FSHE SUMMARY

Analysis Results:	without Recovery	with Recovery
P_{cog}	1.6e-02	1.6e-02
P_{exe}	8.7e-03	8.7e-03
Total HEP		2.5e-02
Error Factor		5

HFE Scenario Description:
A Service Water pipe fails down stream of SW-4A/B causing a low Service Water header pressure.

Related Human Interactions:
None

Performance Shaping Factors:
Extreme stress due to plant conditions during seismic event.

Procedure and step governing HI:
A-SW-02, Steps 1-6

Training:

-   - **None**
- X - **Classroom** Frequency:
- X - **Simulator** Frequency:

Degree of Clarity of Cues & Indications:

- X - **Very Good**
-   - **Average**
-   - **Poor**

Human-Machine Interface:

- X - **Control Room Panels**
-   - **Local Control Panels**
-   - **Local Equipment**

Special Requirements:

Tools	Parts	Clothing

Required Adequate Available	Required Adequate Available	Required Adequate Available

Type of Response:

-    - **Skills**
- X - **Rule**
-    - **Knowledge**

Complexity of Response

Cognitive		Execution	
X	- Complex		- Complex
	- Simple	X	- Simple

Environment:

Lighting		Heat/Humidity	
X	- Normal	X	- Normal
	- Emergency		- Hot / Humid
	- Portable		- Cold

Radiation		Atmosphere	
X	- Background	X	- Normal
	- Green		- Steam
	- Yellow		- Smoke
	- Red		- Respirator required

Equipment Accessibility:

	Location	Accessibility
X	- **Control Room Front Panels**	Accessible
	- **Control Room Back Panels**	
	- **Hot Shutdown Panels**	
	- **Auxiliary Building**	
	- **Electrical Building**	
	- **Containment**	
	- **Pump house**	
	- **Switchyard**	

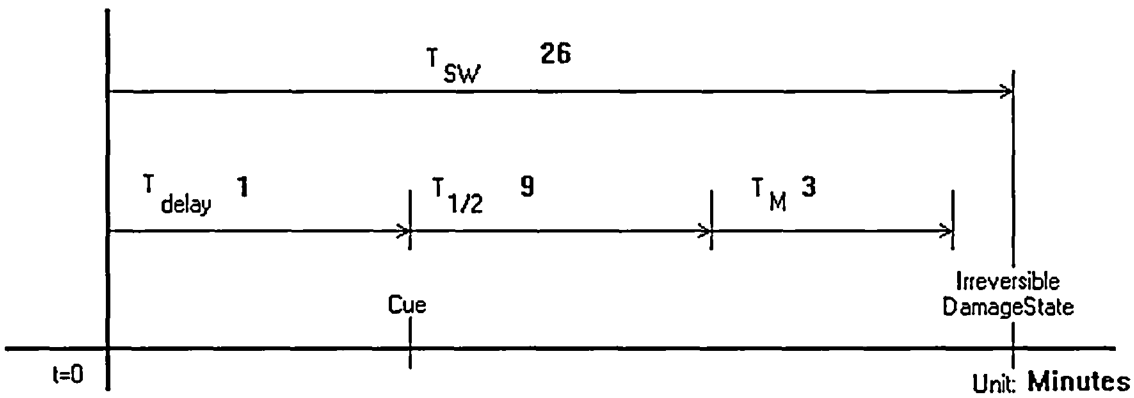
Stress:

-    - **Optimum (Low)**
-    - **Moderate**
- X - **Extreme (High)**

Cognitive Unrecovered

02-SW4A-B--FSHE

Cue:
47033-P, Miscellaneous Sump Level High, and 47023-K, Seismic Trouble, alarms
Additional SW Alarms based on event



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Operator interview

Duration of time window available for action (TW): 13.00 Minutes

Table 30: 02-SW4A-B--FSHE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	c	1.0e-02
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	b	3.0e-03
Pc_g: Misinterpret decision logic	i	3.0e-04
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		1.6e-02

Cognitive Recovery

02-SW4A-B--FSHE

Table 31: 02-SW4A-B--FSHE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	1.0e-02	-	-	-	-	-	NC	-	1.0		1.0e-02
Pc_e:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_f:	3.0e-03	-	-	-	-	-	NC	-	1.0		3.0e-03
Pc_g:	3.0e-04	-	-	-	-	-	NC	-	1.0		3.0e-04
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.6e-02

Recovery Factors Identified:
STAR process is assumed.

Execution Unrecovered

02-SW4A-B--FSHE

Table 32: 02-SW4A-B--FSHE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 6 RNO 2.c	4.3E-4	20-7b	1	E	5	1.3E-3	20-12	3	E	5		8.7e-03
Actions: Position Turb Bldg SW Header switch to ISOL						Comments:						

Execution Recovery

02-SW4A-B--FSHE

Table 33: 02-SW4A-B--FSHE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 6 RNO 2.c		Position Turb Bldg SW Header switch to ISOL	8.7e-03				
		Total Unrecovered:	8.7e-03			Total Recovered:	8.7e-03

HEP	27A-ORR----FSHE	HEP Description	Limit SI flow and Refill RWST (No Cooldown) - Flood/Seismic
Revision Date	7/2/2005	Evaluator	GE Baldwin
Operations Reviewer		Reviewer	E. Coen
Operations Input	I S	Simulator observation and operator interviews conducted from 9/25/02 to 6/3/03	
Scenario	The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow.		
Event Description	The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow. The Operator will direct the throttling of SI-7B to reduce SI flow to the minimum allowed.		
Assumptions for the Event	The following assumptions are made: • Subcooling was lost and not regained prior to entry into ECA-1.1 due to RXCP Seal Leak • A loss of Component Cooling caused the operators to secure the RXCPs • SI Pump B is operating; RHR is not injecting/running; and ICS has not initiated. • Only Bus 6 has power from offsite or Diesel Generator B. • Communications between Control Room and NAO is via PCS phone.		
Timing Analysis	Based on simulator observation and operator interviews conducted from 9/25/02 to 6/3/03, it was determined the average time to perform a control room operator action was 0.8 minutes. This time does not include plant response time for the operator-performed action such as RCS temperature response after initiation of a cooldown. Additionally Simulator observation of 11/4/02 was used to assist in the time line. It is assumed that the operators proceeded in ECA-1.1 at step 17 of E-1 when recirculation capabilities are discovered to be not available. Step 17 of E-1 is reached in approximately 45. The NAO will be dispatched to throttle approximately 2.4 minutes later to throttle SI-7B. It is estimated that it will take the operators approximately 5 minutes to start throttling SI flow and have it positioned in 10 minutes.		
Success Criteria	SI flow is throttled to minimum flow.		
References Used	ECA-1.1		
Cognitive Assumption	It is assumed proper place keeping is used.		
Cognitive Recovery Assumptions	STAR self checking process is used by the operators.		

Execution Assumptions	Stress level remains extreme late into the event due to seismic event.
Execution Recovery Assumptions	None

27A-ORR----FSHE, Limit SI flow and Refill RWST (No Cooldown) - Flood/Seismic

Basic Event Summary

Analyst:	GEB
Rev. Date:	10/20/05
Cognitive Method:	CDBTM/THERP

Table 34: 27A-ORR---FSHE SUMMARY

Analysis Results:	**without Recovery**	**with Recovery**
P_{cog}	3.0e-03	1.5e-03
P_{exe}	8.7e-03	8.7e-03
Total HEP		1.0e-02
Error Factor		5

HFE Scenario Description:
The operator is unable to establish emergency coolant recirculation capability from containment sump B due to loss of 480V safeguard buses. The operator then transfers to ECA-1.1, Loss of Emergency Coolant Recirculation, and takes action to extend the time RWST is available by reducing SI flow.

Related Human Interactions:
None

Performance Shaping Factors:
High stress, ECA procedure is entered with extreme conditions.

Procedure and step governing HI:
ECA-1.1, Steps 14

Training:

- None
- Classroom
- X - Simulator   Frequency: .5

Degree of Clarity of Cues & Indications:

- X - Very Good
- Average
- Poor

Human-Machine Interface:

- X - Control Room Panels
- Local Control Panels
- X - Local Equipment

Special Requirements:

Tools	Parts	Clothing
Required	Required	Required
Adequate	Adequate	Adequate
Available	Available	Available

Type of Response:

- Skills
X - Rule
- Knowledge

Complexity of Response

Cognitive	Execution
X - Complex	X - Complex
- Simple	- Simple

Environment:

Lighting	Heat/Humidity
X - Normal	X - Normal
- Emergency	- Hot / Humid
- Portable	- Cold

Radiation	Atmosphere
- Background	X - Normal
- Green	- Steam
X - Yellow	- Smoke
- Red	- Respirator required

Equipment Accessibility:

Location	Accessibility
X - **Control Room Front Panels**	Accessible
- **Control Room Back Panels**	
- **Hot Shutdown Panels**	
X - **Auxiliary Building**	Accessible
- **Electrical Building**	
- **Containment**	
- **Pump house**	
- **Switchyard**	

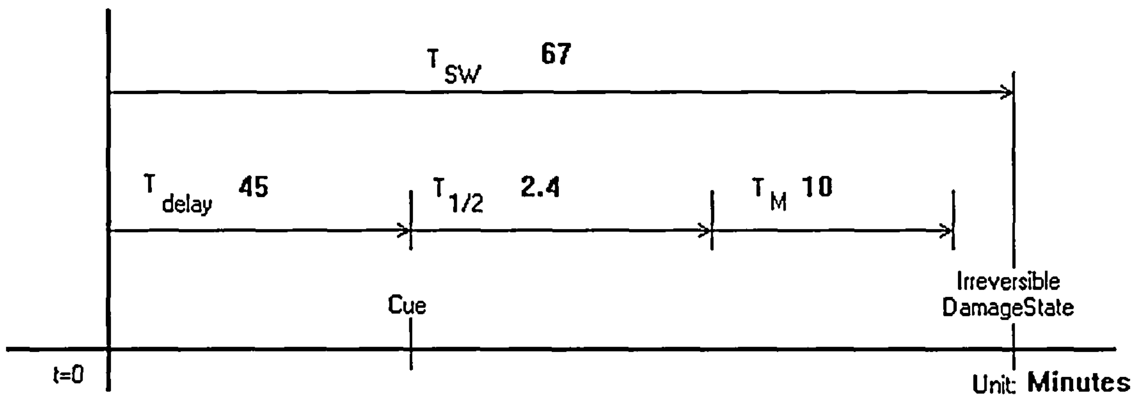
Stress:

- **Optimum (Low)**
- **Moderate**
X - **Extreme (High)**

Cognitive Unrecovered

27A-ORR----FSHE

Cue:
Unable to establish recirculation criteria in step 17 of E-1
47023-K, *Seismic Trouble*, alarms



Reference for System Time: Seismic Analysis

Reference for Manipulation Time: Simulator observation and interviews from 9/02 to 6/03

Duration of time window available for action (TW): 9.60 Minutes

Table 35: 27A-ORR----FSHE COGNITIVE UNRECOVERED

Pc Failure Mechanism	Branch	HEP
Pc_a: Availability of Information	a	neg.
Pc_b: Failure of Attention	h	neg.
Pc_c: Misread/miscommunicate data	a	neg.
Pc_d: Information misleading	a	neg.
Pc_e: Skip a step in procedure	c	3.0e-03
Pc_f: Misinterpret instruction	a	neg.
Pc_g: Misinterpret decision logic	k	neg.
Pc_h: Deliberate violation	a	neg.
Sum of Pc_a through Pc_h = Initial Pc =		3.0e-03

Cognitive Recovery

27A-ORR----FSHE

Table 36: 27A-ORR----FSHE COGNITIVE RECOVERY

	Initial HEP	Self-Review	Extra Crew	STA Review	Shift Change	ERF Review	Recovery Matrix	DF	Multiply HEP By	Override Value	Final Value
Pc_a:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_b:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_c:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_d:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_e:	3.0e-03	X	-	-	-	-	1.0e-01	HD	5.0e-01		1.5e-03
Pc_f:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_g:	neg.	-	-	-	-	-	NC	-	1.0		
Pc_h:	neg.	-	-	-	-	-	NC	-	1.0		
Sum of Pc_a through Pc_h = Initial Pc =											1.5e-03

Recovery Factors Identified:
Trained to perform self review of step prior to transition to next procedure

Execution Unrecovered

27A-ORR----FSHE

Table 37: 27A-ORR----FSHE EXECUTION UNRECOVERED

Step	Omission					Commission					Total	
		Table	Item	Stress	Stress		Table	Item	Stress	Stress	Over	Per
Step No.	HEP	Ref.	Ref.	E/M/O	Value	HEP	Ref.	Ref.	E/M/O	Value	Ride	Step
Step 14.a RNO b.3	4.3E-4	20-7b	1	E	5	1.3E-3	20-13	1	E	5		8.7e-03
Actions: Locally throttle SI-7A(B)						Comments:						

Execution Recovery

27A-ORR----FSHE

Table 38: 27A-ORR----FSHE EXECUTION RECOVERY

Critical Step No.	Recovery Step No.	Action	HEP (Crit)	HEP (Rec)	Dep.	Cond. HEP (Rec)	Total for Step
Step 14.a RNO b.3		Locally throttle SI-7A(B)	8.7e-03				
		Total Unrecovered:	8.7e-03			Total Recovered:	8.7e-03

Appendix F

Seismic Analysis

Attachment 2 - Components Determined Not to be Significant to the Seismic Flooding Model

Components Determined Not to be Significant to the Seismic Flooding Model

Prepared by: Edward D Coen (Signature) Edward D. Coen (Print Name)

10/26/05 (Date)

Reviewed by: ESC for D.L. Moore via telecon 10/27/05 (Signature) David L. Moore (Print Name)

10/27/05 (Date)

Attachment 2 to Appendix F

As discussed in Appendix F, Section 4, some equipment and piping segments had seismic fragilities that were below the screening criterion of 1E-07/year, but were determined to have an insignificant impact on seismic flooding core damage frequency. These components are listed in Table 1 below, and include the justification for not including the components in the seismic flooding models. For example, the piping segment may have insignificant (or no) flow due to its small size, or due to the loss of offsite power (LOSP).

Several of the components are small tanks, with volumes that are insignificant compared to other flooding sources. The volumes of these tanks are documented in Attachment 6 of Appendix F.

System pressure for piping in the Fire Protection system is given in the System Description SD 08, Rev 2, Fire Protection System (FP), 5/23/2002; for the Service Water system in SD 02, Rev 3, Service Water System (SW), 3/10/2004. Flow for the deep well pumps is given in SD 26, Rev 1, Potable Water System (PW), 11/26/03.

All fragilities and descriptions for the components are documented in the fragilities report (Stevenson & Associates, 2005).

Table 1 Components Determined Not to be Significant to the Seismic Flooding Model

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
1	Sulfuric Acid Day Tank	1.35	0.4	300	0	Insignificant volume No flow with LOSP						
2	Caustic Tank	1.64	0.4	5,000	0	Relatively high seismic capacity, with small volume.						
3	Brine Tank	1.5	0.4	564	0	Insignificant volume 200gal liquid (between 50-100% salt)						
4	Hot Water Heater	1.68	0.4	865	140	Small volume Flow based on deep well pump capacity of 140gpm						
5	SG A/B Boric Acid Tanks & Feed Pumps	1.87	0.4	1000	0	Insignificant volume No flow with LOSP, 2 tanks @ 500g usable each						
6	SWPT Coagulant Aid Feed Tank	1.5	0.4	400	0	Insignificant Volume No flow with LOSP						
7	SWPT Coagulant Feed Tank	1.5	0.4	400	0	Insignificant volume No flow with LOSP						
	Piping											
8	Disch from EHC Oil Coolers	1.1	0.5	0	336	correlated 2 lines Flow is not significant even in worst case with CST and RMST failed, since the frequency of this scenario is 9E-8, and there are still 119min for isolation of SW from the control room. Therefore, the contribution to CDF would be less than 1E-8, which is not significant.	OPERM-202-3	SW2002A,B	100	0.8	62.22	336
9	Htr drain pump SW supply lines	1.86	0.5	0	597	correlated 2 lines Flow is not significant even in worst case with CST and RMST failed, since the frequency of this scenario is less than 1E-7, and there are still 67min for isolation of SW from the control room. Therefore, the contribution to CDF would be less than 1E-8, which is not significant.	OPERM-202-3	SW1900A,B	100	1	62.22	597

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
10	Disch from Heater Drain Pumps	1.54	0.5	0	597	correlated lines, max of 2 x 1" Flow is not significant even in worst case with CST and RMST failed, since the frequency of this scenario is less than 1E-7, and there are still 67min for isolation of SW from the control room. Therefore, the contribution to CDF would be less than 1E-8, which is not significant.	OPERM-202-3	SW1911,1921,1931A,B	100	1	62.22	597
11	MD10 drain from hogging jet & gland steam condenser	0.73	0.5	0	0	no flow due to LOSP	OPERM-204, M-212	MD10	0	3	62.22	0
12	Sample connection	0.25	0.5	0	0	no flow due to LOSP	OPERM-204	C500	0	0.5	62.22	0
13	Sample connection	0.25	0.5	0	0	no flow due to LOSP	OPERM-204	C900	0	0.5	62.22	0
14	Filtered water dump from SWPT	0.5	0.5	0	0	no flow from SWPT since upstream NC valves have 1.31g capacity, and no flow from SWPT Filter Feed Pumps due to LOSP	OPERM-204	SW(T)210	0	2	62.22	0
15	3/4" sample connections	0.46	0.5	0	130	correlated 2 lines insign flow from CST (32' head) would not contribute to CST failure scenarios	OPERM-204	MU40A,B	15	0.8	62.22	130
16	1" from 8" header to CD pumps gland seal supply	0.8	0.5	0	140	insign flow from CST (50' head * 0.446psi/ft = 22psi) would not contribute to CST failure scenarios	OPERM-204	MU500	22	1	62.22	140
17	Vent line	0.25	0.5	0	35	insign flow from CST (50'head * 0.446psi/ft = 22psi) would not contribute to CST failure scenarios	OPERM-204	MU500-1	22	0.5	62.22	35
18	Instrumentation in HD system	varies	0.5	0	0	these breaks in 0.5 to 0.75 tubing would release small amounts of steam or water, but would not set off sprinklers, or contribute to water inventory	OPERM-207	various				
19	Piping in HD system	1.87	0.5	0	0	these piping systems are only failed by the moisture separator reheaters, or the main condenser, which are directly included in the model. The heater drain tank is screened based on high capacity.	OPERM-207	various				

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
20	Hydrogen cooler wet sprinkler system	2.2	0.5	0	0	This branch is downstream of a 0.42 capacity branch, so would be subsumed by FP335 failure	OPERM-208					
21	Wet system in CST room	2.2	0.5	0	334	High capacity, low flow: insignificant contributor	OPERM-208	FP311-3	125	1	62.22	334
22	6" supply line to Admin Building	0.98	0.5	0		This branch is in the hallway to the pump station, and would drain down to the pump station. There would not be significant water in any of the safeguards alley rooms to damage equipment.	OPERM-208	FP230				
23	Make-up Water piping (OPERM 209-1, -2)					These systems will have no flow due to LOSP. Supply from SWPT will also have no flow. Therefore, only tank contents can contribute. In many cases, closed valves prevent loss of tank contents. Most piping has high capacity > 1.9g. Exceptions are discussed below.	OPERM-209-1, -2					
24	S/G boric acid tanks supply	1.1	0.5	0	0	piping assumed failed by E. Chem tank block wall no flow, and tanks will not drain since piping enters high on tank wall	OPERM-209-2	MU640-3				
25	header to two bed acid dilution	0.25	0.5	0	0	glass flow indicator in piping no flow in piping	OPERM-209-1					
26	Potable water system piping		0.5	0	140	This system is fed by the 2 deep well pumps. Only one pump is fed by the TSC DG, with the other on offsite power. It has maximum flow of 140gpm, which is not significant. All piping has capacity >1.5g, except for a level gauge on the hydropneumatic tank, which is insignificant flow.	OPERM-209-3					

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
27	CW fan coil piping	0.77-1.77	0.5	0	0	From a walkdown, this piping comes from the bottom of the waterboxes to the strainer and pump on the floor of the TB, and then up high to the overhead, and back down to the fan coolers. The two weakest points are after the piping in the overhead, in the crossover (0.77g) and the discharge to the standpipe (0.99g). In addition, most of the circ water will be drained out of the main CW discharge. Therefore, although there could be some discharge of CW in a break, it will not be significant.	OPERM-215					
28	Secondary sampling system piping		0.5	0		All piping is 4.6g, except for 3/4" and 3/8" tubing from sample coolers to Analytical Instrumentation Panel Cooler rack, which has 0.05g based on interactions. There is insignificant flow from these lines.	OPERM-219	MU221-3, MU241-2				
29	SG Blowdown Treatment	varies	0.5	0		All of the piping has high capacity. Only the SGBT hold up and monitor tanks have non-screened capacity, and are included directly in the model.	OPERM-368					
30	To CW pumps, 4" supply from SWPT cartridge filters, Crossover	1.31	0.5	0		This piping is downstream from 3 other pipe segments of the same or larger size that have lower capacity (1.07), so it is very low probability that the others would be successful, and this piping fail.	OPERM-394	SW(T)202, SW(T)226, SW(T)205				

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
31	Various SW(T) piping that has no or low flow, and would drain only small tanks	varies	0.5	0		The following lines would have insignificant flows or tank drainage: CI2405, SW2822-1, SW2822, SW(T)100A-E, SW(T)225, SW(T)105A-E,SW(T)105F&G, SW(T)106F-G, SW(T)50F&G, SW(T)340/330, SW(T)315, SW(T)325, CI2100, CI2101, CI2000A/B, CI2001A, CI2000B, SW(T)306A/B, SW(T)44, sample lines, SW(T)40A-E, SW(T)104A-E, SW(T)41, SW(T)104F&G, SW(T)120, SW(T)45, SW(T)402A/B, SW(T)402A/B, TB sump to settling basin, SW(T)11A/B, SW(T)101, SW(T)103, SW(T)10A/B/C, SW(T)20	OPERM-394					
32	Flocculator piping	varies	0.5	0		These lines are usually isolated by MOV SW2811, which is a timed valve open 10 min every 8 hours for cleaning the waste sludge pumps (see Attachment 7). Given the low probability of an open MOV (0.02), and since these are downstream of SW(T)2810 and a flow limiting orifice, the potential for flow in these lines is not significant.	OPERM-394	SW(T)400A-C, SW(T)490, SW(T)410SW(T)411, SW(T)412,				
33	Line from potable water break tank to standpipe	0.01	0.5	0		*glass flow indicator* limited to 140gpm from deep well pump	OPERM-394					
34	Steam Generator Blowdown	high	0.5	0		screened high capacity except for main condenser, which is in the model.	OPERM-436					
35	Water treatment (MUP) piping		0.5	0		*Piping has high capacity except* 3/8" plastic tubing, which has insignificant flow.	OPERM-444, OPERM-1274	SW(T)131				

	Tanks and Equipment	Am (g)	Bc	Volume (gal)	Flow (gpm)	Reason to Exclude From Model	Flow Diag	1st Valve	Pres (psi)	Dia (in)	Density	Flow Calc
36	SW fan coil discharge piping interaction	1.76	0.5	0		The following fan coil discharge lines could be damaged by failure of the FP275 piping. However, the flows would be limited to 195gpm, which is not significant compared to the 6000gpm of the FP275 piping. SW1858 (10gpm), SW722/711B (60gpm), SW653 (25gpm), SW721B (20gpm), SW712A (60gpm), SW722A (20gpm). Flows are from System Description SD 16, Rev 2, Turbine Building and Screenhouse Ventilation System (TAV), 11/17/2002.	OPERM-606					

Appendix F

Seismic Analysis

Attachment 3 – Hotwell and Main Condenser Volumes

Hotwell and Main Condenser Volumes

Prepared by: For D L Moore Via Phone EDC ______ David L Moore ______
Signature | Print Name

10/27/05 ______
Date

Reviewed by: Edward D Coen ______ Edward D Coen ______
Signature | Print Name

10/27/05 ______
Date

David L Moore Consulting

21 October 2005 DLMC-05-33

TO: Kewaunee Seismic Flooding File

FROM: David Moore

SUBJECT: Calculation of Spill Volumes of Main Condenser Hotwell and CW Tubes

1. Hotwells: Dimensions of the hotwell were taken rom A-203 General Arrangement, Turbine and Administration Building Basement Floor, Rev AW

28' 4" (N-S dimension) x 38' (E-W dimension)

From System Description SD 03, Condensate System (CD), Rev 3, 7/1/02:

9.75" = 14%, and normal level = 69%

[9.75" / (12"/ft)] * [69 / 14] = 4.0' is equivalent to normal level

28.33' * 38' * 4' * 2 condensers * 7.48 gal/f^3 = 64,420gal

However, the main condenser hotwell is recessed into the TB basement floor about 1' (based on walkdown measurement), so only 3' of the hotwell would contribute to the flood.

Therefore, (64,420g * 3) / 4 = **48,320 gal**

2. Circ Water in Condenser Tubes: System Description SD 04, Circulating Water(CW), Rev 4, 8/12/04:

401,200gpm CW flow; 6.38fps CW velocity through tubes; 40' overall tube length; 1" diameter tubes; 26,232 + 664 + 1904 tubes

40' / 6.38fps = 6.27 s for the flow to go from start to end of CW tube

(401,200gpm * 6.27s) / (60s/min) = **41,920gal**

David L. Moore Consulting • 9721 SE 43rd St. • Mercer Island, WA 98040 • (206) 818-1570

Appendix F

Seismic Analysis

Attachment 4 – SHIP Output Files - Baseline

SHIP Output Files - Baseline

Prepared by: Edward D Coen (Signature) Edward D. Coen (Print Name)

10/28/05
Date

Reviewed by: for David Moor by telephone EDC (Signature) David L Moore (Print Name)

10/28/05
Date

Flooding SDP
Date: 10/28/2005
Time: 09:27:07.60

```
*****************************************************************************
*                                                                           *
*                                                                           *
*                                  SHIP                                     *
*                    Seismic Hazard Integration Package                     *
*                                                                           *
*                              Developed by                                 *
*                  Jack R. Benjamin and Associates, Inc.                    *
*                          Menlo Park, California                           *
*                                                                           *
*                             Copyright 1996                                *
*                              Version 1.02                                 *
*                         Release Date: 07/02/96                            *
*                                                                           *
*  Code: SHIP                                        Code No. : S001-102    *
*                                             Serial No. : S001-102-006Q    *
*                                                                           *
*             This code has been QA verified and complies with              *
*             the requirements of 10 CFR 50 Appendix B                      *
*                                                                           *
*****************************************************************************
```

Problem : Kewaunee Power Station
Case : Seismic PRA
Flooding SDP

Analysis Parameters

No. of Lognormal Fragilities	(NCOMPS)	:	29
No. of Non-Lognormal Fragilities	(NCMPNLN)	:	0
No. of Supercomponents	(NSUPCMP)	:	0
No. of Random Failures	(NR)	:	14
Ground Motion Measure (units)	(AHEAD)	:	pga(units:g)
Minimum Ground Motion Level	(AMIN)	:	.050
Maximum Ground Motion Level	(AMAX)	:	1.590
Increment on Ground Motion	(ADELT)	:	.020

Analysis Options Selected

Best Estimate Analysis	===>	IBEST = 1
Sequences Analyzed	===>	NSEQ = 24
Integration of Hazard and Fragility Curves done	===>	IINTGRT = 1

Input Files

File Description		Filename
Names File	:	seiflood.nam
Basic Input	:	Seiflood.inp
Component Fragilities	:	Seiflood.cmp
System Model	:	Seiflood.stm
Accident Sequences	:	Seiflood.seq
Seismic Hazard	:	EPRI89.haz

Summary of Output Files

File Description	Write to Disk?	Filename
SHIP Basic Output	Y	Seiflood.BAS
Error Messages	Y	Seiflood.ERR
Component Fragilities	Y	Seiflood.CFC
System Fragilities	Y	Seiflood.SYC
Sequence Fragilities	Y	Seiflood.SFC
Percent Contribution of each Ground Motion Level to the Mean Risk	Y	Seiflood.APC

Summary of Plot Files

File Description	Write to Disk?	Filename
Hazard Curve(s)	Y	Seiflood.HZP
Fragility Curves for Sequences and Damage States	Y	Seiflood.SQP
System Fragility Curves	Y	Seiflood.SYP

Seismic Hazard Data
(Hazard Curves Defined at 15 Points)

Curve No.	Probability Weight	pga(units:g) .011	.027	.110	.142	.221	.265	.327	.499
1	1.000	2.100E-03	1.304E-03	1.100E-04	8.120E-05	3.800E-05	2.837E-05	1.874E-05	5.900E-06

Curve No.	Probability Weight	pga(units:g) .555	.633	.846	.931	1.121	1.276	1.590
1	1.000	4.408E-06	2.936E-06	9.600E-07	6.500E-07	2.700E-07	1.660E-07	6.200E-08

Seismic Lognormal Fragility Parameters

Median Capacity Defined in Terms of pga(units:g)

Number	Component Name	Median	Beta-R	Beta-U	Beta-C	HCLPF	Cutoff
1	S-PP-CDPSP---FA	2.200	.500	.000	.500	.964	.000
2	S-PP-FP201---FA	1.380	.500	.000	.500	.605	.000
3	S-PP-FP250---FA	1.710	.500	.000	.500	.749	.000
4	S-PP-FP270---FA	1.970	.500	.000	.500	.863	.000
5	S-PP-FP275---FA	1.760	.500	.000	.500	.771	.000
6	S-PP-FP275-1-FA	1.930	.500	.000	.500	.846	.000
7	S-PP-FP276---FA	1.280	.500	.000	.500	.561	.000
8	S-PP-FP280---FA	1.670	.500	.000	.500	.732	.000
9	S-PP-FP320---FA	1.080	.500	.000	.500	.473	.000
10	S-PP-FP321-1-FA	2.200	.500	.000	.500	.964	.000
11	S-PP-FP331---FA	1.310	.500	.000	.500	.574	.000
12	S-PP-FP335---FA	.420	.500	.000	.500	.184	.000
13	S-PP-FP345---FA	2.030	.500	.000	.500	.890	.000
14	S-PP-FP370---FA	1.310	.500	.000	.500	.574	.000
15	S-PP-FP380A--FA	2.020	.500	.000	.500	.885	.000
16	S-PP-SW1801ABFA	1.800	.500	.000	.500	.789	.000
17	S-PP-SW2200--FA	1.370	.500	.000	.500	.600	.000
18	S-PP-SW2500--FA	1.800	.500	.000	.500	.789	.000
19	S-PP-SW2501ABFA	1.530	.500	.000	.500	.670	.000
20	S-PP-SW2800--FA	1.070	.500	.000	.500	.469	.000
21	S-PP-SW2810--FA	1.070	.500	.000	.500	.469	.000
22	S-PP-SW2820--FA	1.070	.500	.000	.500	.469	.000
23	S-PP-SW2900--FA	1.260	.500	.000	.500	.552	.000
24	S-PPFP341-123FA	1.310	.500	.000	.500	.574	.000
25	S-TK-CNDSR---FA	1.870	.400	.000	.400	.967	.000
26	S-TK-CST-----FA	.670	.400	.000	.400	.346	.000
27	S-TK-MSR-----FA	1.870	.400	.000	.400	.967	.000
28	S-TK-RMST----FA	.540	.400	.000	.400	.279	.000
29	S-TK-SGBT----FA	1.410	.400	.000	.400	.729	.000

Random Failures

No.	Component Name	Mean Failure Rate
1	02-SW4A-B--FSHE	2.50E-02
2	08-FPISO30-F-HE	4.90E-01
3	08-FPISO40-F-HE	5.90E-02
4	08-FPISO57-F-HE	3.10E-02
5	ISOL-FP-S15-SUC	8.22E-01
6	ISOL-FP-S2-SUC	9.61E-01
7	ISOL-FP-S8-SUC	9.56E-01
8	ISOL-FPSW-S10-SC	8.61E-01
9	ISOL-FPSW-S12-SC	4.02E-01
10	ISOL-FPSW-S21-SC	7.81E-01
11	S-SYS-FAIL---FA	9.54E-02
12	SX-SWFP-34-F-HE	3.00E-01
13	SX-SWFP-40-F-HE	1.50E-01
14	SX-SWFP-57-F-HE	5.60E-02

Seismic Systems Analysis

	Computed	Available On File	Total
No. of Systems:	22	0	22
No. of Sequences:	24	0	24
No. of Damage States:	1	-	1

Systems Summary

No.	System Name	Available on disk? Y/N	Filename	To be analyzed? Y/N	To be stored? Y/N	Filename
1	CST	N	-	Y	Y	CST.FRG
2	FP	N	-	Y	Y	FP.FRG
3	FP335	N	-	Y	Y	FP335.FRG
4	HCE	N	-	Y	Y	HCE.FRG
5	ISOFPS15	N	-	Y	Y	ISOFPS15.FRG
6	ISOFPS16	N	-	Y	Y	ISOFPS16.FRG
7	ISOLFP57	N	-	Y	Y	ISOLFP57.FRG
8	ISOLFPS2	N	-	Y	Y	ISOLFPS2.FRG
9	ISOLFPS3	N	-	Y	Y	ISOLFPS3.FRG
10	ISOLFPS8	N	-	Y	Y	ISOLFPS8.FRG
11	ISOLFPS9	N	-	Y	Y	ISOLFPS9.FRG
12	ISOLSW	N	-	Y	Y	ISOLSW.FRG
13	ISOSFS12	N	-	Y	Y	ISOSFS12.FRG
14	ISOSFS13	N	-	Y	Y	ISOSFS13.FRG
15	ISOSFS21	N	-	Y	Y	ISOSFS21.FRG
16	ISOSFS22	N	-	Y	Y	ISOSFS22.FRG
17	ISOSWM10	N	-	Y	Y	ISOSWM10.FRG
18	ISOSWM11	N	-	Y	Y	ISOSWM11.FRG
19	ISOSWS24	N	-	Y	Y	ISOSWS24.FRG
20	RMST	N	-	Y	Y	RMST.FRG
21	SW	N	-	Y	Y	SW.FRG
22	SYSFLRS	N	-	Y	Y	SYSFLRS.FRG

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
1	SEIFLD02	Y	SEIFLD02.FRG	8	\HCE	\CST	\RMST
					\FP335	\SW	FP
					ISOLFPS2	SYSFLRS	
2	SEIFLD03	Y	SEIFLD03.FRG	6	\HCE	\CST	\RMST
					\FP335	\SW	ISOLFPS3
3	SEIFLD04	Y	SEIFLD04.FRG	7	\HCE	\CST	\RMST
					\FP335	SW	\ISOLSW
					SYSFLRS		
4	SEIFLD05	Y	SEIFLD05.FRG	6	\HCE	\CST	\RMST
					\FP335	SW	ISOLSW
5	SEIFLD06	Y	SEIFLD06.FRG	8	\HCE	\CST	\RMST
					FP335	\SW	\FP
					\ISOLFP57	SYSFLRS	
6	SEIFLD07	Y	SEIFLD07.FRG	7	\HCE	\CST	\RMST
					FP335	\SW	\FP
					ISOLFP57		
7	SEIFLD08	Y	SEIFLD08.FRG	8	\HCE	\CST	\RMST
					FP335	\SW	FP
					ISOLFPS8	SYSFLRS	
8	SEIFLD09	Y	SEIFLD09.FRG	6	\HCE	\CST	\RMST
					FP335	\SW	ISOLFPS9
9	SEIFLD10	Y	SEIFLD10.FRG	8	\HCE	\CST	\RMST
					FP335	SW	\FP
					ISOSWM10	SYSFLRS	
10	SEIFLD11	Y	SEIFLD11.FRG	6	\HCE	\CST	\RMST
					FP335	\FP	ISOSWM11

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
11	SEIFLD12	Y	SEIFLD12.FRG	8	\HCE FP335 ISOSFS12	\CST SW SYSFLRS	\RMST FP
12	SEIFLD13	Y	SEIFLD13.FRG	5	\HCE FP335	\CST ISOSFS13	\RMST
13	SEIFLD15	Y	SEIFLD15.FRG	8	\HCE \FP335 ISOFPS15	\CST \SW SYSFLRS	RMST FP
14	SEIFLD16	Y	SEIFLD16.FRG	6	\HCE \FP335	\CST \SW	RMST ISOFPS16
15	SEIFLD17	Y	SEIFLD17.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	RMST \ISOLSW
16	SEIFLD18	Y	SEIFLD18.FRG	6	\HCE \FP335	\CST SW	RMST ISOLSW
17	SEIFLD19	Y	SEIFLD19.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	RMST \FP
18	SEIFLD20	Y	SEIFLD20.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	RMST \FP
19	SEIFLD21	Y	SEIFLD21.FRG	8	\HCE FP335 ISOSFS21	\CST \SW SYSFLRS	RMST FP
20	SEIFLD22	Y	SEIFLD22.FRG	6	\HCE FP335	\CST \SW	RMST ISOSFS22

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
21	SEIFLD23	Y	SEIFLD23.FRG	7	\HCE	\CST	RMST
					FP335	SW	\ISOSWS24
					SYSFLRS		
22	SEIFLD24	Y	SEIFLD24.FRG	6	\HCE	\CST	RMST
					FP335	SW	ISOSWS24
23	SEIFLD25	Y	SEIFLD25.FRG	2	\HCE	CST	
24	SEIFLD26	Y	SEIFLD26.FRG	1	HCE		

Damage State Summary

No.	Damage State Name	To be stored? Y/N	Filename	No. of Sequences	Sequence Names		
1	ALL	Y	ALL.FRG	24	SEIFLD02	SEIFLD03	SEIFLD04
					SEIFLD05	SEIFLD06	SEIFLD07
					SEIFLD08	SEIFLD09	SEIFLD10
					SEIFLD11	SEIFLD12	SEIFLD13
					SEIFLD15	SEIFLD16	SEIFLD17
					SEIFLD18	SEIFLD19	SEIFLD20
					SEIFLD21	SEIFLD22	SEIFLD23
					SEIFLD24	SEIFLD25	SEIFLD26

Best Estimate of Sequence Frequencies

No.	Sequence	Annual Frequency
1	SEIFLD02	4.28E-08
2	SEIFLD03	1.83E-08
3	SEIFLD04	6.62E-08
4	SEIFLD05	1.78E-08
5	SEIFLD06	8.36E-07
6	SEIFLD07	2.80E-07
7	SEIFLD08	4.16E-08
8	SEIFLD09	1.99E-08
9	SEIFLD10	4.71E-08
10	SEIFLD11	6.94E-08
11	SEIFLD12	7.08E-09
12	SEIFLD13	1.10E-07
13	SEIFLD15	1.38E-08
14	SEIFLD16	3.14E-08
15	SEIFLD17	2.83E-08
16	SEIFLD18	7.62E-09
17	SEIFLD19	1.37E-07
18	SEIFLD20	4.60E-08
19	SEIFLD21	2.72E-08
20	SEIFLD22	7.98E-08
21	SEIFLD23	6.67E-08
22	SEIFLD24	1.23E-07
23	SEIFLD25	3.97E-06
24	SEIFLD26	4.90E-07

Best Estimate of Damage State Frequencies

No.	Damage State	Annual Frequency
1	ALL	6.58E-06

No.	Damage State Name	Damage State Risk	No. of Sequences	Contributing Sequence Risks (in decreasing order of importance)			
1	ALL	6.58E-06	24	No.	Sequence Name	Sequence Risk	% of Total
				1	SEIFLD25	3.97E-06	60.35
				2	SEIFLD06	8.36E-07	12.71
				3	SEIFLD26	4.90E-07	7.44
				4	SEIFLD07	2.80E-07	4.26
				5	SEIFLD19	1.37E-07	2.09
				6	SEIFLD24	1.23E-07	1.88
				7	SEIFLD13	1.10E-07	1.68
				8	SEIFLD22	7.98E-08	1.21
				9	SEIFLD11	6.94E-08	1.06
				10	SEIFLD23	6.67E-08	1.01
				11	SEIFLD04	6.62E-08	1.01
				12	SEIFLD10	4.71E-08	.72
				13	SEIFLD20	4.60E-08	.70
				14	SEIFLD02	4.28E-08	.65
				15	SEIFLD08	4.16E-08	.63
				16	SEIFLD16	3.14E-08	.48
				17	SEIFLD17	2.83E-08	.43
				18	SEIFLD21	2.72E-08	.41
				19	SEIFLD09	1.99E-08	.30
				20	SEIFLD03	1.83E-08	.28
				21	SEIFLD05	1.78E-08	.27
				22	SEIFLD15	1.38E-08	.21
				23	SEIFLD18	7.62E-09	.12
				24	SEIFLD12	7.08E-09	.11
					Sum:	6.58E-06	100.00

Summary of Plant Level Fragility

Conditional Probability of Failure	pga(units:g)
.050	.292
.150	.389
.250	.453
.500	.588
.750	.758
.850	.874
.950	1.095
HCLPF (See note)	.203

Note: Best Estimate Case HCLPF

HCLPF = Ground motion level for which there is a high confidence of a low probability of failure

= Amed * exp(-2.3 * Beta)
(Assuming the plant fragility is Lognormally distributed, the HCLPF corresponds to a 1.072% probability of failure)

```
***************************************************************************
*                                                                         *
*                                                                         *
*                                SHIP                                     *
*                  Seismic Hazard Integration Package                     *
*                                                                         *
*                            Developed by                                 *
*                 Jack R. Benjamin and Associates, Inc.                   *
*                        Menlo Park, California                           *
*                                                                         *
*                           Copyright 1996                                *
*                            Version 1.02                                 *
*                        Release Date: 07/02/96                           *
*                                                                         *
*  Code: SHIP                                       Code No. : S001-102   *
*                                            Serial No. : S001-102-006Q   *
*                                                                         *
*             This code has been QA verified and complies with            *
*             the requirements of 10 CFR 50 Appendix B                    *
*                                                                         *
***************************************************************************
```

Problem : Kewaunee Power Station
Case : Seismic PRA
Flooding Sucess Test

Analysis Parameters

No. of Lognormal Fragilities	(NCOMPS)	:	29
No. of Non-Lognormal Fragilities	(NCMPNLN)	:	0
No. of Supercomponents	(NSUPCMP)	:	0
No. of Random Failures	(NR)	:	14
Ground Motion Measure (units)	(AHEAD)	:	pga(units:g)
Minimum Ground Motion Level	(AMIN)	:	.050
Maximum Ground Motion Level	(AMAX)	:	1.590
Increment on Ground Motion	(ADELT)	:	.020

Analysis Options Selected

Best Estimate Analysis	===>	IBEST = 1
Sequences Analyzed	===>	NSEQ = 12
Integration of Hazard and Fragility Curves done	===>	IINTGRT = 1

Input Files		
File Description		Filename
Names File	:	seiflsuc.nam
Basic Input	:	Seiflsuc.inp
Component Fragilities	:	Seiflood.cmp
System Model	:	Seiflood.stm
Accident Sequences	:	Seiflsuc.seq
Seismic Hazard	:	EPRI89.haz

Summary of Output Files

File Description	Write to Disk?	Filename
SHIP Basic Output	Y	Seiflsuc.BAS
Error Messages	Y	Seiflsuc.ERR
Component Fragilities	Y	Seiflsuc.CFC
System Fragilities	Y	Seiflsuc.SYC
Sequence Fragilities	Y	Seiflsuc.SFC
Percent Contribution of each Ground Motion Level to the Mean Risk	Y	Seiflsuc.APC

Summary of Plot Files

File Description	Write to Disk?	Filename
Hazard Curve(s)	Y	Seiflsuc.HZP
Fragility Curves for Sequences and Damage States	Y	Seiflsuc.SQP
System Fragility Curves	Y	Seiflsuc.SYP

Seismic Hazard Data
(Hazard Curves Defined at 15 Points)

Curve No.	Probability Weight	pga(units:g) .011	.027	.110	.142	.221	.265	.327	.499
1	1.000	2.100E-03	1.304E-03	1.100E-04	8.120E-05	3.800E-05	2.837E-05	1.874E-05	5.900E-06

Curve No.	Probability Weight	pga(units:g) .555	.633	.846	.931	1.121	1.276	1.590
1	1.000	4.408E-06	2.936E-06	9.600E-07	6.500E-07	2.700E-07	1.660E-07	6.200E-08

Seismic Lognormal Fragility Parameters

Median Capacity Defined in Terms of pga(units:g)

Number	Component Name	Median	Beta-R	Beta-U	Beta-C	HCLPF	Cutoff
1	S-PP-CDPSP---FA	2.200	.500	.000	.500	.964	.000
2	S-PP-FP201---FA	1.380	.500	.000	.500	.605	.000
3	S-PP-FP250---FA	1.710	.500	.000	.500	.749	.000
4	S-PP-FP270---FA	1.970	.500	.000	.500	.863	.000
5	S-PP-FP275---FA	1.760	.500	.000	.500	.771	.000
6	S-PP-FP275-1-FA	1.930	.500	.000	.500	.846	.000
7	S-PP-FP276---FA	1.280	.500	.000	.500	.561	.000
8	S-PP-FP280---FA	1.670	.500	.000	.500	.732	.000
9	S-PP-FP320---FA	1.080	.500	.000	.500	.473	.000
10	S-PP-FP321-1-FA	2.200	.500	.000	.500	.964	.000
11	S-PP-FP331---FA	1.310	.500	.000	.500	.574	.000
12	S-PP-FP335---FA	.420	.500	.000	.500	.184	.000
13	S-PP-FP345---FA	2.030	.500	.000	.500	.890	.000
14	S-PP-FP370---FA	1.310	.500	.000	.500	.574	.000
15	S-PP-FP380A--FA	2.020	.500	.000	.500	.885	.000
16	S-PP-SW1801ABFA	1.800	.500	.000	.500	.789	.000
17	S-PP-SW2200--FA	1.370	.500	.000	.500	.600	.000
18	S-PP-SW2500--FA	1.800	.500	.000	.500	.789	.000
19	S-PP-SW2501ABFA	1.530	.500	.000	.500	.670	.000
20	S-PP-SW2800--FA	1.070	.500	.000	.500	.469	.000
21	S-PP-SW2810--FA	1.070	.500	.000	.500	.469	.000
22	S-PP-SW2820--FA	1.070	.500	.000	.500	.469	.000
23	S-PP-SW2900--FA	1.260	.500	.000	.500	.552	.000
24	S-PPFP341-123FA	1.310	.500	.000	.500	.574	.000
25	S-TK-CNDSR---FA	1.870	.400	.000	.400	.967	.000
26	S-TK-CST-----FA	.670	.400	.000	.400	.346	.000
27	S-TK-MSR-----FA	1.870	.400	.000	.400	.967	.000
28	S-TK-RMST----FA	.540	.400	.000	.400	.279	.000
29	S-TK-SGBT----FA	1.410	.400	.000	.400	.729	.000

Random Failures

No.	Component Name	Mean Failure Rate
1	02-SW4A-B--FSHE	2.50E-02
2	08-FPISO30-F-HE	4.90E-01
3	08-FPISO40-F-HE	5.90E-02
4	08-FPISO57-F-HE	3.10E-02
5	ISOL-FP-S15-SUC	8.22E-01
6	ISOL-FP-S2-SUC	9.61E-01
7	ISOL-FP-S8-SUC	9.56E-01
8	ISOL-FPSW-S10-SC	8.61E-01
9	ISOL-FPSW-S12-SC	4.02E-01
10	ISOL-FPSW-S21-SC	7.81E-01
11	S-SYS-FAIL---FA	9.54E-02
12	SX-SWFP-34-F-HE	3.00E-01
13	SX-SWFP-40-F-HE	1.50E-01
14	SX-SWFP-57-F-HE	5.60E-02

Seismic Systems Analysis

	Computed	Available On File	Total
No. of Systems:	22	0	22
No. of Sequences:	12	0	12
No. of Damage States:	0	-	0

Systems Summary

No.	System Name	Available on disk? Y/N	Filename	To be analyzed? Y/N	To be stored? Y/N	Filename
1	CST	N	-	Y	Y	CST.FRG
2	FP	N	-	Y	Y	FP.FRG
3	FP335	N	-	Y	Y	FP335.FRG
4	HCE	N	-	Y	Y	HCE.FRG
5	ISOFPS15	N	-	Y	Y	ISOFPS15.FRG
6	ISOFPS16	N	-	Y	Y	ISOFPS16.FRG
7	ISOLFP57	N	-	Y	Y	ISOLFP57.FRG
8	ISOLFPS2	N	-	Y	Y	ISOLFPS2.FRG
9	ISOLFPS3	N	-	Y	Y	ISOLFPS3.FRG
10	ISOLFPS8	N	-	Y	Y	ISOLFPS8.FRG
11	ISOLFPS9	N	-	Y	Y	ISOLFPS9.FRG
12	ISOLSW	N	-	Y	Y	ISOLSW.FRG
13	ISOSFS12	N	-	Y	Y	ISOSFS12.FRG
14	ISOSFS13	N	-	Y	Y	ISOSFS13.FRG
15	ISOSFS21	N	-	Y	Y	ISOSFS21.FRG
16	ISOSFS22	N	-	Y	Y	ISOSFS22.FRG
17	ISOSWM10	N	-	Y	Y	ISOSWM10.FRG
18	ISOSWM11	N	-	Y	Y	ISOSWM11.FRG
19	ISOSWS24	N	-	Y	Y	ISOSWS24.FRG
20	RMST	N	-	Y	Y	RMST.FRG
21	SW	N	-	Y	Y	SW.FRG
22	SYSFLRS	N	-	Y	Y	SYSFLRS.FRG

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
1	SEIFLD2	Y	SEIFLD2.FRG	6	\HCE \FP335	\CST \SW	\RMST FP
2	SEIFLD2F	Y	SEIFLD2F.FRG	6	\HCE \FP335	\CST \SW	\RMST ISOLFPS3
3	SEIFLD8	Y	SEIFLD8.FRG	6	\HCE FP335	\CST \SW	\RMST FP
4	SEIFLD8F	Y	SEIFLD8F.FRG	6	\HCE FP335	\CST \SW	\RMST ISOLFPS9
5	SEIFL10	Y	SEIFL10.FRG	5	\HCE FP335	\CST SW	\RMST
6	SEIFL10F	Y	SEIFL10F.FRG	5	\HCE FP335	\CST ISOSWM11	\RMST
7	SEIFLD12	Y	SEIFLD12.FRG	6	\HCE FP335	\CST SW	\RMST FP
8	SEIFLD12F	Y	SEIFLD12.FRG	5	\HCE FP335	\CST ISOSFS13	\RMST
9	SEIFL15	Y	SEIFL15.FRG	6	\HCE \FP335	\CST \SW	RMST FP
10	SEIFL15F	Y	SEIFL15F.FRG	6	\HCE \FP335	\CST \SW	RMST ISOFPS16
11	SEIFL21	Y	SEIFL21.FRG	6	\HCE FP335	\CST \SW	RMST FP
12	SEIFL21F	Y	SEIFL21F.FRG	6	\HCE FP335	\CST \SW	RMST ISOSFS22

Best Estimate of Sequence Frequencies

No.	Sequence	Annual Frequency
1	SEIFLD2	4.66E-07
2	SEIFLD2F	1.83E-08
3	SEIFLD8	4.56E-07
4	SEIFLD8F	1.99E-08
5	SEIFL10	7.58E-07
6	SEIFL10F	1.05E-07
7	SEIFLD12	1.84E-07
8	SEIFLD12F	1.10E-07
9	SEIFL15	1.76E-07
10	SEIFL15F	3.14E-08
11	SEIFL21	3.65E-07
12	SEIFL21F	7.98E-08

Appendix F

Seismic Analysis

Attachment 5 – SHIP Output Files - Sensitivity

SHIP Output Files - Sensitivity

Prepared by: Edward D. Coen (signature) Edward D. Coen
Signature Print Name

10/28/05
Date

Reviewed by: For David L Moore by phone David L. Moore
Signature Print Name

10/28/05
Date

HEPS with < 30% Time
Date: 10/28/2005
Time: 09:28:01.37

```
*****************************************************************************
*                                                                           *
*                                                                           *
*                                   SHIP                                    *
*                     Seismic Hazard Integration Package                    *
*                                                                           *
*                               Developed by                                *
*                   Jack R. Benjamin and Associates, Inc.                   *
*                           Menlo Park, California                          *
*                                                                           *
*                              Copyright 1996                               *
*                               Version 1.02                                *
*                         Release Date: 07/02/96                            *
*                                                                           *
*  Code: SHIP                                       Code No. : S001-102     *
*                                             Serial No. : S001-102-006Q    *
*                                                                           *
*           This code has been QA verified and complies with                *
*           the requirements of 10 CFR 50 Appendix B                        *
*                                                                           *
*****************************************************************************
```

Problem : Kewaunee Power Station
Case : Seismic PRA
HEPS with < 30% Time

Analysis Parameters

No. of Lognormal Fragilities	(NCOMPS)	:	29
No. of Non-Lognormal Fragilities	(NCMPNLN)	:	0
No. of Supercomponents	(NSUPCMP)	:	0
No. of Random Failures	(NR)	:	14
Ground Motion Measure (units)	(AHEAD)	:	pga(units:g)
Minimum Ground Motion Level	(AMIN)	:	.050
Maximum Ground Motion Level	(AMAX)	:	1.590
Increment on Ground Motion	(ADELT)	:	.020

Analysis Options Selected

Best Estimate Analysis	===>	IBEST = 1
Sequences Analyzed	===>	NSEQ = 24
Integration of Hazard and Fragility Curves done	===>	IINTGRT = 1

Input Files

File Description		Filename
Names File	:	hep30.nam
Basic Input	:	HEP30.inp
Component Fragilities	:	HEP30.cmp
System Model	:	Seiflood.stm
Accident Sequences	:	Seiflood.seq
Seismic Hazard	:	EPRI89.haz

Summary of Output Files

File Description	Write to Disk?	Filename
SHIP Basic Output	Y	HEP30.BAS
Error Messages	Y	HEP30.ERR
Component Fragilities	Y	HEP30.CFC
System Fragilities	Y	HEP30.SYC
Sequence Fragilities	Y	HEP30.SFC
Percent Contribution of each Ground Motion Level to the Mean Risk	Y	HEP30.APC

Summary of Plot Files

File Description	Write to Disk?	Filename
Hazard Curve(s)	Y	HEP30.HZP
Fragility Curves for Sequences and Damage States	Y	HEP30.SQP
System Fragility Curves	Y	HEP30.SYP

Seismic Hazard Data
(Hazard Curves Defined at 15 Points)

Curve No.	Probability Weight	pga(units:g) .011	.027	.110	.142	.221	.265	.327	.499
1	1.000	2.100E-03	1.304E-03	1.100E-04	8.120E-05	3.800E-05	2.837E-05	1.874E-05	5.900E-06

Curve No.	Probability Weight	pga(units:g) .555	.633	.846	.931	1.121	1.276	1.590
1	1.000	4.408E-06	2.936E-06	9.600E-07	6.500E-07	2.700E-07	1.660E-07	6.200E-08

Seismic Lognormal Fragility Parameters

Median Capacity Defined in Terms of pga(units:g)

Number	Component Name	Median	Beta-R	Beta-U	Beta-C	HCLPF	Cutoff
1	S-PP-CDPSP---FA	2.200	.500	.000	.500	.964	.000
2	S-PP-FP201---FA	1.380	.500	.000	.500	.605	.000
3	S-PP-FP250---FA	1.710	.500	.000	.500	.749	.000
4	S-PP-FP270---FA	1.970	.500	.000	.500	.863	.000
5	S-PP-FP275---FA	1.760	.500	.000	.500	.771	.000
6	S-PP-FP275-1-FA	1.930	.500	.000	.500	.846	.000
7	S-PP-FP276---FA	1.280	.500	.000	.500	.561	.000
8	S-PP-FP280---FA	1.670	.500	.000	.500	.732	.000
9	S-PP-FP320---FA	1.080	.500	.000	.500	.473	.000
10	S-PP-FP321-1-FA	2.200	.500	.000	.500	.964	.000
11	S-PP-FP331---FA	1.310	.500	.000	.500	.574	.000
12	S-PP-FP335---FA	.420	.500	.000	.500	.184	.000
13	S-PP-FP345---FA	2.030	.500	.000	.500	.890	.000
14	S-PP-FP370---FA	1.310	.500	.000	.500	.574	.000
15	S-PP-FP380A--FA	2.020	.500	.000	.500	.885	.000
16	S-PP-SW1801ABFA	1.800	.500	.000	.500	.789	.000
17	S-PP-SW2200--FA	1.370	.500	.000	.500	.600	.000
18	S-PP-SW2500--FA	1.800	.500	.000	.500	.789	.000
19	S-PP-SW2501ABFA	1.530	.500	.000	.500	.670	.000
20	S-PP-SW2800--FA	1.070	.500	.000	.500	.469	.000
21	S-PP-SW2810--FA	1.070	.500	.000	.500	.469	.000
22	S-PP-SW2820--FA	1.070	.500	.000	.500	.469	.000
23	S-PP-SW2900--FA	1.260	.500	.000	.500	.552	.000
24	S-PPFP341-123FA	1.310	.500	.000	.500	.574	.000
25	S-TK-CNDSR---FA	1.870	.400	.000	.400	.967	.000
26	S-TK-CST-----FA	.670	.400	.000	.400	.346	.000
27	S-TK-MSR-----FA	1.870	.400	.000	.400	.967	.000
28	S-TK-RMST----FA	.540	.400	.000	.400	.279	.000
29	S-TK-SGBT----FA	1.410	.400	.000	.400	.729	.000

Random Failures

No.	Component Name	Mean Failure Rate
1	02-SW4A-B--FSHE	5.00E-02
2	08-FPISO30-F-HE	4.90E-01
3	08-FPISO40-F-HE	5.90E-02
4	08-FPISO57-F-HE	3.10E-02
5	ISOL-FP-S15-SUC	7.91E-01
6	ISOL-FP-S2-SUC	9.61E-01
7	ISOL-FP-S8-SUC	9.59E-01
8	ISOL-FPSW-S10-SC	8.61E-01
9	ISOL-FPSW-S12-SC	4.02E-01
10	ISOL-FPSW-S21-SC	7.81E-01
11	S-SYS-FAIL---FA	9.54E-02
12	SX-SWFP-34-F-HE	3.00E-01
13	SX-SWFP-40-F-HE	1.50E-01
14	SX-SWFP-57-F-HE	5.60E-02

Seismic Systems Analysis

	Computed	Available On File	Total
No. of Systems:	22	0	22
No. of Sequences:	24	0	24
No. of Damage States:	1	-	1

Systems Summary

No.	System Name	Available on disk? Y/N	Filename	To be analyzed? Y/N	To be stored? Y/N	Filename
1	CST	N	-	Y	Y	CST.FRG
2	FP	N	-	Y	Y	FP.FRG
3	FP335	N	-	Y	Y	FP335.FRG
4	HCE	N	-	Y	Y	HCE.FRG
5	ISOFPS15	N	-	Y	Y	ISOFPS15.FRG
6	ISOFPS16	N	-	Y	Y	ISOFPS16.FRG
7	ISOLFP57	N	-	Y	Y	ISOLFP57.FRG
8	ISOLFPS2	N	-	Y	Y	ISOLFPS2.FRG
9	ISOLFPS3	N	-	Y	Y	ISOLFPS3.FRG
10	ISOLFPS8	N	-	Y	Y	ISOLFPS8.FRG
11	ISOLFPS9	N	-	Y	Y	ISOLFPS9.FRG
12	ISOLSW	N	-	Y	Y	ISOLSW.FRG
13	ISOSFS12	N	-	Y	Y	ISOSFS12.FRG
14	ISOSFS13	N	-	Y	Y	ISOSFS13.FRG
15	ISOSFS21	N	-	Y	Y	ISOSFS21.FRG
16	ISOSFS22	N	-	Y	Y	ISOSFS22.FRG
17	ISOSWM10	N	-	Y	Y	ISOSWM10.FRG
18	ISOSWM11	N	-	Y	Y	ISOSWM11.FRG
19	ISOSWS24	N	-	Y	Y	ISOSWS24.FRG
20	RMST	N	-	Y	Y	RMST.FRG
21	SW	N	-	Y	Y	SW.FRG
22	SYSFLRS	N	-	Y	Y	SYSFLRS.FRG

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
1	SEIFLD02	Y	SEIFLD02.FRG	8	\HCE \FP335 ISOLFPS2	\CST \SW SYSFLRS	\RMST FP
2	SEIFLD03	Y	SEIFLD03.FRG	6	\HCE \FP335	\CST \SW	\RMST ISOLFPS3
3	SEIFLD04	Y	SEIFLD04.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	\RMST \ISOLSW
4	SEIFLD05	Y	SEIFLD05.FRG	6	\HCE \FP335	\CST SW	\RMST ISOLSW
5	SEIFLD06	Y	SEIFLD06.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	\RMST \FP
6	SEIFLD07	Y	SEIFLD07.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	\RMST \FP
7	SEIFLD08	Y	SEIFLD08.FRG	8	\HCE FP335 ISOLFPS8	\CST \SW SYSFLRS	\RMST FP
8	SEIFLD09	Y	SEIFLD09.FRG	6	\HCE FP335	\CST \SW	\RMST ISOLFPS9
9	SEIFLD10	Y	SEIFLD10.FRG	8	\HCE FP335 ISOSWM10	\CST SW SYSFLRS	\RMST \FP
10	SEIFLD11	Y	SEIFLD11.FRG	6	\HCE FP335	\CST \FP	\RMST ISOSWM11

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
11	SEIFLD12	Y	SEIFLD12.FRG	8	\HCE FP335 ISOSFS12	\CST SW SYSFLRS	\RMST FP
12	SEIFLD13	Y	SEIFLD13.FRG	5	\HCE FP335	\CST ISOSFS13	\RMST
13	SEIFLD15	Y	SEIFLD15.FRG	8	\HCE \FP335 ISOFPS15	\CST \SW SYSFLRS	RMST FP
14	SEIFLD16	Y	SEIFLD16.FRG	6	\HCE \FP335	\CST \SW	RMST ISOFPS16
15	SEIFLD17	Y	SEIFLD17.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	RMST \ISOLSW
16	SEIFLD18	Y	SEIFLD18.FRG	6	\HCE \FP335	\CST SW	RMST ISOLSW
17	SEIFLD19	Y	SEIFLD19.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	RMST \FP
18	SEIFLD20	Y	SEIFLD20.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	RMST \FP
19	SEIFLD21	Y	SEIFLD21.FRG	8	\HCE FP335 ISOSFS21	\CST \SW SYSFLRS	RMST FP
20	SEIFLD22	Y	SEIFLD22.FRG	6	\HCE FP335	\CST \SW	RMST ISOSFS22

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
21	SEIFLD23	Y	SEIFLD23.FRG	7	\HCE FP335 SYSFLRS	\CST SW	RMST \ISOSWS24
22	SEIFLD24	Y	SEIFLD24.FRG	6	\HCE FP335	\CST SW	RMST ISOSWS24
23	SEIFLD25	Y	SEIFLD25.FRG	2	\HCE	CST	
24	SEIFLD26	Y	SEIFLD26.FRG	1	HCE		

Damage State Summary

No.	Damage State Name	To be stored? Y/N	Filename	No. of Sequences	Sequence Names		
1	ALL	Y	ALL.FRG	24	SEIFLD02	SEIFLD03	SEIFLD04
					SEIFLD05	SEIFLD06	SEIFLD07
					SEIFLD08	SEIFLD09	SEIFLD10
					SEIFLD11	SEIFLD12	SEIFLD13
					SEIFLD15	SEIFLD16	SEIFLD17
					SEIFLD18	SEIFLD19	SEIFLD20
					SEIFLD21	SEIFLD22	SEIFLD23
					SEIFLD24	SEIFLD25	SEIFLD26

Best Estimate of Sequence Frequencies

No.	Sequence	Annual Frequency
1	SEIFLD02	4.28E-08
2	SEIFLD03	1.83E-08
3	SEIFLD04	6.45E-08
4	SEIFLD05	3.56E-08
5	SEIFLD06	8.36E-07
6	SEIFLD07	2.80E-07
7	SEIFLD08	4.17E-08
8	SEIFLD09	1.99E-08
9	SEIFLD10	4.71E-08
10	SEIFLD11	6.94E-08
11	SEIFLD12	7.08E-09
12	SEIFLD13	1.10E-07
13	SEIFLD15	1.33E-08
14	SEIFLD16	3.14E-08
15	SEIFLD17	2.76E-08
16	SEIFLD18	1.52E-08
17	SEIFLD19	1.37E-07
18	SEIFLD20	4.60E-08
19	SEIFLD21	2.72E-08
20	SEIFLD22	7.98E-08
21	SEIFLD23	6.67E-08
22	SEIFLD24	1.23E-07
23	SEIFLD25	3.97E-06
24	SEIFLD26	4.90E-07

Best Estimate of Damage State Frequencies

No.	Damage State	Annual Frequency
1	ALL	6.60E-06

No.	Damage State Name	Damage State Risk	No. of Sequences	No.	Sequence Name	Sequence Risk	% of Total
1	ALL	6.60E-06	24	1	SEIFLD25	3.97E-06	60.14
				2	SEIFLD06	8.36E-07	12.67
				3	SEIFLD26	4.90E-07	7.42
				4	SEIFLD07	2.80E-07	4.25
				5	SEIFLD19	1.37E-07	2.08
				6	SEIFLD24	1.23E-07	1.87
				7	SEIFLD13	1.10E-07	1.67
				8	SEIFLD22	7.98E-08	1.21
				9	SEIFLD11	6.94E-08	1.05
				10	SEIFLD23	6.67E-08	1.01
				11	SEIFLD04	6.45E-08	.98
				12	SEIFLD10	4.71E-08	.71
				13	SEIFLD20	4.60E-08	.70
				14	SEIFLD02	4.28E-08	.65
				15	SEIFLD08	4.17E-08	.63
				16	SEIFLD05	3.56E-08	.54
				17	SEIFLD16	3.14E-08	.48
				18	SEIFLD17	2.76E-08	.42
				19	SEIFLD21	2.72E-08	.41
				20	SEIFLD09	1.99E-08	.30
				21	SEIFLD03	1.83E-08	.28
				22	SEIFLD18	1.52E-08	.23
				23	SEIFLD15	1.33E-08	.20
				24	SEIFLD12	7.08E-09	.11
					Sum:	6.60E-06	100.00

Contributing Sequence Risks (in decreasing order of importance)

Summary of Plant Level Fragility

Conditional Probability of Failure	pga(units:g)
.050	.291
.150	.388
.250	.453
.500	.587
.750	.758
.850	.874
.950	1.095
HCLPF (See note)	.203

Note: Best Estimate Case HCLPF

HCLPF = Ground motion level for which there is a high confidence of a low probability of failure

= Amed * exp(-2.3 * Beta)
(Assuming the plant fragility is Lognormally distributed, the HCLPF corresponds to a 1.072% probability of failure)

Skill of Craft HEPS
Date: 10/28/2005
Time: 09:28:15.64

```
************************************************************************
*                                                                      *
*                                                                      *
*                               SHIP                                   *
*                  Seismic Hazard Integration Package                  *
*                                                                      *
*                            Developed by                              *
*                 Jack R. Benjamin and Associates, Inc.                *
*                        Menlo Park, California                        *
*                                                                      *
*                           Copyright 1996                             *
*                            Version 1.02                              *
*                        Release Date: 07/02/96                        *
*                                                                      *
*  Code: SHIP                                    Code No. : S001-102   *
*                                         Serial No. : S001-102-006Q   *
*                                                                      *
*          This code has been QA verified and complies with            *
*          the requirements of 10 CFR 50 Appendix B                    *
*                                                                      *
************************************************************************
```

Problem : Kewaunee Power Station
Case : Seismic PRA
Skill of Craft HEPS

Analysis Parameters

No. of Lognormal Fragilities	(NCOMPS)	:	29
No. of Non-Lognormal Fragilities	(NCMPNLN)	:	0
No. of Supercomponents	(NSUPCMP)	:	0
No. of Random Failures	(NR)	:	14
Ground Motion Measure (units)	(AHEAD)	:	pga(units:g)
Minimum Ground Motion Level	(AMIN)	:	.050
Maximum Ground Motion Level	(AMAX)	:	1.590
Increment on Ground Motion	(ADELT)	:	.020

Analysis Options Selected

Best Estimate Analysis	===>	IBEST = 1
Sequences Analyzed	===>	NSEQ = 24
Integration of Hazard and Fragility Curves done	===>	IINTGRT = 1

Input Files

File Description		Filename
Names File	:	hepsoc.nam
Basic Input	:	HEPSOC.inp
Component Fragilities	:	HEPSOC.cmp
System Model	:	Seiflood.stm
Accident Sequences	:	Seiflood.seq
Seismic Hazard	:	EPRI89.haz

Summary of Output Files

File Description	Write to Disk?	Filename
SHIP Basic Output	Y	HEPSOC.BAS
Error Messages	Y	HEPSOC.ERR
Component Fragilities	Y	HEPSOC.CFC
System Fragilities	Y	HEPSOC.SYC
Sequence Fragilities	Y	HEPSOC.SFC
Percent Contribution of each Ground Motion Level to the Mean Risk	Y	HEPSOC.APC

Summary of Plot Files

File Description	Write to Disk?	Filename
Hazard Curve(s)	Y	HEPSOC.HZP
Fragility Curves for Sequences and Damage States	Y	HEPSOC.SQP
System Fragility Curves	Y	HEPSOC.SYP

Seismic Hazard Data
(Hazard Curves Defined at 15 Points)

Curve No.	Probability Weight	pga(units:g) .011	.027	.110	.142	.221	.265	.327	.499
1	1.000	2.100E-03	1.304E-03	1.100E-04	8.120E-05	3.800E-05	2.837E-05	1.874E-05	5.900E-06

Curve No.	Probability Weight	pga(units:g) .555	.633	.846	.931	1.121	1.276	1.590
1	1.000	4.408E-06	2.936E-06	9.600E-07	6.500E-07	2.700E-07	1.660E-07	6.200E-08

Seismic Lognormal Fragility Parameters

Median Capacity Defined in Terms of pga(units:g)

Number	Component Name	Median	Beta-R	Beta-U	Beta-C	HCLPF	Cutoff
1	S-PP-CDPSP---FA	2.200	.500	.000	.500	.964	.000
2	S-PP-FP201---FA	1.380	.500	.000	.500	.605	.000
3	S-PP-FP250---FA	1.710	.500	.000	.500	.749	.000
4	S-PP-FP270---FA	1.970	.500	.000	.500	.863	.000
5	S-PP-FP275---FA	1.760	.500	.000	.500	.771	.000
6	S-PP-FP275-1-FA	1.930	.500	.000	.500	.846	.000
7	S-PP-FP276---FA	1.280	.500	.000	.500	.561	.000
8	S-PP-FP280---FA	1.670	.500	.000	.500	.732	.000
9	S-PP-FP320---FA	1.080	.500	.000	.500	.473	.000
10	S-PP-FP321-1-FA	2.200	.500	.000	.500	.964	.000
11	S-PP-FP331---FA	1.310	.500	.000	.500	.574	.000
12	S-PP-FP335---FA	.420	.500	.000	.500	.184	.000
13	S-PP-FP345---FA	2.030	.500	.000	.500	.890	.000
14	S-PP-FP370---FA	1.310	.500	.000	.500	.574	.000
15	S-PP-FP380A--FA	2.020	.500	.000	.500	.885	.000
16	S-PP-SW1801ABFA	1.800	.500	.000	.500	.789	.000
17	S-PP-SW2200--FA	1.370	.500	.000	.500	.600	.000
18	S-PP-SW2500--FA	1.800	.500	.000	.500	.789	.000
19	S-PP-SW2501ABFA	1.530	.500	.000	.500	.670	.000
20	S-PP-SW2800--FA	1.070	.500	.000	.500	.469	.000
21	S-PP-SW2810--FA	1.070	.500	.000	.500	.469	.000
22	S-PP-SW2820--FA	1.070	.500	.000	.500	.469	.000
23	S-PP-SW2900--FA	1.260	.500	.000	.500	.552	.000
24	S-PPFP341-123FA	1.310	.500	.000	.500	.574	.000
25	S-TK-CNDSR---FA	1.870	.400	.000	.400	.967	.000
26	S-TK-CST-----FA	.670	.400	.000	.400	.346	.000
27	S-TK-MSR-----FA	1.870	.400	.000	.400	.967	.000
28	S-TK-RMST----FA	.540	.400	.000	.400	.279	.000
29	S-TK-SGBT----FA	1.410	.400	.000	.400	.729	.000

Random Failures

No.	Component Name	Mean Failure Rate
1	02-SW4A-B--FSHE	2.50E-02
2	08-FPISO30-F-HE	9.80E-01
3	08-FPISO40-F-HE	1.18E-01
4	08-FPISO57-F-HE	6.20E-02
5	ISOL-FP-S15-SUC	7.91E-01
6	ISOL-FP-S2-SUC	9.61E-01
7	ISOL-FP-S8-SUC	9.59E-01
8	ISOL-FPSW-S10-SC	8.61E-01
9	ISOL-FPSW-S12-SC	4.02E-01
10	ISOL-FPSW-S21-SC	7.81E-01
11	S-SYS-FAIL---FA	9.54E-02
12	SX-SWFP-34-F-HE	6.00E-01
13	SX-SWFP-40-F-HE	3.00E-01
14	SX-SWFP-57-F-HE	1.12E-01

Seismic Systems Analysis	Computed	Available On File	Total
No. of Systems:	22	0	22
No. of Sequences:	24	0	24
No. of Damage States:	1	-	1

Systems Summary

No.	System Name	Available on disk? Y/N	Filename	To be analyzed? Y/N	To be stored? Y/N	Filename
1	CST	N	-	Y	Y	CST.FRG
2	FP	N	-	Y	Y	FP.FRG
3	FP335	N	-	Y	Y	FP335.FRG
4	HCE	N	-	Y	Y	HCE.FRG
5	ISOFPS15	N	-	Y	Y	ISOFPS15.FRG
6	ISOFPS16	N	-	Y	Y	ISOFPS16.FRG
7	ISOLFP57	N	-	Y	Y	ISOLFP57.FRG
8	ISOLFPS2	N	-	Y	Y	ISOLFPS2.FRG
9	ISOLFPS3	N	-	Y	Y	ISOLFPS3.FRG
10	ISOLFPS8	N	-	Y	Y	ISOLFPS8.FRG
11	ISOLFPS9	N	-	Y	Y	ISOLFPS9.FRG
12	ISOLSW	N	-	Y	Y	ISOLSW.FRG
13	ISOSFS12	N	-	Y	Y	ISOSFS12.FRG
14	ISOSFS13	N	-	Y	Y	ISOSFS13.FRG
15	ISOSFS21	N	-	Y	Y	ISOSFS21.FRG
16	ISOSFS22	N	-	Y	Y	ISOSFS22.FRG
17	ISOSWM10	N	-	Y	Y	ISOSWM10.FRG
18	ISOSWM11	N	-	Y	Y	ISOSWM11.FRG
19	ISOSWS24	N	-	Y	Y	ISOSWS24.FRG
20	RMST	N	-	Y	Y	RMST.FRG
21	SW	N	-	Y	Y	SW.FRG
22	SYSFLRS	N	-	Y	Y	SYSFLRS.FRG

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
1	SEIFLD02	Y	SEIFLD02.FRG	8	\HCE	\CST	\RMST
					\FP335	\SW	FP
					ISOLFPS2	SYSFLRS	
2	SEIFLD03	Y	SEIFLD03.FRG	6	\HCE	\CST	\RMST
					\FP335	\SW	ISOLFPS3
3	SEIFLD04	Y	SEIFLD04.FRG	7	\HCE	\CST	\RMST
					\FP335	SW	\ISOLSW
					SYSFLRS		
4	SEIFLD05	Y	SEIFLD05.FRG	6	\HCE	\CST	\RMST
					\FP335	SW	ISOLSW
5	SEIFLD06	Y	SEIFLD06.FRG	8	\HCE	\CST	\RMST
					FP335	\SW	\FP
					\ISOLFP57	SYSFLRS	
6	SEIFLD07	Y	SEIFLD07.FRG	7	\HCE	\CST	\RMST
					FP335	\SW	\FP
					ISOLFP57		
7	SEIFLD08	Y	SEIFLD08.FRG	8	\HCE	\CST	\RMST
					FP335	\SW	FP
					ISOLFPS8	SYSFLRS	
8	SEIFLD09	Y	SEIFLD09.FRG	6	\HCE	\CST	\RMST
					FP335	\SW	ISOLFPS9
9	SEIFLD10	Y	SEIFLD10.FRG	8	\HCE	\CST	\RMST
					FP335	SW	\FP
					ISOSWM10	SYSFLRS	
10	SEIFLD11	Y	SEIFLD11.FRG	6	\HCE	\CST	\RMST
					FP335	\FP	ISOSWM11

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
11	SEIFLD12	Y	SEIFLD12.FRG	8	\HCE FP335 ISOSFS12	\CST SW SYSFLRS	\RMST FP
12	SEIFLD13	Y	SEIFLD13.FRG	5	\HCE FP335	\CST ISOSFS13	\RMST
13	SEIFLD15	Y	SEIFLD15.FRG	8	\HCE \FP335 ISOFPS15	\CST \SW SYSFLRS	RMST FP
14	SEIFLD16	Y	SEIFLD16.FRG	6	\HCE \FP335	\CST \SW	RMST ISOFPS16
15	SEIFLD17	Y	SEIFLD17.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	RMST \ISOLSW
16	SEIFLD18	Y	SEIFLD18.FRG	6	\HCE \FP335	\CST SW	RMST ISOLSW
17	SEIFLD19	Y	SEIFLD19.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	RMST \FP
18	SEIFLD20	Y	SEIFLD20.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	RMST \FP
19	SEIFLD21	Y	SEIFLD21.FRG	8	\HCE FP335 ISOSFS21	\CST \SW SYSFLRS	RMST FP
20	SEIFLD22	Y	SEIFLD22.FRG	6	\HCE FP335	\CST \SW	RMST ISOSFS22

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
21	SEIFLD23	Y	SEIFLD23.FRG	7	\HCE	\CST	RMST
					FP335	SW	\ISOSWS24
					SYSFLRS		
22	SEIFLD24	Y	SEIFLD24.FRG	6	\HCE	\CST	RMST
					FP335	SW	ISOSWS24
23	SEIFLD25	Y	SEIFLD25.FRG	2	\HCE	CST	
24	SEIFLD26	Y	SEIFLD26.FRG	1	HCE		

Damage State Summary

No.	Damage State Name	To be stored? Y/N	Filename	No. of Sequences	Sequence Names		
1	ALL	Y	ALL.FRG	24	SEIFLD02	SEIFLD03	SEIFLD04
					SEIFLD05	SEIFLD06	SEIFLD07
					SEIFLD08	SEIFLD09	SEIFLD10
					SEIFLD11	SEIFLD12	SEIFLD13
					SEIFLD15	SEIFLD16	SEIFLD17
					SEIFLD18	SEIFLD19	SEIFLD20
					SEIFLD21	SEIFLD22	SEIFLD23
					SEIFLD24	SEIFLD25	SEIFLD26

Best Estimate of Sequence Frequencies

No.	Sequence	Annual Frequency
1	SEIFLD02	4.28E-08
2	SEIFLD03	3.66E-08
3	SEIFLD04	6.62E-08
4	SEIFLD05	1.78E-08
5	SEIFLD06	8.10E-07
6	SEIFLD07	5.61E-07
7	SEIFLD08	4.17E-08
8	SEIFLD09	3.95E-08
9	SEIFLD10	4.71E-08
10	SEIFLD11	1.11E-07
11	SEIFLD12	7.08E-09
12	SEIFLD13	1.39E-07
13	SEIFLD15	1.33E-08
14	SEIFLD16	6.24E-08
15	SEIFLD17	2.83E-08
16	SEIFLD18	7.62E-09
17	SEIFLD19	1.33E-07
18	SEIFLD20	9.21E-08
19	SEIFLD21	2.72E-08
20	SEIFLD22	1.57E-07
21	SEIFLD23	5.49E-08
22	SEIFLD24	2.47E-07
23	SEIFLD25	3.97E-06
24	SEIFLD26	4.90E-07

Best Estimate of Damage State Frequencies

No.	Damage State	Annual Frequency
1	ALL	7.20E-06

No.	Damage State Name	Damage State Risk	No. of Sequences	No.	Sequence Name	Sequence Risk	% of Total
1	ALL	7.20E-06	24	1	SEIFLD25	3.97E-06	55.13
				2	SEIFLD06	8.10E-07	11.24
				3	SEIFLD07	5.61E-07	7.79
				4	SEIFLD26	4.90E-07	6.80
				5	SEIFLD24	2.47E-07	3.43
				6	SEIFLD22	1.57E-07	2.18
				7	SEIFLD13	1.39E-07	1.93
				8	SEIFLD19	1.33E-07	1.85
				9	SEIFLD11	1.11E-07	1.54
				10	SEIFLD20	9.21E-08	1.28
				11	SEIFLD04	6.62E-08	.92
				12	SEIFLD16	6.24E-08	.87
				13	SEIFLD23	5.49E-08	.76
				14	SEIFLD10	4.71E-08	.65
				15	SEIFLD02	4.28E-08	.59
				16	SEIFLD08	4.17E-08	.58
				17	SEIFLD09	3.95E-08	.55
				18	SEIFLD03	3.66E-08	.51
				19	SEIFLD17	2.83E-08	.39
				20	SEIFLD21	2.72E-08	.38
				21	SEIFLD05	1.78E-08	.25
				22	SEIFLD15	1.33E-08	.18
				23	SEIFLD18	7.62E-09	.11
				24	SEIFLD12	7.08E-09	.10
					Sum:	7.20E-06	100.00

Contributing Sequence Risks (in decreasing order of importance)

Summary of Plant Level Fragility

Conditional Probability of Failure	pga(units:g)
.050	.282
.150	.378
.250	.440
.500	.564
.750	.717
.850	.827
.950	1.057
HCLPF (See note)	.195

Note: Best Estimate Case HCLPF

HCLPF = Ground motion level for which there is a high confidence of a low probability of failure

= Amed * exp(-2.3 * Beta)
(Assuming the plant fragility is Lognormally distributed, the HCLPF corresponds to a 1.072% probability of failure)

Fldng SDP LLNL Curve
Date: 10/28/2005
Time: 09:28:40.44

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*****************************************************************************
*                                                                           *
*                                                                           *
*                                  SHIP                                     *
*                     Seismic Hazard Integration Package                    *
*                                                                           *
*                               Developed by                                *
*                   Jack R. Benjamin and Associates, Inc.                   *
*                         Menlo Park, California                            *
*                                                                           *
*                             Copyright 1996                                *
*                              Version 1.02                                 *
*                         Release Date: 07/02/96                            *
*                                                                           *
*  Code: SHIP                                      Code No. : S001-102      *
*                                           Serial No. : S001-102-006Q      *
*                                                                           *
*            This code has been QA verified and complies with               *
*            the requirements of 10 CFR 50 Appendix B                       *
*                                                                           *
*****************************************************************************
```

Problem : Kewaunee Power Station
Case : Seismic PRA
Fldng SDP LLNL Curve

Analysis Parameters

No. of Lognormal Fragilities	(NCOMPS)	:	29
No. of Non-Lognormal Fragilities	(NCMPNLN)	:	0
No. of Supercomponents	(NSUPCMP)	:	0
No. of Random Failures	(NR)	:	14
Ground Motion Measure (units)	(AHEAD)	:	pga(units:g)
Minimum Ground Motion Level	(AMIN)	:	.050
Maximum Ground Motion Level	(AMAX)	:	1.590
Increment on Ground Motion	(ADELT)	:	.020

Analysis Options Selected

Best Estimate Analysis	===>	IBEST = 1
Sequences Analyzed	===>	NSEQ = 24
Integration of Hazard and Fragility Curves done	===>	IINTGRT = 1

File Description		Filename
Input Files		
Names File	:	seifllnl.nam
Basic Input	:	SeifLLNL.inp
Component Fragilities	:	Seiflood.cmp
System Model	:	Seiflood.stm
Accident Sequences	:	Seiflood.seq
Seismic Hazard	:	LLNL93Ex.haz

Summary of Output Files

File Description	Write to Disk?	Filename
SHIP Basic Output	Y	SeifLLNL.BAS
Error Messages	Y	SeifLLNL.ERR
Component Fragilities	Y	SeifLLNL.CFC
System Fragilities	Y	SeifLLNL.SYC
Sequence Fragilities	Y	SeifLLNL.SFC
Percent Contribution of each Ground Motion Level to the Mean Risk	Y	SeifLLNL.APC

Summary of Plot Files

File Description	Write to Disk?	Filename
Hazard Curve(s)	Y	SeifLLNL.HZP
Fragility Curves for Sequences and Damage States	Y	SeifLLNL.SQP
System Fragility Curves	Y	SeifLLNL.SYP

Seismic Hazard Data
(Hazard Curves Defined at 14 Points)

Curve No.	Probability Weight	pga(units:g) .050	.051	.076	.153	.255	.306	.408	.510
1	1.000	3.104E-04	3.040E-04	1.777E-04	6.422E-05	2.748E-05	1.979E-05	1.141E-05	7.212E-06

Curve No.	Probability Weight	pga(units:g) .663	.816	1.020	1.200	1.400	1.600
1	1.000	4.043E-06	2.474E-06	1.409E-06	8.598E-07	4.962E-07	2.864E-07

Seismic Lognormal Fragility Parameters

Median Capacity Defined in Terms of pga(units:g)

Number	Component Name	Median	Beta-R	Beta-U	Beta-C	HCLPF	Cutoff
1	S-PP-CDPSP---FA	2.200	.500	.000	.500	.964	.000
2	S-PP-FP201---FA	1.380	.500	.000	.500	.605	.000
3	S-PP-FP250---FA	1.710	.500	.000	.500	.749	.000
4	S-PP-FP270---FA	1.970	.500	.000	.500	.863	.000
5	S-PP-FP275---FA	1.760	.500	.000	.500	.771	.000
6	S-PP-FP275-1-FA	1.930	.500	.000	.500	.846	.000
7	S-PP-FP276---FA	1.280	.500	.000	.500	.561	.000
8	S-PP-FP280---FA	1.670	.500	.000	.500	.732	.000
9	S-PP-FP320---FA	1.080	.500	.000	.500	.473	.000
10	S-PP-FP321-1-FA	2.200	.500	.000	.500	.964	.000
11	S-PP-FP331---FA	1.310	.500	.000	.500	.574	.000
12	S-PP-FP335---FA	.420	.500	.000	.500	.184	.000
13	S-PP-FP345---FA	2.030	.500	.000	.500	.890	.000
14	S-PP-FP370---FA	1.310	.500	.000	.500	.574	.000
15	S-PP-FP380A--FA	2.020	.500	.000	.500	.885	.000
16	S-PP-SW1801ABFA	1.800	.500	.000	.500	.789	.000
17	S-PP-SW2200--FA	1.370	.500	.000	.500	.600	.000
18	S-PP-SW2500--FA	1.800	.500	.000	.500	.789	.000
19	S-PP-SW2501ABFA	1.530	.500	.000	.500	.670	.000
20	S-PP-SW2800--FA	1.070	.500	.000	.500	.469	.000
21	S-PP-SW2810--FA	1.070	.500	.000	.500	.469	.000
22	S-PP-SW2820--FA	1.070	.500	.000	.500	.469	.000
23	S-PP-SW2900--FA	1.260	.500	.000	.500	.552	.000
24	S-PPFP341-123FA	1.310	.500	.000	.500	.574	.000
25	S-TK-CNDSR---FA	1.870	.400	.000	.400	.967	.000
26	S-TK-CST-----FA	.670	.400	.000	.400	.346	.000
27	S-TK-MSR-----FA	1.870	.400	.000	.400	.967	.000
28	S-TK-RMST----FA	.540	.400	.000	.400	.279	.000
29	S-TK-SGBT----FA	1.410	.400	.000	.400	.729	.000

Random Failures

No.	Component Name	Mean Failure Rate
1	02-SW4A-B--FSHE	2.50E-02
2	08-FPISO30-F-HE	4.90E-01
3	08-FPISO40-F-HE	5.90E-02
4	08-FPISO57-F-HE	3.10E-02
5	ISOL-FP-S15-SUC	8.22E-01
6	ISOL-FP-S2-SUC	9.61E-01
7	ISOL-FP-S8-SUC	9.56E-01
8	ISOL-FPSW-S10-SC	8.61E-01
9	ISOL-FPSW-S12-SC	4.02E-01
10	ISOL-FPSW-S21-SC	7.81E-01
11	S-SYS-FAIL---FA	9.54E-02
12	SX-SWFP-34-F-HE	3.00E-01
13	SX-SWFP-40-F-HE	1.50E-01
14	SX-SWFP-57-F-HE	5.60E-02

Seismic Systems Analysis

	Computed	Available On File	Total
No. of Systems:	22	0	22
No. of Sequences:	24	0	24
No. of Damage States:	1	-	1

Systems Summary

No.	System Name	Available on disk? Y/N	Available on disk? Filename	To be analyzed? Y/N	To be stored? Y/N	To be stored? Filename
1	CST	N	-	Y	Y	CST.FRG
2	FP	N	-	Y	Y	FP.FRG
3	FP335	N	-	Y	Y	FP335.FRG
4	HCE	N	-	Y	Y	HCE.FRG
5	ISOFPS15	N	-	Y	Y	ISOFPS15.FRG
6	ISOFPS16	N	-	Y	Y	ISOFPS16.FRG
7	ISOLFP57	N	-	Y	Y	ISOLFP57.FRG
8	ISOLFPS2	N	-	Y	Y	ISOLFPS2.FRG
9	ISOLFPS3	N	-	Y	Y	ISOLFPS3.FRG
10	ISOLFPS8	N	-	Y	Y	ISOLFPS8.FRG
11	ISOLFPS9	N	-	Y	Y	ISOLFPS9.FRG
12	ISOLSW	N	-	Y	Y	ISOLSW.FRG
13	ISOSFS12	N	-	Y	Y	ISOSFS12.FRG
14	ISOSFS13	N	-	Y	Y	ISOSFS13.FRG
15	ISOSFS21	N	-	Y	Y	ISOSFS21.FRG
16	ISOSFS22	N	-	Y	Y	ISOSFS22.FRG
17	ISOSWM10	N	-	Y	Y	ISOSWM10.FRG
18	ISOSWM11	N	-	Y	Y	ISOSWM11.FRG
19	ISOSWS24	N	-	Y	Y	ISOSWS24.FRG
20	RMST	N	-	Y	Y	RMST.FRG
21	SW	N	-	Y	Y	SW.FRG
22	SYSFLRS	N	-	Y	Y	SYSFLRS.FRG

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
1	SEIFLD02	Y	SEIFLD02.FRG	8	\HCE \FP335 ISOLFPS2	\CST \SW SYSFLRS	\RMST FP
2	SEIFLD03	Y	SEIFLD03.FRG	6	\HCE \FP335	\CST \SW	\RMST ISOLFPS3
3	SEIFLD04	Y	SEIFLD04.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	\RMST \ISOLSW
4	SEIFLD05	Y	SEIFLD05.FRG	6	\HCE \FP335	\CST SW	\RMST ISOLSW
5	SEIFLD06	Y	SEIFLD06.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	\RMST \FP
6	SEIFLD07	Y	SEIFLD07.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	\RMST \FP
7	SEIFLD08	Y	SEIFLD08.FRG	8	\HCE FP335 ISOLFPS8	\CST \SW SYSFLRS	\RMST FP
8	SEIFLD09	Y	SEIFLD09.FRG	6	\HCE FP335	\CST \SW	\RMST ISOLFPS9
9	SEIFLD10	Y	SEIFLD10.FRG	8	\HCE FP335 ISOSWM10	\CST SW SYSFLRS	\RMST \FP
10	SEIFLD11	Y	SEIFLD11.FRG	6	\HCE FP335	\CST \FP	\RMST ISOSWM11

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
11	SEIFLD12	Y	SEIFLD12.FRG	8	\HCE FP335 ISOSFS12	\CST SW SYSFLRS	\RMST FP
12	SEIFLD13	Y	SEIFLD13.FRG	5	\HCE FP335	\CST ISOSFS13	\RMST
13	SEIFLD15	Y	SEIFLD15.FRG	8	\HCE \FP335 ISOFPS15	\CST \SW SYSFLRS	RMST FP
14	SEIFLD16	Y	SEIFLD16.FRG	6	\HCE \FP335	\CST \SW	RMST ISOFPS16
15	SEIFLD17	Y	SEIFLD17.FRG	7	\HCE \FP335 SYSFLRS	\CST SW	RMST \ISOLSW
16	SEIFLD18	Y	SEIFLD18.FRG	6	\HCE \FP335	\CST SW	RMST ISOLSW
17	SEIFLD19	Y	SEIFLD19.FRG	8	\HCE FP335 \ISOLFP57	\CST \SW SYSFLRS	RMST \FP
18	SEIFLD20	Y	SEIFLD20.FRG	7	\HCE FP335 ISOLFP57	\CST \SW	RMST \FP
19	SEIFLD21	Y	SEIFLD21.FRG	8	\HCE FP335 ISOSFS21	\CST \SW SYSFLRS	RMST FP
20	SEIFLD22	Y	SEIFLD22.FRG	6	\HCE FP335	\CST \SW	RMST ISOSFS22

Sequence Summary

No.	Sequence Name	To be stored? Y/N	Filename	No. of Events	Event Names		
21	SEIFLD23	Y	SEIFLD23.FRG	7	\HCE	\CST	RMST
					FP335	SW	\ISOSWS24
					SYSFLRS		
22	SEIFLD24	Y	SEIFLD24.FRG	6	\HCE	\CST	RMST
					FP335	SW	ISOSWS24
23	SEIFLD25	Y	SEIFLD25.FRG	2	\HCE	CST	
24	SEIFLD26	Y	SEIFLD26.FRG	1	HCE		

Damage State Summary

No.	Damage State Name	To be stored? Y/N	Filename	No. of Sequences	Sequence Names		
1	ALL	Y	ALL.FRG	24	SEIFLD02	SEIFLD03	SEIFLD04
					SEIFLD05	SEIFLD06	SEIFLD07
					SEIFLD08	SEIFLD09	SEIFLD10
					SEIFLD11	SEIFLD12	SEIFLD13
					SEIFLD15	SEIFLD16	SEIFLD17
					SEIFLD18	SEIFLD19	SEIFLD20
					SEIFLD21	SEIFLD22	SEIFLD23
					SEIFLD24	SEIFLD25	SEIFLD26

Best Estimate of Sequence Frequencies

No.	Sequence	Annual Frequency
1	SEIFLD02	3.62E-08
2	SEIFLD03	1.56E-08
3	SEIFLD04	5.66E-08
4	SEIFLD05	1.52E-08
5	SEIFLD06	7.12E-07
6	SEIFLD07	2.39E-07
7	SEIFLD08	3.77E-08
8	SEIFLD09	1.83E-08
9	SEIFLD10	4.23E-08
10	SEIFLD11	6.50E-08
11	SEIFLD12	7.43E-09
12	SEIFLD13	1.18E-07
13	SEIFLD15	1.28E-08
14	SEIFLD16	2.96E-08
15	SEIFLD17	2.73E-08
16	SEIFLD18	7.34E-09
17	SEIFLD19	1.21E-07
18	SEIFLD20	4.04E-08
19	SEIFLD21	2.77E-08
20	SEIFLD22	8.28E-08
21	SEIFLD23	7.48E-08
22	SEIFLD24	1.38E-07
23	SEIFLD25	4.41E-06
24	SEIFLD26	9.85E-07

Best Estimate of Damage State Frequencies

No.	Damage State	Annual Frequency
1	ALL	7.32E-06

No.	Damage State Name	Damage State Risk	No. of Sequences	Contributing Sequence Risks (in decreasing order of importance)			
1	ALL	7.32E-06	24	No.	Sequence Name	Sequence Risk	% of Total
				1	SEIFLD25	4.41E-06	60.26
				2	SEIFLD26	9.85E-07	13.45
				3	SEIFLD06	7.12E-07	9.72
				4	SEIFLD07	2.39E-07	3.26
				5	SEIFLD24	1.38E-07	1.89
				6	SEIFLD19	1.21E-07	1.65
				7	SEIFLD13	1.18E-07	1.61
				8	SEIFLD22	8.28E-08	1.13
				9	SEIFLD23	7.48E-08	1.02
				10	SEIFLD11	6.50E-08	.89
				11	SEIFLD04	5.66E-08	.77
				12	SEIFLD10	4.23E-08	.58
				13	SEIFLD20	4.04E-08	.55
				14	SEIFLD08	3.77E-08	.52
				15	SEIFLD02	3.62E-08	.49
				16	SEIFLD16	2.96E-08	.40
				17	SEIFLD21	2.77E-08	.38
				18	SEIFLD17	2.73E-08	.37
				19	SEIFLD09	1.83E-08	.25
				20	SEIFLD03	1.56E-08	.21
				21	SEIFLD05	1.52E-08	.21
				22	SEIFLD15	1.28E-08	.18
				23	SEIFLD12	7.43E-09	.10
				24	SEIFLD18	7.34E-09	.10
					Sum:	7.32E-06	100.00

Summary of Plant Level Fragility

Conditional Probability of Failure	pga(units:g)
.050	.292
.150	.389
.250	.453
.500	.588
.750	.758
.850	.874
.950	1.095
HCLPF (See note)	.203

Note: Best Estimate Case HCLPF

HCLPF = Ground motion level for which there is a high confidence of a low probability of failure

= Amed * exp(-2.3 * Beta)
(Assuming the plant fragility is Lognormally distributed, the HCLPF corresponds to a 1.072% probability of failure)

Appendix F

Seismic Analysis

Attachment 6 – Tank Volume Calculation

Tank Volume Calculation

Prepared by: [signature] KENNETH P. DEWBERRY
Signature — Print Name

10/19/05
Date

Reviewed by: [signature] PAUL E. SNYDER
Signature — Print Name

10/19/05
Date

Tank Name	Equipment No.	Drwg/ Sys Dscrp/ Field Calc (FC)	Capacity
SG B/D Tank	153-131	Drwg XK-146-3 & FC 4' X 10'10" System Dscrp # 7	1000g
Heater Drain	153-321	Drwg XK-146-4 System Dscrp # 11	10,000g
Waste Neutralization Tank	153-211	Drwg XK-147-35 & FC 15' X 15' System Dscrp #27A	19,000g
Caustic Tank	153-251	Drwg XK-146-2 System Dscrp #27A	5,000g
Sulfuric Acid Day Tank	153-271	System Dscrp #27A	300g
Hydro Pneumatic Tank	153-241	Operm-209-3 System Dscrp #26	1000g
Brine	153-111	XK-171-1 System Dscrp #26 (6' X 4')	564g
Hot Water Heater	153-491	System Dscrp #26	865g
Boric Acid	153-081 & 153-082	XK-100-180-3 & System Dscrp #35	600g EA
SG BT Hold UP	153-511 & 153-512	M-368 System Dscrp # 7	10,000g EA
SG BT Monitor	153-451 & 153-452	M-368 System Dscrp # 7	10,000g EA
Potable Water Break Tank	153-923	DCR 1789 / PO 37255 FC 60" X 5'2"	750g
SWPT Coagulant Aid Feed Tank	153-731	System Dscrp #27B	400g
SWPT Coagulant Feed Tank	153-741	System Dscrp #27B	400g
SWPT Settled Water Tank	153-721	System Dscrp #27B	3,125g
Flocculator		System Dscrp #27B	17,775g

Appendix F

Seismic Analysis

Attachment 7 – Valve SW-2811 Operation

Valve SW-2811 Operation

Prepared by: [signature] — JEFFREY T. STAFFORD

Signature — Print Name

10-20-05

Date

Reviewed by: [signature] — Paul T. Rappel

Signature — Print Name

10/20/05

Date

10/20/2005 03:26:43 PM - Lotus Notes

Jeffrey T Stafford
10/20/2005 03:35 PM

To: Steven G Pietryk/NUC/VANCPOWER@VANCPOWER
cc:
Subject:

Steve, (for Dave Moore)

I have confirmed, by operator interview, that the sludge blowdown cycle timer for the flocculator/clarifier is set for every 8 hours. Based on my experience, the setting for this timer has been unchanged since 1988. Per System Description 27, the blowdown cycle lasts 39 minutes. Of those 39 minutes, SW-2811 is open for 10 minutes. I will be glad to answer any further questions on this topic.

Jeff Stafford
Supervisor - Nuclear Shift Operations
Kewaunee Power Station
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PCS: 7309
E-mail: Jeffrey_T_Stafford@dom.com