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Subject: **NEDO-33201, Revision 1, "ESBWR Probabilistic Risk Assessment," Section 18**

Enclosure 1 contains the subject partial ESBWR Probabilistic Risk Assessment (PRA) document (Revision 1).

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
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D068

Enclosure:

1. MFN 06-242 – NEDO-33201, Revision 1, "ESBWR Probabilistic Risk Assessment:"
   - Section 18 – PRA Insights Affecting ESBWR Design

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ENCLOSURE 1

MFN 06-242

NEDO-33201, Revision 1, "ESBWR Probabilistic Risk Assessment"

- **Section 18 – PRA Insights Affecting ESBWR Design**

18 PRA INSIGHTS AFFECTING ESBWR DESIGN

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18 PRA INSIGHTS AFFECTING ESBWR DESIGN

18.1 INTRODUCTION

In this section, the results of the full scope PRA are reviewed to determine the important ESBWR design characteristics that contribute more significantly to the mitigation or prevention of a particular accident sequence or event scenario.

The ESBWR PRA has been developed in parallel with other ESBWR design activities. There have also been strong interactions between the two activities. As a consequence, the ESBWR design has benefited from preliminary results of the PRA. The PRA has provided valuable feedback to the selection of design alternatives. The result of those design alternative choices is to maximize the reduction of risk.

The PRA results are reviewed to identify the important features. The PRA results include the minimal cutsets leading to core damage, as well as importance measures of those components and systems represented as basic events in the models. These results provide one basis for a systematic review to identify important features and capabilities. In the majority of cases, cutsets and importance measures identify "features" at the component level. By reviewing the accident sequences and cutsets resulting from this detailed evaluation, it is possible to identify those systems, features and capabilities which are most important in assuring that the ESBWR core damage frequency is very low. Further insight was gained regarding risk by examining the Fussell-Vesely and Risk Achievement Worth importance measures of the basic components contributing to the performance of each system or feature.

This information provides valuable feedback to the selection of design alternatives that maximize the reduction of risk.

18.2 IMPORTANT FEATURES FROM LEVEL 1 INTERNAL EVENTS ANALYSES

18.2.1 Summary of Analysis

The ESBWR internal events probabilistic risk assessment (PRA) was performed to assess plant vulnerability to potential internal accident sequence initiators. The ESBWR Level 1 internal events PRA is based upon detailed fault tree models of the various plant systems as well as event trees that define possible progressions and outcomes of each potential accident initiator. These fault trees and sequence of events are used to estimate the core damage frequency due to each potential accident sequence.

18.2.2 Key Features

The specific capabilities and features identified as being important to minimize the risk to the public associated with ESBWR operation are discussed below.

Control Rod Drive (High Pressure Makeup)

The high pressure makeup mode of Control Rod Drive system is able to automatically provide Reactor Pressure Vessel (RPV) makeup when water level drops to Level 2 so that RPV water level can be recovered. The design flow of this system mode provides high pressure make-up redundancy in potential Small Loss of Coolant Accidents and other reactor coolant pressure boundary leakage scenarios. This active system provides a first line of defense that prevents the need to demand the actuation of safety related systems. The provided redundancy of the system together with the design diversity with respect to those second line safety related systems, even in the actuation logic, contributes significantly to lowering the risk relevance of Small Loss of Coolant Accidents as is shown in the Probabilistic Risk Analysis (PRA).

The system also provides the required water makeup to avoid reactor automatic depressurization as a result of reactor vessel level decrease during plant transients where reactor makeup from the feedwater system is suddenly and completely lost: loss of feedwater and loss of preferred power. One or two CRD pumps (depending upon the severity of the RCS leakage) are required in the PRA to inject water in the High Pressure Makeup mode.

Isolation Condenser

The Isolation Condenser System (ICS) is able to maintain reactor pressure and temperature within an acceptable range so that Safety/Relief valves will not lift (as a result of pressure rises following a turbine trip or isolation event with successful scram) and to ensure, jointly with the CRD system in some transients, as indicated above, that reactor automatic depressurization will not occur when the reactor becomes isolated during power operations (as a result of reactor vessel level decrease). The system is a safety related system and has four totally independent loops. The ICS is in "ready standby" during normal operation at power and is designed to accommodate a single failure criterion. This is a significant feature of the ESBWR design that provides full decay heat removal capability in all transients with loss of normal heat sink.

The system shares the passive heat sink of water in the IC/PCC pools with the Passive Containment Cooling System. The IC/PCC pools provide sufficient water inventory for decay heat removal beyond 72 hours. The system redundancy, independence and diversity of actuation signals contributes significantly to lower the risk of isolation transients as is shown in the Probabilistic Risk Analysis (PRA).

Fuel and Auxiliary Pools Cooling System (FAPCS)

The low pressure core injection (LPCI) mode of Fuel and Auxiliary Pools Cooling System is able to provide Reactor Pressure Vessel (RPV) makeup when water level drops within the RPV and RPV pressure is at or below 0.689 MPa gauge (100 psig). The design flow of this system mode provides low pressure make-up redundancy in potential Loss of Coolant Accidents and other transient scenarios when the RPV is depressurized. The system injects water from the suppression pool and is manually initiated. This active system mode provides a first line of defense that prevents the necessity to demand the actuation of other safety related injection systems (Gravity Core Cooling System).

The suppression pool cooling mode is another relevant function of the system that provides a way to remove decay heat to the ultimate heat sink. This function is actuated automatically upon receipt of suppression pool high temperature. This active system mode provides a first line of defense that prevents the necessity to demand the actuation of other safety related cooling systems (Passive Containment Cooling System) or a backup to this safety related system for containment heat removal in certain accident or transient scenarios.

The redundancy provided by the FAPCS system together with the design diversity with respect to those second line safety related systems, including the actuation logic, contributes significantly to lower the risk of Loss of Coolant Accidents as is shown in the Probabilistic Risk Analysis (PRA).

Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC)

The shutdown cooling mode of the RWCU of ESBWR is able to be aligned at reactor rated pressure and temperature conditions and continues during the entire shutdown period. The design of this system mode allows RPV decay heat removal redundancy in all transient scenarios both at high and low RPV pressure to provide adequate core cooling. This active system mode provides a first line of defense that prevents the necessity to require the actuation of other containment heat removal systems.

Depressurization System (DPV)

The Depressurization Valves, part of the Automatic Depressurization System, provide a highly reliable means of depressurizing the reactor to the Drywell cavity. If the high pressure makeup function fails, the operators will manually initiate RPV depressurization to allow low pressure injection using either FAPCS or the Fire Protection System (FPS) in the injection mode.

If manual depressurization does not occur or if FAPCS and FPS do not sufficiently recover level, ADS will automatically actuate on RPV water level L1. This permits core cooling with safety related Gravity Driven Cooling System and containment cooling with Passive Containment Cooling System, avoids high pressure core melt sequences, and substantially reduces the calculated CDF. This is a highly reliable safety function with diverse actuation signals.

Gravity Driven Cooling System

The Gravity Driven Cooling System provides emergency core cooling after any event that threatens the reactor coolant inventory following RPV depressurization via ADS or the DPVs. It also injects sufficient water into the depressurized RPV to keep the fuel covered following a LOCA. In the event of a severe accident that results in high temperature in the lower drywell floor, the GDCS supplies water to the Basemat Internal Melt Arrest and Coolability (BiMAC) device and floods the lower region with the water inventory of the three GDCS pools. The GDCS does not require external AC electrical power sources or operator intervention for their actuation. The system redundancy, independence, and diversity of actuation signals contributes significantly to lowering the risk of RPV depressurization scenarios, as shown in the Probability Risk Analysis (PRA).

Passive Containment Cooling System

The Passive Containment Cooling System provides core decay heat removal following a Loss-of-Coolant Accident (LOCA), or actuation of Depressurization Valves, by condensing steam from the containment and returning it to the vessel via GDCS. This is a passive system designed with single failure criteria. The system shares the passive heat sink of water in the IC/PCC pools with the Isolation Condenser System. The IC/PCC pools provide enough water inventory for decay heat removal beyond 72 hours (automatic valve actuations, on low pool level, are required to make the entire IC/PCC pool inventory available). The system redundancy, independence and diversity of actuation signals contributes significantly to lower the risk relevance of IC/PCC pool makeup function as is shown in the Probabilistic Risk Analysis (PRA).

Prevention of Intersystem LOCA

SECY 90-016 and 93-087 recommend that designers reduce the possibility of a loss of coolant accident outside containment by designing (to the extent practical) all systems and subsystems connected to the Reactor Coolant System (RCS) to withstand full RCS pressure. All ESBWR piping systems, major systems components (pumps and valves), and subsystems connected to the reactor coolant pressure boundary (RCPB) which extend outside the primary containment boundary are designed to the extent practicable to an ultimate rupture strength (URS) at least equal to full RCPB pressure. These design provisions reduce the already low likelihood of an intersystem loss of coolant accident (ISLOCA).

Reactor Protection System (RPS)

The ESBWR has a highly reliable and diverse CRD scram system incorporating both hydraulic insert and electric drive capabilities. The control rod drive system utilizes hydraulic pressure as the principal scram mechanism with electric drive capabilities for backup to the hydraulic scram capabilities. The hydraulic scram system also includes additional backup scram valves to relieve scram air header pressure thereby causing the control rods to insert. Redundant and diverse scram signals are provided from the RPS and Alternate Rod Insertion (ARI) System to the hydraulic scram mechanisms and the electric drive capability. This redundant and diverse scram capability significantly reduces the probability of an ATWS.

Automatic Standby Liquid Control System (SLCS) and Feedwater Pump Trip

The ESBWR has a highly reliable and diverse scram system incorporating both hydraulic and electric drive capabilities to reduce the probability of an ATWS. In the unlikely event of an ATWS, the standby liquid control system and feedwater pump trip provide backup reactor shutdown capability.

Four Divisions of Safety Related Systems

The ESBWR is designed with four independent and separated divisions of Safety Related Systems, each containing RPV depressurization capability, low pressure gravity driven coolant injection (GDCS) and decay heat removal systems. Providing four passive divisions designed with single failure criteria substantially reduces the calculated CDF for events that require the actuation of safety related systems. Complete physical separation of electrical and mechanical divisions is important. Piping of these systems that penetrate containment are designed as extensions of containment.

Two On-site Diesel Generators (DG)

The ESBWR is designed with two independent and separated diesel generators (DGs), one dedicated to each of the two first line AC power system buses (RWCU, FAPCS, etc.) and each capable of powering the complete set of normal safe shutdown loads in its division. This configuration provides redundant sources of on-site AC power as added defense against loss of preferred power events.

Four Divisions of Safety System Logic and Control (SSLC)

The ESBWR is designed with four divisions of self-tested safety system logic and control (SSLC) instrumentation using two-out-of-four actuation logic. This configuration provides highly reliable initiation of ESF core cooling and heat removal systems. A four division two-out-of-four SSLC provides protection against inadvertent actuation in addition to assuring the highly reliable actuation capability. This redundancy in the SSLC substantially reduces the calculated CDF for events that require SSLC signals as well as the reduction in unwanted system actuation resulting from inadvertent signals due to spurious inputs, surveillance and maintenance errors, and other causes of single signals.

The ESBWR additionally incorporates a Diverse Protection System that is completely independent and diverse from SSLC and provides logic signals for actuation of some significant safety related systems (DPV, SRV, GDCS, ARI, and SCRAM). This diverse actuation system minimizes the possibility of common cause failures between the control systems.

In addition, the non-safety digital control systems provide a second diverse means of providing core and containment cooling via the Plant Investment Protection (PIP) systems. In nearly all PRA scenarios, instrument and control failures can only cause core damage if all three diverse digital control systems fail to function. This provides a level of protection that drives the ESBWR CDF down to a very small value.

Fire Protection System Injection (FPS)

The FPS provides diverse capability to inject water to the reactor through FAPCS and FW lines in potential Loss of Coolant Accidents and other transient scenarios when the RPV is depressurized. FPS injection to the RPV is aligned by manual actions. In the event that AC power is not available, the system has a diesel driven pump with an independent water supply and all necessary valves can be accessed and operated manually. Additionally, the IC/PCCS pools have a makeup connection through FAPCS lines for independent long term makeup capability that is supplied from FPS lines or through a direct connection to a pump truck. Even though the FPS is not a first line prevention or mitigation system with respect to core damage, it is an important alternative for water makeup in preventing and mitigating severe accidents in the unlikely event that all other systems are unavailable.

18.2.3 Summary of Key Results

Risk results for the internal events full power PRA are provided in Tables 18-1 and 18-2. Table 18-1 provides a summary of the dominant internal events initiators, and Table 18-2 provides a summary of risk importance results. Key insights from these results are summarized below.

Key Initiating Events

As can be seen from Table 18-1, the dominant initiating events in the internal events full power PRA are:

- Loss of Preferred Power (57% contribution to internal events CDF)
- Loss of Feedwater (41% contribution to internal events CDF)

Each of the remaining initiating events individually represent less than 1% of CDF.

Key Operator Actions

The dominant post-initiator operator actions in the internal events full power PRA are:

- Failure to Recognize Need for LP Makeup (72% contribution to internal events CDF)
- Failure to Start Standby RCCW Pump (2% contribution to internal events CDF)

Each of the remaining operator actions individually represent less than 1% of the internal events CDF.

The dominant recovery action is Failure to Recover Offsite Power. The model includes multiple LOPP recovery actions for different time phases of the LOPP accident progression, collectively they contribute approximately 36% to internal events CDF.

Key Common Cause Failures

The dominant common cause failures in the internal event full power PRA are:

- CCF of 7 Squib Valves in GDCS Lines (43% contribution to internal events CDF)
- CCF of All Squib Valves (43% contribution to internal events CDF)
- CCF of All DC Batteries (1% contribution to internal events CDF)

Each of the remaining CCF events in the PRA individually represent less than 1% of the internal events CDF.

Key SSCs

The dominant system, structure or component random failures in the internal events full power PRA are:

- Check Valve #1 in FW Line B Fails to Open (6% contribution to internal events CDF)
- Check Valve #2 in FW Line B Fails to Open (6% contribution to internal events CDF)
- CRD Check Valve F022 Fails to Open (6% contribution to internal events CDF)

- Diesel Generator A Fails to Run (5% contribution to internal events CDF)
- Diesel Generator B Fails to Run (5% contribution to internal events CDF)

18.3 IMPORTANT FEATURES FROM SEISMIC ANALYSES

18.3.1 Summary of Analysis

The ESBWR seismic margin analyses are performed to assess plant vulnerability to potential seismic initiators. The analysis covers both power operation and shutdown conditions.

The seismic margins analysis (SMA) conducted for the ESBWR calculates high confidence low probability of failure (HCLPF) accelerations for important accident sequences.

The HCLPF acceleration is defined as the 95th percent confidence level that at that acceleration the seismic-induced failure probability of the structure or component in question is less than 0.05 (5%). HCLPFs for accident sequences are evaluated through use of event trees, and seismic system analysis is performed with fault trees to determine HCLPFs of systems.

The passive safety systems credited in the analysis have just a few active components (valves), all with automatic actuation and none with reliance on human actions that might represent a single failure dominating the overall system reliability. Human actions are required only in the long term and as such, given the low likelihood of failure for operator actions with very long allowable time windows, human action errors do not dominate system failure. As such, random failures are assumed to be non-significant contributors to seismic risk (consistent with past industry seismic studies) and are not explicitly included in the analysis.

The seismic margins approach used in this analysis evaluates the capability of the plant and equipment to withstand a large earthquake of two times the safe shutdown earthquake (2*SSE). In this analysis, the MIN-MAX method is used to assess the seismic accident sequences. Per the MIN-MAX method, the overall fragility of a group of inputs combined using OR logic (i.e., seismic event tree nodal fault tree) is determined by the lowest (minimum) HCLPF input. Conversely, per the MIN-MAX method, the overall fragility of a group of inputs combined using AND logic (i.e., seismic event tree sequence) is determined by the highest (maximum) HCLPF input.

A seismic event tree is developed for each operating mode. The event tree top events represent the operation of passive systems that are necessary to mitigate the consequences of the seismically induced initiating event and to reach a stable situation in the long term. Each top event corresponds to a seismic fault tree. These fault trees contain the key components subject to seismic failure. One of the important ground rules of the seismic margin analysis is that all similar components in a system always fail together.

The HCLPF value of accident sequences obtained from the min-max analysis shows that no accident sequence has a HCLPF lower than 0.60 g.

18.3.2 Key Features

Loss of structural integrity of one or more key structures due to a seismic event is modeled as directly leading to core damage. In this analysis, any one or more of these structural failures are conservatively presumed to result in core damage. The key structures modeled are the reactor building, containment, RPV pedestal, RPV supports, and control building. The reactor building has the lowest seismic capacity of these structures (0.67g HCLPF).

The structural failure nodal fault tree for the shutdown event trees conservatively includes additional failures related to reactivity control (fuel assemblies, shroud support, and CRD housings; the fuel assemblies have the lowest seismic capacity, 0.62g HCLPF).

Only passive safety systems are credited in the seismic analysis. The passive concept means that these systems do not require AC power supply for their actuation. However, a DC power supply is required for a number of functions in these systems (PCCS is the only fully passive system). As such, DC power supply is included in the seismic event tree as a separate top event. The components modeled in the DC nodal fault tree are the batteries, cable trays that contain the cables associated with DC distribution, and motor control centers. Failure at the DC power node is modeled as leading directly to a high pressure core damage scenario because all control is lost, the isolation condensers fail, and the reactor cannot be depressurized.

The full power seismic event tree requires opening of the safety relief valves to prevent RPV failure due to overpressure. Failure of the safety relief valves to open is modeled as leading directly to core damage.

Failure of the scram function is dominated by the seismic capacity of the fuel assemblies (0.62g HCLPF).

Given failure of the scram function, the Standby Liquid Control (SLCS) system is questioned in the full power seismic event tree. Failure at the SLCS node is modeled as leading directly to core damage. The SLCS nodal fault tree is dominated by the seismic capacity of the SLCS tank (0.62g HCLPF).

The other top events in the seismic event tree address the Isolation Condensers, RPV depressurization, Gravity Driven Cooling, Passive Containment cooling and Fire Protection Water injection.

18.3.3 Summary of Key Results

The seismic risk analysis uses a seismic margins approach and does not provide probabilistic core damage frequency or release frequency information. Key insights from the seismic margins analysis is provided below in a qualitative manner.

Key Initiating Events

The seismic margins analysis shows that no seismic-induced accident sequence has a HCLPF lower than 0.60g. As such, low magnitude seismic initiating events are not significant contributors to risk. High magnitude earthquakes, greater than 2 x SSE, are expected to be the major contributors to the seismic risk profile (this is consistent with past industry seismic PRAs).

Given the low seismic capacity of switchyard components, the majority of seismic events will result in a LOPP scenario.

Key Operator Actions

Based on past industry seismic PRAs, seismic risk is dominated by seismic-induced SSC failures and not by random SSCs failures or human actions. The passive safety systems credited in the analysis have just a few active components (valves), all with automatic actuation and none with reliance on human actions that might represent a single failure dominating the overall system reliability. Human actions are required only in the long term and as such, given the low likelihood of failure for operator actions with very long allowable time windows, human action errors are judged to be non-significant contributors to the seismic risk profile.

Key Common Cause Failures

Given that the seismic risk profile will be dominated by LOPP scenarios, the key non-seismic-induced common cause failures are judged to be:

- CCF of 7 Squib Valves in GDCS Lines
- CCF of All DC Batteries
- CCF of All Diesel Generators to Run
- CCF of All Diesel Generators to Start

Key SSCs

The most limiting HCLPF sequences (both 0.62g HCLPF) are seismic-induced loss of DC power and seismic-induced ATWS due to seismic-induced failure of the fuel channels and seismic-induced failure of the SLCS tank. Each of these scenarios also involves seismic-induced LOPP.

18.4 IMPORTANT FEATURES FROM FIRE ANALYSES

18.4.1 Summary of Analysis

The fire risk analysis shows that the core damage frequency due to fire is a non-significant contributor to ESBWR core damage risk. The scope of the analysis includes both at-power and shutdown fire-induced accident scenarios.

The ESBWR internal fires probabilistic risk assessment is performed per the Fire Vulnerability Evaluation (FIVE) Methodology developed by the Electric Power Research Institute (EPRI). The FIVE methodology provides procedures for identifying fire compartments for evaluation purposes, defining fire ignition frequencies, and performing quantitative analyses of fire risk.

The FIVE methodology involves the following three major steps:

(1) Identification of plant areas

(2) Calculation of fire ignition frequencies

(3) Calculation of fire-induced core damage frequencies

Fire ignition frequencies during power operation are estimated using the FIVE methodology and data. Fire frequencies for shutdown conditions are estimated using the information included in RES/OERAB/S02-01 "Fire Events Update of U.S. Operating Experience 1986-1999".

The internal events PRA accident sequence structures and system fault trees and success criteria are used in the calculation of the fire CDF.

The fire risk analysis is performed using conservative assumptions due, in part, to the status of the development of the design. The key conservative assumptions are summarized below:

(1) Fire areas are grouped to simplify the analysis. The fire frequency contributions from all the fire areas in the group are added together. The analysis assumes the worst effects of fire on all the equipment and systems located in each group of fire areas. Consequently, the analysis assumes that any fire in any fire area in the group will cause the worst damage.

(2) In the case of the reactor building, the fire frequencies from certain pumps located in the building (RWCU and CRD) and the fire frequencies from panels, battery chargers and batteries are added together despite the fact that these items are located in well-separated locations inside the building. Fires initiated in these separated locations are highly unlikely to affect divisional equipment.

(3) The analysis assumes that a fire ignition in any fire area continues to grow unchecked into a fully-developed fire. The analysis does not take credit for any fire suppression (i.e., self-extinguishment, installed suppression systems, nor manual fire fighting activities).

(4) The analysis assumes that all fires disable all potentially affected equipment in the area. The analysis does not take credit for the distance between fire sources and targets.

(5) The analysis assumes that all fire-induced equipment damage occurs at t=0.

(6) Every fire in the reactor building is conservatively assumed to result in an IORV initiating event. This is conservative because only a few cables in the reactor building could result in

spurious opening of SRVs. In addition, a specific fire-induced circuit failure would be required to cause the IORV.

The highest risk important component failure in the at-power internal fires risk analysis, using the F-V importance measure, is common cause failure of the GDCS squib valves to open. The highest risk important failure in the shutdown internal fires risk analysis is failure of a fire barrier separating divisional fire areas in the reactor building (this failure is also a dominant failure in the at-power fire analysis).

The highest risk important post-initiator operator action failure, using the F-V importance measure, is failure of the operators to recognize the need to manually align low pressure injection (e.g., fire protection injection). This is the dominant post-initiator action for both internal fire accidents initiated at-power and during shutdown.

18.4.2 Key Features

Fire protection is achieved through an adequate balance of:

- Preventing fires from starting
- Detecting fires quickly, suppressing those fires by controlling and extinguishing them quickly, and limiting their damage; and
- Designing plant safety and safety-related systems so that a fire that starts and burns for considerable time does not prevent essential plant safety functions.

The plant is divided into separate fire areas, and the redundant cables and equipment are separated with fire barriers to limit any damage caused by a fire and to provide a means to ensure that there is sufficient capacity to perform safety functions in case of fire.

The ESBWR plant design has three-hour fire rated barriers separating:

(1) Safety-related systems from any potential fires in nonsafety-related areas that could affect their ability to perform their safety function;

(2) Redundant divisions or trains of safety-related systems so that both are not subject to damage from a single credible fire that could consume everything within the given fire area; fires within inerted containment during plant operation are not considered credible;

(3) Components within a single safety division that could present a fire hazard to other safety-related components;

(4) Each remote shutdown panel from the other remote shutdown panel.

The application of these separation criteria ensures an adequate independence of each safety system division, such that a single fire can only affect one safety system division. These criteria are used in the analysis to support definitions of the major fire areas.

Fires in the Control Room have reduced plant impact due to the ESBWR optical fiber design. A fire in the Control Room cannot cause, for example, a fire-induced inadvertent opening of an SRV (i.e., IORV initiating event). If evacuation of the Control Room is required because of the fire, the plant proceeds to a safe shutdown automatically without the need for operator intervention. The operators monitor the shutdown from the remote shutdown panels and can perform manual actions if necessary automatic actuations fail.

The dominant fire area is the turbine building, due to the comparatively higher fire ignition frequency and the resulting damage impact given the turbine building is modeled as a single fire area. In the other key buildings the different divisions are separated by fire barriers and failure of a fire barrier is estimated at less than 1% given a fire.

18.4.3 Summary of Key Results

The risk importance results for the internal fires PRA are provided in Tables 18-3 (full power) and 18-4 (shutdown). Key insights from these results are summarized below.

Key Initiating Events

Full Power Internal Fires PRA

The dominant fire initiating events in the full power internal fires PRA are:

- Fire in Turbine Building (80% contribution to full power fire CDF)
- Fire in Rx Bldg. Division I Zone (6% contribution to full power fire CDF)
- Fire in Rx Bldg. Division II Zone (6% contribution to full power fire CDF)
- Fire in Rx Bldg. Division III Zone (3% contribution to full power fire CDF)
- Fire in Rx Bldg. Division IV Zone (3% contribution to full power fire CDF)

Each of the remaining fire initiating events individually represent less than 1% of the full power internal fires CDF.

Shutdown Internal Fires PRA

The dominant fire initiating events in the shutdown internal fires PRA are:

- Fire in Rx Bldg. Div. II Zone – Mode 5 (33% contribution to shutdown fire CDF)
- Fire in Rx Bldg. Div. I Zone – Mode 5 (31% contribution to shutdown fire CDF)
- Fire in Rx Bldg. Div. IV Zone – Mode 5 (17% contribution to shutdown fire CDF)
- Fire in Rx Bldg. Div. III Zone – Mode 5 (16% contribution to shutdown fire CDF)

Each of the remaining fire initiating events individually represent less than 1% of the shutdown fire CDF.

Key Operator Actions

Full Power Internal Fires PRA

The dominant operator actions in the full power internal fires PRA are:

- Failure to Recognize Need for LP Makeup (60% contribution to full power fire CDF)
- Failure to Recognize Need for RPV Depressurization (13% contribution to full power fire CDF)

Each of the remaining operator actions individually represent less than 1% of the full power internal fires CDF.

Shutdown Internal Fires PRA

The dominant operator actions in the shutdown internal fires PRA are:

- Failure to Recognize Need for RPV Depressurization (63% contribution to shutdown fire CDF)
- Failure to Start Condensate Pump D (53% contribution to shutdown fire CDF)
- Failure to Start Feedwater Pump D (44% contribution to shutdown fire CDF)
- Failure to Recognize Need for LP Makeup (2% contribution to shutdown fire CDF)

Each of the remaining operator actions individually represent less than 1% of the shutdown internal fires CDF.

Key Common Cause Failures

Full Power Internal Fires PRA

The dominant common cause failures in the full power internal fires PRA are:

- CCF of 7 Squib Valves in GDCS Lines (35% contribution to full power fire CDF)
- CCF of All Squib Valves (35% contribution to full power fire CDF)
- CCF of DPVs to Open (1% contribution to full power fire CDF)

Each of the remaining common cause failures in the model individually represent less than 1% of the full power internal fires CDF.

Shutdown Internal Fires PRA

The dominant common cause failures in the shutdown internal fires PRA are:

- CCF of DPVs to Open (6% contribution to shutdown fire CDF)
- CCF of 7 Squib Valves in GDCS Lines (3% contribution to shutdown fire CDF)
- CCF of All Squib Valves (3% contribution to shutdown fire CDF)
- CCF of 3/4 DTMs of SSLC (1% contribution to shutdown fire CDF)

Each of the remaining common cause failures in the model individually represent less than 1% of the shutdown internal fires CDF.

Key SSCs

Full Power Internal Fires PRA

The dominant system, structure or component random failures in the full power internal fires PRA are:

- Reactor Building Fire Barrier Fails (16% contribution to full power fire CDF)
- TCCW HXs Bypass Valve Fails to Regulate (9% contribution to full power fire CDF)
- Check Valve #1 in FW Line B Fails to Open (6% contribution to full power fire CDF)
- Check Valve #2 in FW Line B Fails to Open (6% contribution to full power fire CDF)

- CRD Check Valve F022 Fails to Open (6% contribution to full power fire CDF)

Shutdown Internal Fires PRA

The dominant system, structure or component random failures in the shutdown internal fires PRA are:

- Reactor Building Fire Barrier Fails (83% contribution to shutdown fire CDF)
- Diesel Fire Pump Injection Hardware Failure (9% contribution shutdown fire CDF)
- Div. 3 EMS Fails to Function (7% contribution to shutdown fire CDF)
- DTM of SSLC Div. 3 Fails to Trip (6% contribution to shutdown fire CDF)
- DTM of SSLC Div. 4 Fails to Trip (6% contribution to shutdown fire CDF)

18.5 IMPORTANT FEATURES FROM FLOODING ANALYSES

18.5.1 Summary of Analysis

The objective of the ESBWR internal probabilistic flood analysis is to identify and provide a quantitative assessment of the core damage frequency due to internal flood events. It models potential flood vulnerabilities, in conjunction with random failures modeled as part of the internal events PRA. A simplified probabilistic flooding approach is employed using general design assumptions to identify potential flooding vulnerabilities. The scope of the analysis includes both at-power and shutdown flood-induced accident scenarios.

The buildings included in the analysis scope are the following:

- Reactor Building
- Control Building
- Fuel Building
- Turbine Building
- Electrical Building
- Service Water Building
- Tunnels and Galleries connected with these buildings.

Floods in the remaining ESBWR buildings are not considered in the study because the flood water cannot propagate to any of the above buildings.

The frequencies of flood scenarios in these buildings are based on generic information.

The analysis considers aspects that affect flood progression in each building. Depending on the building and the origin of the flood, the following aspects are considered:

- Automatic flood detection systems
- Automatic systems to terminate flooding
- Watertight doors to prevent the progression of flooding
- Other design or construction characteristics that contribute to minimize the consequences of flooding

The systems inside each building that could represent a flood source are considered. From these systems, the building flood source that presents the most critical characteristics for flood progression and which has the capacity to damage mitigation equipment is chosen.

The highest risk important component failure in the internal floods risk analysis, using the F-V importance measure, is common cause failure of the GDCS squib valves to open. This is the dominant component failure for both internal flood accidents initiated at-power and during shutdown.

The highest risk important post-initiator operator action failure in the at-power internal floods analysis, using the F-V importance measure, is failure of the operators to align FAPCS in LPCI mode; however, this failure is a non-significant risk contributor to at-power internal flood risk (appearing in less than 1% of the at-power internal flood CDF sequences). The highest risk important post-initiator operator action failure in the shutdown internal floods analysis is failure of the operators to recognize the need to manually align low pressure injection (e.g., fire protection injection).

18.5.2 Key Features

This bounding analysis shows that the contribution of floods to the CDF during power or during shutdown is not significant to the overall plant CDF.

The plant is divided into separate flood areas, redundant equipment are separated by barriers to limit flood damage. For example, the reactor building is divided into four quadrants, each containing a safety division. Flood waters flowing to the basement of the reactor building will not propagate to the Control Building via the cable galleries due to the design arrangements and features provided.

The dominant scenario is a CIRC pipe break in the turbine building, due to the comparatively higher frequency and magnitude of flood sources in the turbine building and the less compartmentalized nature of the turbine building.

Due to the inherent ESBWR flooding mitigation capability, only a small number of flooding specific design features are key in the mitigation of significant flood sources, for example:

- Using watertight doors in the accesses to tunnels and galleries from the Control and Reactor Buildings.
- Not locating flood sources with a significant volume of water in the Control Building.
- Locating flood sources in the Electrical Building in such a way that a flood does not affect key components.
- Limiting the volume of water that the FPS can distribute in the Reactor Building.
- Reducing as much as possible the time interval during which the Drywell atmosphere and the atmosphere of other buildings are communicated through the hatches.
- Locating an automatic CWS pump trip and valve closure on high water level in the condenser pit.

While timely operator action can limit potential flood damage, all postulated floods can be mitigated (from a risk perspective) without operator action.

18.5.3 Summary of Key Results

The risk importance results for the internal flooding PRA are provided in Tables 18-5 (full power) and 18-6 (shutdown). Key insights from these results are summarized below.

Key Initiating Events

<u>Full Power Internal Flooding PRA</u>

The dominant flood initiating event in the full power internal flooding PRA is a CIRC pipe break in the turbine building, contributing over 99% to the full power internal flooding CDF.

Each of the remaining flood initiating events individually represent much less than 1% of the full power internal flooding CDF.

Shutdown Internal Flooding PRA

The dominant flood initiating events in the shutdown internal flooding PRA are:

- CRD Break in Rx Bldg. – Mode 6 (91% contribution to shutdown flood CDF)
- FPS Break in Rx Bldg. – Mode 6 (5% contribution to shutdown flood CDF)
- FPS Break in Fuel Bldg. – Mode 6 (4% contribution to shutdown flood CDF)

Each of the remaining flood initiating events individually represent much less than 1% of the shutdown flood CDF.

Key Operator Actions

Full Power Internal Flooding PRA

Operator actions are non-significant contributors to the full power internal flooding risk profile. All operator actions in the model individually contribute less than 1% to internal flooding CDF. The highest risk important post-initiator operator action failure in the full power internal floods analysis, using the F-V importance measure, is Failure to Align FAPCS in LPCI Mode (0.2% contribution to full power flooding CDF).

Shutdown Internal Flooding PRA

The dominant operator actions in the shutdown internal flooding PRA are:

- Failure to Recognize Need for LP Makeup (57% contribution to shutdown flood CDF)
- Failure to Align FAPCS in LPCI Mode (6% contribution to shutdown flood CDF)

Each of the remaining operator actions individually represent less than 1% of the shutdown internal flooding CDF.

Key Common Cause Failures

Full Power Internal Flooding PRA

The dominant common cause failures in the full power internal flooding PRA are:

- CCF of 7 Squib Valves in GDCS Lines (41% contribution to full power flood CDF)
- CCF of All Squib Valves (41% contribution to full power flood CDF)

Each of the remaining common cause failures in the model individually represent less than 1% of the full power internal flooding CDF.

Shutdown Internal Flooding PRA

The dominant common cause failures in the shutdown internal flooding PRA are:

- CCF of 7 Squib Valves in GDCS Lines (38% contribution to shutdown flood CDF)
- CCF of All Squib Valves (38% contribution to shutdown flood CDF)

Each of the remaining common cause failures in the model individually represent less than 1% of the shutdown internal flooding CDF.

Key SSCs

Full Power Internal Flooding PRA

The dominant system, structure or component random failures in the full power internal flooding PRA are:

- Check Valve #1 in FW Line B Fails to Open (10% contribution to full power flood CDF)
- Check Valve #2 in FW Line B Fails to Open (10% contribution to full power flood CDF)
- CRD Check Valve F022 Fails to Open (10% contribution to full power flood CDF)
- GDCS Squib Valve F009A/D/E/H/I/L Spuriously Opens (4% contribution to full power flood CDF for each valve)
- GDCS Squib Valve F009B/C/F/G/J/K Spuriously Opens (3% contribution to full power flood CDF for each valve)

Shutdown Internal Flooding PRA

The dominant system, structure or component random failures in the shutdown internal flooding PRA are:

- Diesel Fire Pump Injection Hardware Failure (9% contribution shutdown flood CDF)
- GDCS Pool B in Maintenance (8% contribution to shutdown flood CDF)
- GDCS Squib Valve F009A/D/E/H/I/L Spuriously Opens (5% contribution to shutdown flood CDF for each valve)
- GDCS Squib Valve F009B/C/F/G/J/K Spuriously Opens (3% contribution to shutdown flood CDF for each valve)
- GDCS Squib Valve F009A/D/E/H Fails to Operate (2% contribution to shutdown flood CDF for each valve)

18.6 IMPORTANT FEATURES FROM SUPPRESSION POOL BYPASS AND EX-CONTAINMENT LOCA ANALYSES

18.6.1 Summary of Analysis Results

Suppression pool bypass pathways, potential pathways for the release of radioactive material that do not receive the benefits of suppression pool scrubbing, were evaluated.

Ex-containment LOCAs that bypass the suppression pool were evaluated based on event trees.

18.6.2 Logical Process Used to Select Important Design Features

The bypass fraction was used to verify that bypass paths contribute less than 10% of the total offsite risk from internal event sequences and therefore do not present an undue offsite risk. The features that contribute to the prevention or mitigation of containment bypass were systematically reviewed to evaluate their specific contribution to containment bypass.

The core cooling features that could prevent or mitigate containment bypass were systematically reviewed to determine their contribution to total CDF. Those features that would increase the calculated CDF by more than a factor of 2, whether they failed or were not included in the design, were identified as important features.

DW-WW Vacuum Breakers

Assuming an event leads to wetwell pressurization, the vacuum breakers would open and then close thereby isolating the drywell from the wetwell. Failure of a DW-WW vacuum breaker to close following the assumed event provides a significant bypass from the drywell into the wetwell airspace. A similar scenario happens if a Vacuum Breaker remains open inadvertently before a Loss of Cooling Accident. If the Containment Inerting System bleed line is opened as result of the loss of suppression pool function, due to the vacuum breaker failure, there would be a direct pathway from the drywell/wetwell to the environment. The consequence of a vacuum breaker failing to close or inadvertently remaining open was evaluated in the PRA.

Redundant MSIVs

There are four main steamlines (MSL), each with two in-series automatic isolation valves. The MSIVs are a pneumatic operated, spring close, fail-closed design actuated by redundant solenoids through two-out-of-four logic. If both MSIVs in any one MSL fail to close there will be a large bypass pathway from the RPV to the Turbine Building. The potential bypass pathway is large compared to other potential bypass pathways. Therefore, the failure of two MSIVs to close in any one steamline would result in a higher consequence from a given postulated event. Although it is extremely unlikely, it is possible that two MSIVs in the same steamline could fail to close and, depending on the event, the failure could result in a substantial offsite dose consequence.

Design and Fabrication of the SRV Discharge Lines

The discharge of the SRVs is piped through the drywell airspace to the suppression pool that is inside the wetwell. To ensure the integrity of the SRV discharge lines, especially in the wetwell region, these lines are designed and fabricated to Quality Group C requirements and the welds in the wetwell region above the surface of the suppression pool are non-destructively examined to the requirements of ASME Section III, Class 2. The discharge of the SRVs are piped downward through the drywell/wetwell vent wall and then emerge into the suppression pool below the pool surface to minimize potential for bypass of the suppression pool as result of a break in one of these lines in the wetwell airspace that could result in the rapid pressurization of the containment.

Normally Closed Sample Lines and Drywell Purge Lines

The sample lines and drywell purge lines are normally closed during plant power operation. Although the valves in the sample and drywell purge lines are normally closed in order to limit the risk of bypass, if one or more of these lines are open when an event initiates a potential bypass path can exist. Depending on the event and the size and number of lines open, a substantial fission product release could result in a significant increase in the consequences of a given event.

Diverse Reactor Water Cleanup System Isolation Valves

In the event of a break in the RWCU system, it is important that the break be isolated. The probability of not isolating a RWCU line break outside containment is very low due to inclusion of three automatic diverse isolation valves (in addition to the a remote manual shutoff valve). Even though the exposed structures and safety related equipment are designed for the loads and environment that could follow from an unisolated break, there is some potential for failure. Further, there is some potential for the operator not properly controlling reactor vessel water level during the recovery phase.

Several plant features treated in the analysis were judged much less important than those discussed above. These are noted in the following paragraphs.

Piping dimensions are judged to be less important to suppression pool bypass evaluations than other features. Design dimensions of the plant such as piping size and length determine the flow split fraction. While important in the evaluation of suppression pool bypass, the evaluation was based on conservatively low estimates of bypass path resistance. Consequently these features were not considered important within the context of the final system design. Only much larger piping sizes in identified pathways would be of concern, but significant variations are not considered likely.

The level of water in the suppression pool is considered less important than other features. Higher suppression pool level tends to increase the amount of flow that passes through a bypass pathway because of the increased resistance within the suppression pool path. This characteristic is less important to the results because the flow split fraction varies as the square root of the differential pressure and thus the suppression pool level. Since the suppression pool water level is limited by the return line elevation to 1.6 m above the normal level of the suppression pool, the maximum effect on the bypass fraction is about 10%.

The closing of the turbine bypass valve is considered less important than other features. If the MSIVs fail to close in one of the steamlines, the turbine bypass valve would normally be expected to close in response to the Turbine Pressure Control System after RPV pressure has reduced below normal operating pressure. Failure of this valve to close is one component of the definition of the main steamline bypass pathway. The feature is considered relatively unimportant in comparison with the reliability of MSIV closure.

The instrument check valves are also less important than other features. All instruments which sense RPV or containment parameters contain inline flow-limiting orifice and excess flow check valves to limit the release in the event of an instrument line break. However due to their small line size, even if the check valves fail to prevent excess flow, the total bypass fraction from instruments would only contribute about 1.5% of the total bypass fraction. Therefore this feature is considered of lesser importance to the results of the bypass evaluation.

Reliable seating of redundant Feedwater and SLC check is considered to be of lesser importance than other features that prevent or mitigate suppression pool bypass. Because of the relatively large line size, failure of the redundant feedwater check valves can lead to a bypass if a break occurs in the feedwater, RWCU or FAPCS (LPCI) return lines, both check valves fail to prevent full reverse flow and core damage occurs. Redundant SLC lines also result in a bypass path if the check valves fail to prevent reverse flow and a piping failure occurs.

18.7 IMPORTANT FEATURES FROM TORNADO ANALYSES

18.7.1 Summary of Analysis

The analysis involves the following three major steps:

(1) Tornado hazard frequency

(2) Tornado-induced plant impacts

(3) Calculation of tornado-induced core damage frequencies

The tornado hazard frequency is based on generic data. The tornado-induced plant impacts are based on a qualitative evaluation based on ESBWR plant design criteria. The internal events PRA accident sequence structures and system fault trees and success criteria are used in the calculation of the tornado CDF.

Both at-power and shutdown tornado-induced accident scenarios are quantified.

18.7.2 Key Features

Due to the strength of construction of the ESBWR Category I buildings, the effects of a tornado strike are limited primarily to long-term LOPP and potential CST failure (this is consistent with past industry tornado studies).

The following additional ESBWR key features further minimize tornado risk:

- Diesel driven fire protection water injection as an alternative RPV injection method
- 24-hr DC battery life.

18.7.3 Summary of Key Results

The risk importance results for the tornado PRA are provided in Tables 18-7 (full power) and 18-8 (shutdown). Key insights from these results are summarized below.

Key Operator Actions

Full Power Tornado PRA

The highest risk important post-initiator operator action failure in the full power tornado analysis, using the F-V importance measure, is Failure to Recognize the Need for LP Makeup (78% contribution to full power tornado CDF).

All other operator actions in the model individually represent less than 1% of the full power tornado CDF.

Shutdown Tornado PRA

Operator actions are non-significant contributors to the shutdown tornado risk profile.

Key Common Cause Failures

Full Power Tornado PRA

The dominant common cause failures in the full power tornado PRA are:

- CCF of 7 Squib Valves in GDCS Lines (48% contribution to full power tornado CDF)

- CCF of All Squib Valves (48% contribution to full power tornado CDF)
- CCF of All DC Batteries (3% contribution to full power tornado CDF)

Each of the remaining common cause failures in the model individually represent less than 1% of the full power tornado CDF.

Shutdown Tornado PRA

The dominant common cause failure in the shutdown tornado PRA is CCF of All DC Batteries.

Key SSCs

Full Power Tornado PRA

The dominant system, structure or component random failures in the full power tornado PRA are:

- Diesel Generator A Fails to Start (6% contribution to full power tornado CDF)
- Diesel Generator B Fails to Start (6% contribution to full power tornado CDF)
- CB from Transformer A Fails to Open (3% contribution to full power tornado CDF)
- CB from Transformer B Fails to Open (3% contribution to full power tornado CDF)

Shutdown Tornado PRA

The shutdown tornado risk profile is dominated by common cause failure of the DC batteries. Random SSC failures are non-significant risk contributors.

18.8 IMPORTANT FEATURES FROM SHUTDOWN EVENTS ANALYSES

18.8.1 Summary of Analysis

The internal events shutdown analysis evaluates the potential for core damage during shutdown modes (i.e., Modes 5, 6-Unflooded, and 6-Flooded). The analysis focuses on the following safety functions:

(1) Decay heat removal

(2) Inventory control

The evaluation encompasses plant operation in shutdown modes and addresses conditions in which there is fuel in the RPV. It includes all aspects of the NSSS, the containment, and all systems that support operation of the NSSS and containment.

18.8.2 Key Features

The capabilities and features identified as being important to safety are discussed below. Only those features with key importance to shutdown PRA are discussed here. Although, most of the features described in Section 18.2 (important features based on the full power PRA) also contribute to reducing shutdown CDF.

The highest risk important component failure in the internal events shutdown risk analysis, using the F-V importance measure, is common cause failure of the DC batteries.

The highest risk important post-initiator operator action failure in the internal events shutdown risk analysis, using the F-V importance measure, is failure of the operators to close the DW hatch during instrument line break scenarios inside containment.

Decay Heat Removal

Isolation Condenser System (ICS). During Mode 5, the ICS is able to maintain reactor pressure and temperature within an acceptable range so that Safety/Relief valves will not lift (as a result of pressure increases to lift set-point). The system is a safety related system featuring four totally independent loops and is designed with a single failure criterion. This is a significant feature of ESBWR design that provides full decay heat removal capability in all transients with loss of normal heat sink during Modes 1 through 5. The ICS is not viable during Mode 6 when the RPV is open. The system shares the passive heat sink of water in the IC/PCC pools with the Passive Containment Cooling System. The IC/PCC pools provide enough water inventory for decay heat removal beyond 72 hours. The system redundancy, independence and diversity of actuation signals greatly reduce the contribution of Mode 5 to shutdown CDF.

Reactor Water Cleanup / Shutdown Cooling System (RWCU/SDC). RWCU/SDC has two trains in operation during the cooldown phase of shutdown (which is the most critical, as decay heat is still significant). However, one single train has enough decay heat removal capacity to maintain reactor pressure vessel temperature within acceptable limits during this phase, as well as other phases of shutdown. The resulting low frequency of loss of RWCU/SDC initiators contributes to lowing the ESBWR shutdown CDF due to loss of decay heat removal.

Water inventory in-vessel and in the reactor building upper pools. The large amount of water stored in the vessel provides a reliable, passive heat sink during all phases of Mode 6, increasing the time margin for operator actions. Once the reactor cavity has been flooded, water inventory in the reactor building upper pools further increases the heat sink capacity, making loss of decay heat removal core damage accidents during Mode 6-Flooded negligible risk contributors.

Gravity Driven Cooling System (GDCS). GDCS does not rely upon cooling systems or external power, making it available to mitigate all initiating events considered. This system features four independent and separated divisions designed with single failure criteria, which substantially reduces the calculated CDF for sequences mitigated by GDCS.

Injection Mode of Fire Protection System (FPS). Although not a passive system, the FPS features a diesel engine powered pump, allowing it to effectively mitigate Loss of Preferred Power and Loss of RCCWS/PSWS events, thus contributing to the reduction of shutdown CDF.

Inventory Control

Containment Isolation. Loss of Coolant Accidents outside containment are negligible contributors to shutdown risk based on a number of ESBWR design features:

- These events can only occur in RWCU/SDC piping, as this is the only system extracting reactor coolant from containment in Mode 6, the rest of the RPV vessel piping is isolated. (LOCAs outside containment during Mode 5 are addressed in the at-power PRA.)
- The RWCU/SDC containment penetrations have redundant and automatic power-operated containment isolation valves that close on signals from the leak detection and isolation system, and the reactor protection system.
- The leak detection and isolation system, utilizing a two-out-of-four logic, closes the containment isolation valves on detection of high flow in the ASME Section III Class 1 portion of the RWCU/SDC piping system or on detection of high temperature in the Main Steam Tunnel. These independent methods provide a diverse means of detecting large breaks in the RWCU/SDC piping.
- A postulated break in the RWCU/SDC piping system inside the Reactor Building, which would otherwise allow reactor coolant to flow backwards through main feedwater lines and to spill into the Reactor Building, is isolated by the redundant RWCU/SDC check valves even if a single failure of one check valve is assumed.

Reactor Water Cleanup / Shutdown Cooling System (RWCU/SDC). The specific design of ESBWR significantly reduces the number of potential RPV draindown pathways due to system misalignment during shutdown conditions. In particular, as compared to Residual Heat Removal System in current BWRs, the RWCU/SDCS in the ESBWR does not have the potential for diverting RPV inventory to the suppression pool through SP suction, return or spray lines. In addition, the absence of recirculation lines in the ESBWR design further reduces the potential RPV draining paths.

18.8.3 Summary of Key Results

The risk importance results for the internal events shutdown PRA are provided in Table 18-9. Key insights from these results are summarized below.

Key Initiating Events

The dominant initiating events in the internal events shutdown PRA are:

- Instrument Line Break Below TAF – Mode 6, Flooded (42% contribution to internal events shutdown CDF)
- LOPP – Mode 6, Unflooded (31% contribution to internal events shutdown CDF)
- RWCU/SDC Drain Line Break Below TAF – Mode 6, Flooded (12% contribution to internal events shutdown CDF)
- Instrument Line Break Below TAF – Mode 6, Unflooded (10% contribution to internal events shutdown CDF)
- RWCU/SDC Drain Line Break Below TAF – Mode 6, Unflooded (3% contribution to internal events shutdown CDF)

Each of the remaining initiating events individually represent less than 1% of the internal events shutdown CDF.

Key Operator Actions

Operator actions are non-significant contributors to shutdown risk. The dominant post-initiator operator action in the internal events shutdown PRA is Failure to Recognize Need for LP Makeup (1% contribution to internal events shutdown CDF).

Each of the remaining post-initiator operator actions individually represent less than 1% of the internal events shutdown CDF.

The dominant recovery action is Failure to Recover Offsite Power. The model includes multiple LOPP recovery actions for different operating modes, collectively they contribute approximately 31% to internal events shutdown CDF.

Key Common Cause Failures

The dominant common cause failure in the internal events shutdown PRA is CCF of All DC Batteries (1% contribution to internal events shutdown CDF).

Each of the remaining CCF events in the PRA individually represent less than 1% of the internal events shutdown CDF.

Key SSCs

Random failures of systems, structures or components are not significant contributors to the internal events shutdown CDF.

18.9 ESBWR FEATURES TO MITIGATE SEVERE ACCIDENTS

The ESBWR is designed to minimize the potential of a core damage accident. In fact, the probability of a core damage accident is significantly less than 1 chance in 1 million. This represents an improvement in severe accident prevention when compared to current plants. In the extremely unlikely event of a core damage accident, the ESBWR containment is designed with specific mitigating capabilities. These capabilities not only mitigate the consequences of a severe accident but also address uncertainties in severe accident phenomena. The capabilities and associated severe accident phenomena are discussed below. The severe accident issues addressed are consistent with the issues discussed in SECY 90-016.

AC-Independent Fire Water Addition System

This Fire Protection System (FPS) and Fuel and Auxiliary Pools Cooling System (FAPCS) not only play an important role in preventing core damage, but they are the backup source of water for flooding the lower drywell should the core become damaged and relocate into the containment (the primary source is the deluge subsystem pipes of the Gravity Driven Cooling System). The primary injection path is via LPCI injection, through feedwater and into the reactor pressure vessel. Flow can also be delivered directly to the drywell through the drywell spray header. The drywell spray mode of this system not only provides for debris cooling, but it also directly cools the upper drywell atmosphere and provides scrubbing of airborne fission products. This system has sufficient capacity to cover the ex-vessel core debris and provide debris cooling and scrub fission products released as a result of continued core-concrete interactions.

The system operating in the drywell spray mode also reduces the consequences of a suppression pool bypass or containment isolation failure. This is due to the fission product removal function performed by this mode of operation.

The system is sized to optimize the containment pressure response and slow the rate of containment pressurization.

GDCS Deluge Subsystem

The lower drywell deluge subsystem is included in the ESBWR design to provide primary cavity flooding in the event of core debris discharge from the reactor vessel. The melting of a fusible plug actuates the thermally activated squib valves. The system consists of four independent deluge lines, each is further branched into three lines, located about 4 m below the normal suppression pool water level discharging into the lower drywell about 1 m above the floor. Only two of the valves are required to open to remove decay heat energy and the energy from zirconium-water reaction and allow for quenching of the debris. The passive flooder will not open until after vessel failure. By flooding after the introduction of core material, the potential for energetic core-water interactions during debris discharge is minimized. The flooder will cover the core debris with water providing for debris cooling and scrubbing any fission products released from the debris due to core-concrete interactions.

Containment Inerting System Bleed Line

The Containment Inerting System Bleed Line has air operated valves mounted on a line that connects the wetwell airspace to the reactor building HVAC discharge. This system will provide for a scrubbed release path in the event that pressure in the containment cannot be maintained below the structural limit. The path can be opened or closed at pressures up to the ultimate capability of the containment.

Vessel Depressurization

The ESBWR reactor vessel is designed with a highly reliable depressurization system. The nitrogen supply and battery capacity are sufficient to allow depressurization after potential IC failures. This system plays a major role in preventing core damage. However, even in the event of a severe accident, the RPV depressurization system can prevent the effects of direct containment heating (DCH) from high pressure core melt ejection. If the reactor vessel fails at an elevated pressure, fragmented core debris could be transported into the upper drywell. The resulting heatup of the upper drywell could pressurize and fail the drywell. The ESBWR has many different means of depressurizing the vessel, thus reducing the potential for high pressure core melt ejection.

Inerted Containment

One of the important severe accident consequences is the generation of combustible gases. Combustion of these gasses could increase the containment temperature and pressure. The ESBWR containment is inerted during operation to minimize the impact from the generation of these gases.

Containment Isolation

The ESBWR containment design strives to minimize the number of penetrations. This impacts the severe accident response due to a smaller probability of containment isolation failure. All lines that originate in the reactor vessel or the containment have dual barrier protection that is generally obtained by redundant isolation valves. Lines that are considered non-essential in mitigating an accident isolate automatically in response to diverse isolation signals. Lines which may be useful in mitigating an accident have means to detect leakage or breaks and may be isolated should this occur.

Upgraded Low Pressure Piping

The low pressure piping that could be exposed to RPV pressure is upgraded in the ESBWR design to withstand RPV rated pressure. This reduces the probability of an interfacing system LOCA and the severe accident consequences associated with such an event.

Drywell-Wetwell Vacuum Breakers

The ESBWR contains three vacuum breakers that provide positive position indication in the Control Room. Failure of the vacuum breakers to close as designed can potentially lead to increased source terms and early containment failure. If the operators have indications that any of the vacuum breakers has failed or is leaking there is a built-in provision to isolate the failed component. The vacuum breakers are located high in the wetwell to reduce potential loads occurring during pool swell. The analysis in the PRA assumes that the position switch that provides annunciation in the Control Room can sense a gap between the disk and the seating surface lower than 1 cm^2 (0.155 in^2). Additionally, the vacuum breakers are tested during periodic outages to ensure operability. The result of the vacuum breaker design in the ESBWR is to reduce the potential for suppression pool bypass.

Overall Containment Performance

The design of the ESBWR containment provides for holdup and delay for fission product release should the containment integrity be challenged. The containment design is a low leakage that is expected to apply to severe accidents. Long term containment pressurization is governed by the generation of decay heat and non-condensable gases. The primary source of noncondensable gas generation is metal-water reaction of the zirconium in the core. The containment is designed to withstand the generation of 100% metal-water reaction of the clad surrounding the fuel. The ultimate strength capability is important for rapid containment challenges such as direct containment heating and rapid steam generation. The mitigating systems discussed above ensure that the decay energy results in steam production. The suppression pool absorbs this energy, resulting in very slow containment response that ensures ample time for fission product removal.

Basemat Internal Melt Arrest and Coolability Device (BiMAC)

The ESBWR design uses a passively-cooled boundary that is impenetrable by the core debris in whatever configuration it could possibly exist on the lower drywell (LDW) floor. For ex-vessel implementation, this boundary is provided by a series of side-by-side inclined pipes, forming a jacket which can be effectively and passively cooled by natural circulation when subjected to thermal loading on any portion(s) of it. Water is supplied to this device from the GDCS pools via a set of squib-valve-activated deludge lines. The timing and flows are such that (a) cooling becomes available immediately upon actuation, and (b) the chance of flooding the LDW prematurely, to the extent that this opens up a vulnerability to steam explosions, is very remote. The jacket is buried inside the concrete basemat and would be called into action only in the event that some or all of the core debris on top is non-coolable.

Analyses have shown that the containment will not fail by Basemat melt-through or by overpressurization as long as the BiMAC functions.

Table 18-1

Important Initiating Events with Internal Events CDF Contributions >0.05%

Initiating Event (IE)	IE Prob [/yr]	CDF [/yr]	Contribution
T-LOPP: Loss of Preferred Power	4.60E-2	1.67E-08	57.04%
T-FDW: Loss of Feedwater Transient	9.25E-2	1.20E-08	41.09%
ML-L: Medium Liquid LOCA	2.51E-5	2.23E-10	0.76%
T-GEN: General Transient	1.30E+0	1.30E-10	0.44%
T-IORV: Inadvertent Open Relief Valve Transient	4.60E-2	1.17E-10	0.40%
T-PCS: Transient with PCS Unavailable	3.74E-1	3.70E-11	0.13%
LL-S-FDWB: Large Steam LOCA in FDW Line B	7.42E-6	2.36E-11	0.08%
Total		**2.92E-08**	**100%**

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
XXX-XHE-FO-LPMAKEUP	1.61E-01	7.20E-01	4.75	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
E50-SQV-CF-GDCS7OPEN	1.50E-05	4.32E-01	2.88E+04	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	4.32E-01	2.88E+04	CCF OF ALL SQUIB VALVES TO OPEN
R11-SYS-FF-NOREC	6.13E-01	3.55E-01	1.22	FAILURE IN OFFSITE POWER RECOVERY
G21-XHE-MH-F334	4.80E-02	2.08E-01	5.13	MISPOSITION OF VALVE F334
C12-XHE-MH-F013A	4.80E-02	1.80E-01	4.58	MISPOSITION OF VALVE F013A
C12-XHE-MH-F013B	4.80E-02	1.80E-01	4.58	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015A	4.80E-02	1.80E-01	4.58	MISPOSITION OF VALVE F015A
C12-XHE-MH-F015B	4.80E-02	1.80E-01	4.58	MISPOSITION OF VALVE F015B
P30-XHE-MH-F015	4.80E-02	7.94E-02	2.58	MISPOSITION OF VALVE F01T
B21-UV_-CC-F102B	1.60E-03	6.01E-02	38.55	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	6.01E-02	38.55	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	6.01E-02	38.55	CHECK VALVE F022 FAILS TO OPEN
R21-DG_-FR-DGA	5.60E-02	5.42E-02	1.91	DIESEL GENERATOR "A" FAILS TO RUN GIVEN START
R21-DG_-FR-DGB	5.60E-02	4.84E-02	1.82	DIESEL GENERATOR "B" FAILS TO RUN GIVEN START
C12-XHE-MH-F018A	1.20E-02	3.60E-02	3.96	MISPOSITION OF VALVE F018A
C12-XHE-MH-F021A	1.20E-02	3.60E-02	3.96	MISPOSITION OF VALVE F021A
C12-XHE-MH-F003B	1.20E-02	2.91E-02	3.39	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018B	1.20E-02	2.91E-02	3.39	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021B	1.20E-02	2.91E-02	3.39	MISPOSITION OF VALVE F021B
R21-DG_-FS-DGA	1.40E-02	2.60E-02	2.83	DIESEL GENERATOR "A" FAILS TO START
R21-DG_-FS-DGB	1.40E-02	2.47E-02	2.74	D/G "B" FAILS TO START AND LOAD
E50-SQV-CO-F009A	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-SQV-CO-F009H	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	2.44E-02	7.96	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
P21-XHE-FO-STDBYPUMP	2.69E-01	1.73E-02	1.05	OP. FAILS MAN. ACT. OF STDBY PUMP WHEN AUT. ACTUATION FAIL
E50-SQV-CO-F009B	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009B SPUR. OPENING [#7]
E50-SQV-CO-F009C	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009C SPUR. OPENING [#7]
E50-SQV-CO-F009F	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009F SPUR. OPENING [#7]
E50-SQV-CO-F009G	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009G SPUR. OPENING [#7]
E50-SQV-CO-F009J	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]
E50-SQV-CO-F009K	3.50E-03	1.69E-02	5.81	SQUIB DELUGE VALVE F009K SPUR. OPENING [#7]
R11-MCB-CC-XFRMAA2	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER FROM XFRM-A FAILS TO OPEN
R22-MCB-CC-1LOAD1	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-1LOAD2	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-1LOAD3	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-1LOAD4	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-1LOAD5	7.96E-03	1.40E-02	2.74	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN
C12-MOV-CC-F014A	4.00E-03	1.34E-02	4.33	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F014B	4.00E-03	1.34E-02	4.33	MOTOR OPER. VALVE F014B FAILS TO OPEN
U43-SYS-FF-LPCI	2.40E-02	1.34E-02	1.55	U43 HARDWARE FAILURES
R11-MCB-CC-XFRMBB2	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER FROM XFRM-B FAILS TO OPEN
R22-MCB-CC-2LOAD1	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-2LOAD2	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-2LOAD3	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-2LOAD4	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-2LOAD5	7.96E-03	1.33E-02	2.65	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Full Power
Core Damage Frequency = 2.82E-08

Event Name	Probability	F-V	RAW	Description
R16-BT_-CF-ALLBATT	9.00E-06	1.23E-02	1.37E+03	BATTERY CCF #2
C12-MOV-CC-F020A	4.00E-03	1.14E-02	3.84	MOTOR OPER. VALVE F020A FAILS TO OPEN
R21-DG_-TM-DGA	6.00E-03	1.05E-02	2.74	STANDBY DIESEL GENERATOR "A" IN MAINTENANCE
E50-SQV-CC-F002A	3.00E-03	1.04E-02	4.46	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	1.04E-02	4.46	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	1.04E-02	4.46	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	1.04E-02	4.46	SQUIB VALVE F002H FAILS TO OPERATE
R21-DG_-TM-DGB	6.00E-03	9.94E-03	2.65	STANDBY DIESEL GENERATOR "B" IN MAINTENANCE
C12-MOV-CC-F020B	4.00E-03	9.13E-03	3.27	MOTOR OPER. VALVE F020B FAILS TO OPEN
C12-MOV-FC-F020A	3.13E-03	8.80E-03	3.81	FLOW CONTROL A FAILS WIDE OPEN
U43-XHE-FO-LPCIADS	1.61E-02	8.30E-03	1.51	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
R11-SYS-FF-NOREC24	1.77E-01	8.27E-03	1.04	Conditional Probability that offsite power is recovered within 24 hours
R21-DG_-CR-ALLDG	4.44E-03	7.72E-03	2.73	CCF OF DIESEL GENERATORS TO RUN
R16-BT_-TM-R16BTA2	1.00E-03	7.36E-03	8.35	BATTERY R16-BTA2 IN TEST
R16-BT_-TM-R16BTB2	1.00E-03	7.36E-03	8.35	BATTERY R16-BTB2 IN TEST
E50-SYS-FF-MLLOCA	3.79E-01	7.29E-03	1.01	PROBABILITY OF MEDIUM LOCA IN GDCS LINES
R21-DG_-CS-ALLDG	8.52E-04	7.08E-03	9.3	CCF OF DIESEL GENERATORS TO START AND LOAD
C12-MOV-FC-F020B	3.13E-03	7.04E-03	3.25	FLOW CONTROL B FAILS WIDE OPEN
R21-SYS-FC-FUELDG4	4.00E-03	6.88E-03	2.71	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
C12-SYS-TM-TRAINB	3.00E-03	6.70E-03	3.23	TRAIN B IN MAINTENANCE
C71-SYS-FF-SCRAM	1.00E-08	6.64E-03	6.58E+05	SCRAM FAILURE
R21-SYS-FC-FUELDG5	4.00E-03	6.52E-03	2.62	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
G21-ACV-CC-F332	2.00E-03	6.39E-03	4.19	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
C12-MP_-FS-C001BOIL	2.40E-03	5.31E-03	3.21	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	5.31E-03	3.21	MOTOR-DRIVEN PUMP C001B FAILS TO START

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Full Power
Core Damage Frequency = 2.82E-08

Event Name	Probability	F-V	RAW	Description
E50-UV_-OC-F003A	1.75E-03	5.21E-03	3.97	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	5.21E-03	3.97	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	5.21E-03	3.97	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	5.21E-03	3.97	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
B21-UV_-CC-F102A	1.60E-03	5.02E-03	4.14	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	5.02E-03	4.14	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
G21-UV_-CC-F333	1.60E-03	5.02E-03	4.14	CHECK VALVE F333 FAILS TO OPEN
C62-VLU-CF-DIDALL	3.12E-05	4.97E-03	160.14	CCF OF VOTER LOGIC UNITS
P22-ACV-FT-BYPASS	2.00E-03	4.76E-03	3.38	HEAT EXCHANGERS BYPASS VALVE FAILS TO REGULATE
C12-MP_-FS-C001AOIL	2.40E-03	4.15E-03	2.72	MOTOR-DRIVEN AUX. OIL PUMP FOR C001A FAILS TO RESTART
C12-MPC-FS-C001A	2.40E-03	4.15E-03	2.72	MOTOR-DRIVEN PUMP C001A FAILS TO START
P21-ACV-FT-F022A	2.00E-03	3.57E-03	2.78	AIR OPERATED VALVE F022A FAILS TO TRANSFER
P21-ACV-FT-F022B	2.00E-03	3.57E-03	2.78	AIR OPERATED VALVE F022B FAILS TO TRANSFER
P21-ACV-FT-F025A	2.00E-03	3.57E-03	2.78	AIR OPERATED VALVE F025A FAILS TO TRANSFER
P21-ACV-FT-F025B	2.00E-03	3.57E-03	2.78	AIR OPERATED VALVE F025B FAILS TO TRANSFER
R16-BT_-TM-R16BTA1	1.00E-03	3.44E-03	4.44	BATTERY R16-BTA1 IN TEST
R16-BT_-TM-R16BTB1	1.00E-03	3.35E-03	4.35	BATTERY R16-BTB1 IN TEST
R16-BT_-LP-R16BTA2	5.00E-04	3.25E-03	7.5	BATTERY R16-BTA2 FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB2	5.00E-04	3.25E-03	7.5	BATTERY R16-BTB2 FAILS TO PROVIDE OUTPUT
U43-SYS-FF-YARD	2.00E-03	3.16E-03	2.58	HARDWARE FAILURES IN YARD AREA
R13-INV-FC-R13A2	4.80E-04	3.12E-03	7.5	INVERTER TO R13-A2 FAILS
R13-INV-FC-R13B2	4.80E-04	3.12E-03	7.5	INVERTER TO R13-B2 FAILS
N21-ACV-OC-F018	1.31E-03	2.95E-03	3.24	AIR OPERATED VALVE N21-F018 FAILS TO REMAIN OPEN
U43-XHE-FO-YARD	1.77E-03	2.79E-03	2.57	OPERATOR FAILS TO MAKE UP FROM YARD AREA
R22-RE_-FD-10A11	8.00E-04	2.63E-03	4.28	UNDERVOLTAGE RELAY FOR R22-10A11 FAILS TO OPERATE

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
XXX-XHE-FO-ICPCCS	1.61E-03	2.57E-03	2.59	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
R22-RE_-FD-10A21	8.00E-04	2.56E-03	4.2	UNDERVOLTAGE RELAY SENSING VOLTAGE ON BUS 10A21 FAILS
B21-LT_-CF-N001ABCD	1.20E-07	2.42E-03	2.02E+04	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
G21-UV_-TM-F332/333	8.00E-04	2.32E-03	3.89	MAINTENANCE FOR CV F332 OR CV F333
B32-SYS-TM-ICA	4.16E-02	2.18E-03	1.05	IC "A" UNAVAILABLE [# 7]
C12-MCB-OO-C001B	1.00E-03	2.12E-03	3.12	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
H23-EMS-FC-DIVADID	6.00E-04	1.93E-03	4.21	ESSENTIAL MULTIPLEXING SYSTEM DIV A (DID) FAILS TO FUNCTION
E50-STR-CF-SPPLUG	3.75E-04	1.92E-03	6.1	CCF FILTER/STRAINER IN PSP TO PLUG
H23-EMS-FC-DIVBDID	6.00E-04	1.87E-03	4.12	ESSENTIAL MULTIPLEXING SYSTEM DIV B (DID) FAILS TO FUNCTION
B21-SQV-CF-DPVOPEN	1.50E-05	1.71E-03	115.19	CCF OF DPV'S TO OPEN
XXX-XHE-FO-DEPRESS	1.61E-01	1.67E-03	1.01	OPERATOR FAILS TO RECOGNIZE NEED OF DEPRESSURIZATION
C12-MCB-OO-C001A	1.00E-03	1.63E-03	2.63	CIRCUIT BREAKER FOR C001A & OIL PUMP A FAILS TO CLOSE
R16-BT_-LP-R16BTA1	5.00E-04	1.59E-03	4.17	BATTERY R16-BTA1 FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB1	5.00E-04	1.54E-03	4.08	BATTERY R16-BTB1 FAILS TO PROVIDE OUTPUT
C62-DTM-FC-N1EA	9.00E-04	1.51E-03	2.67	DIGITAL TRIP MODULE TRAIN A NO 1E FAILS
C62-DTM-FC-N1EB	9.00E-04	1.51E-03	2.67	DIGITAL TRIP MODULE TRAIN B NO 1E FAILS
R13-INV-FC-R13A1	4.80E-04	1.51E-03	4.14	INVERTER TO R13-A1 FAILS
R16-BT_-TM-R16BTA	1.00E-03	1.49E-03	2.49	BATTERY R16-BTA IN TEST
R21-MCB-OO-DGAR11A2	1.00E-03	1.49E-03	2.49	CIRCUIT BREAKER FROM DG-A TO R11-A2 FAILS TO CLOSE
R21-SYS-FC-AIRDG4	1.00E-03	1.49E-03	2.49	AIR STARTING SYSTEM FAILURE [#13]
R13-INV-FC-R13B1	4.80E-04	1.47E-03	4.07	INVERTER TO R13-B1 FAILS
G21-XHE-FO-LPCIADS	1.61E-02	1.41E-03	1.09	OPERATOR FAILS TO ALIGN AND ACTUATE FAPCS IN LPCI MODE
R16-BT_-TM-R16BTB	1.00E-03	1.40E-03	2.4	BATTERY R16-BTB IN TEST
R21-MCB-OO-DGBR11B2	1.00E-03	1.40E-03	2.4	CIRCUIT BREAKER FROM DG-B TO R11-B2 FAILS TO CLOSE
R21-SYS-FC-AIRDG5	1.00E-03	1.40E-03	2.4	AIR STARTING SYSTEM FAILURE

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-OR_-CF-PLUGALL	7.20E-08	1.36E-03	1.89E+04	CCF OF ALL ORIFICES TO PLUG
R10-CBU-FC-PRE500KV	7.20E-05	1.32E-03	19.32	500KV TRANSMISSION LINE FAILS
E50-OR_-CF-7PLUG	7.00E-08	1.31E-03	1.87E+04	CCF OF 7 ORIFICES TO PLUG
R21-MP_-CS-FUELTRANS	1.71E-04	1.27E-03	8.41	CCF TO START MOTOR-DRIVEN FUEL TRANSFER PUMPS
C12-OR_-PG-D007A	6.48E-04	1.24E-03	2.91	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
C41-UV_-CC-F004A	1.60E-03	1.02E-03	1.64	CHECK VALVE F004A FAILS TO OPEN
C41-UV_-CC-F004B	1.60E-03	1.02E-03	1.64	CHECK VALVE F004B FAILS TO OPEN
C41-UV_-CC-F005A	1.60E-03	1.02E-03	1.64	CHECK VALVE F005A FAILS TO OPEN
C41-UV_-CC-F005B	1.60E-03	1.02E-03	1.64	CHECK VALVE F005B FAILS TO OPEN
P21-MP_-TM-C002A	2.00E-03	9.13E-04	1.46	PUMP C002A IN MAINTENANCE
P21-MP_-TM-C002B	2.00E-03	9.13E-04	1.46	PUMP C002B IN MAINTENANCE
H23-RMU-FC-ESF1ADID	3.00E-04	8.87E-04	3.95	1ST DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2ADID	3.00E-04	8.87E-04	3.95	2ND DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
C12-OR_-PG-D007B	6.48E-04	8.85E-04	2.37	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
H23-RMU-FC-10A11	3.00E-04	8.78E-04	3.93	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-R102	3.00E-04	8.78E-04	3.93	DTM/TLU 002 OR MUX INTERFACE FAIL TO TRIP (2Y TEST)
H23-RMU-FC-ESF1BDID	3.00E-04	8.70E-04	3.9	1ST DIV B (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2BDID	3.00E-04	8.70E-04	3.9	2ND DIV B (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-10A21	3.00E-04	8.61E-04	3.87	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-R101	3.00E-04	8.61E-04	3.87	DTM/TLU 001 OR MUX INTERFACE FAIL TO TRIP (2Y TEST)
B32-ACV-CC-F006B	2.00E-03	8.27E-04	1.41	AIR OPERATED VALVE F006B FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006C	2.00E-03	8.27E-04	1.41	AIR OPERATED VALVE F006A FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006D	2.00E-03	8.27E-04	1.41	AIR OPERATED VALVE F006D FAILS TO OP. TO DEENERG. POSIT.
C41-XHE-FO-OPENF002A	2.69E-01	6.89E-04	1	OPERATOR FAILS TO OPEN VALVE F002A (AFTER INADV.CLOS.)
C41-XHE-FO-OPENF002B	2.69E-01	6.89E-04	1	OPERATOR FAILS TO OPEN VALVE F002B (AFTER INADV.CLOS.)

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C41-XHE-MH-F002A	4.03E-03	6.89E-04	1.17	MISPOSITION OF VALVE F002A
C41-XHE-MH-F002B	4.03E-03	6.89E-04	1.17	MISPOSITION OF VALVE F002B
C62-DTM-CF-N1EALL	5.50E-05	6.75E-04	13.27	CCF OF DIGITAL TRIP MODULES NO 1E
R11-MCB-CF-69CLOSE	9.29E-05	6.70E-04	8.21	CCF CIRCUIT BREAKERS 6.9 KV TO CLOSE
R16-BT_-LP-R16BTA	5.00E-04	6.67E-04	2.33	BATTERY R16-BTA FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB	5.00E-04	6.24E-04	2.25	BATTERY R16-BTB FAILS TO PROVIDE OUTPUT
P21-MP_-FS-C001A	1.30E-03	5.65E-04	1.43	MOTOR DRIVEN PUMP C001A FAILS TO START
P21-MP_-FS-C001B	1.30E-03	5.65E-04	1.43	MOTOR-DRIVEN PUMP C001B FAILS TO START
P21-MP_-FS-C002A	1.30E-03	5.65E-04	1.43	MOTOR-DRIVEN PUMP (ALL TYPES) FAILS TO START
P21-MP_-FS-C002B	1.30E-03	5.65E-04	1.43	MOTOR-DRIVEN PUMP C002B FAILS TO START
P21-MP_-FS-C003A	1.30E-03	5.65E-04	1.43	MOTOR-DRIVEN PUMP C0003A FAILS TO START
P21-MP_-FS-C003B	1.30E-03	5.65E-04	1.43	MOTOR-DRIVEN PUMP C003B FAILS TO START
N21-LT_-NO-FWTKA	8.71E-03	4.93E-04	1.06	LEVEL TRANSMITTER TRAIN A FAILS
N21-LT_-NO-FWTKB	8.71E-03	4.93E-04	1.06	LEVEL TRANSMITTER TRAIN B FAILS
N21-LT_-NO-FWTKC	8.71E-03	4.93E-04	1.06	LEVEL TRANSMITTER TRAIN C FAILS
P21-MCB-OO-C001A	1.00E-03	4.29E-04	1.43	CIRCUIT BREAKER OF PUMP C001A FAILS TO CLOSE
P21-MCB-OO-C001B	1.00E-03	4.29E-04	1.43	CIRCUIT BREAKER OF PM C001B FAILS TO CLOSE
P21-MCB-OO-C002A	1.00E-03	4.29E-04	1.43	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C002B	1.00E-03	4.29E-04	1.43	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C003A	1.00E-03	4.29E-04	1.43	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C003B	1.00E-03	4.29E-04	1.43	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
N21-ACV-CC-F023	1.58E-02	4.16E-04	1.03	AIR OPERATED VALVE N21-F023 FAILS TO OPEN
N21-ACV-CC-F026	1.58E-02	4.16E-04	1.03	AIR OPERATED VALVE N21-F026 FAILS TO OPEN
H23-RMU-FC-N038B	3.00E-04	4.00E-04	2.33	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-P21N038A	3.00E-04	4.00E-04	2.33	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
B21-SYS-FF-1/9OPEN	5.85E-02	3.83E-04	1.01	1 OUT OF 9 SRV FAIL TO CLOSE AFTER OPENING
C12-MOV-CF-OPEN	1.78E-04	3.63E-04	3.04	CCF MOV TO OPEN
P51-CMP-CR-RUN	1.49E-04	3.05E-04	3.05	CCF OF P51 COMPRESSORS TO RUN
R16-BT_-TM-R16BT11	1.00E-03	2.60E-04	1.26	BATTERY R16-BT11 IN TEST.
H23-EMS-CF-DIDALL	1.80E-06	2.56E-04	143.24	CCF OF ALL DIVISION OF THE EMS
N21-LT_-NO-HWA	8.71E-03	2.25E-04	1.03	LEVEL TRANSMITTER TRAIN A FAILS
N21-LT_-NO-HWB	8.71E-03	2.25E-04	1.03	LEVEL TRANSMITTER TRAIN B FAILS
N21-LT_-NO-HWC	8.71E-03	2.25E-04	1.03	LEVEL TRANSMITTER TRAIN C FAILS
C12-MP_-CS-C001A/BOIL	2.05E-04	2.11E-04	2.03	CCF AUX. OIL PUMPS TO START
C12-MPC-CS-C001A/B	2.05E-04	2.11E-04	2.03	CCF PUMPS TO START
P21-MP_-CS-TRAINAB	1.95E-04	2.01E-04	2.03	CCF TO START PUMPS TRAINS A AND B
C51-ACT-CF-1PRM	2.98E-04	1.89E-04	1.64	CCF APRM NEUTRON CHANNELS
C51-ACT-CF-SRNM	2.98E-04	1.89E-04	1.64	CCF OF SRNM CORE FLUX CHANNELS
P30-UV_-CC-CV01T	2.00E-04	1.71E-04	1.86	CHECK VALVE CV01T FAILS TO OPEN
N21-ACV-CF-MKUPA/B	1.08E-04	1.60E-04	2.48	CCF TO OPERATE AOVs TRAINS A & B
B32-ACV-CF-2ICABCD	1.55E-05	1.34E-04	9.69	CCF TO OPEN 2/4 ACV VALVES TRAINS A,B,C,D
B21-UV_-CF-102/3B	4.00E-04	1.29E-04	1.32	CCF OF CHECK VALVES F103B AND F102B TO CLOSE
H23-RMU-CF-DIDALL	9.00E-07	1.28E-04	143.24	CCF OF REMOTE MULTIPLEXING UNITS (DID)
R13-XFL-LP-R13A21	1.92E-05	1.16E-04	7.05	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13B21	1.92E-05	1.16E-04	7.05	TRANSFORMER FAILS DURING OPERATION
N21-LT_-CF-FWTKNO	4.38E-05	1.14E-04	3.6	CCF FEEDWATER STORAGE TANK LEVEL TRANSMITTERS
N21-ACV-OC-F016	1.31E-03	1.07E-04	1.08	AIR OPERATED VALVE N21-F016 FAILS TO REMAIN OPEN
N21-MOV-CC-F061	3.13E-02	1.07E-04	1	MOTOR OPERATED VALVE N21-F061 FAILS TO OPEN
B32-ACV-CC-F006A	2.00E-03	1.04E-04	1.05	AIR OPERATED VALVE F006A FAILS TO OP. TO DEENERG. POSIT.
P41-MP_-CR-3ALL	1.17E-05	1.03E-04	9.76	CCF TO RUN 3 PUMPS TRAINS A AND B

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P41-STR-CF-3ALL	1.07E-05	9.37E-05	9.76	CCF 3 STRAINERS PLUGGED
G21-ACV-CC-F321	2.00E-03	9.21E-05	1.05	AOV F321 FAILS TO OPERATE TO NOT DEENERG.POS.
G21-ACV-CC-F322	2.00E-03	9.21E-05	1.05	AOV F322 FAILS TO OPERATE TO NOT DEENERG.POS.
P51-XHE-FO-STDBYCOMP	1.77E-02	9.08E-05	1.01	OPERATOR FAILS TO ACTUATE STAND-BY COMPRESSOR
C41-SQV-CF-F003AC	1.50E-04	9.07E-05	1.6	CCF TO OPERATE OF SQUIB VALVES ON SLCS-A
C41-SQV-CF-F003BD	1.50E-04	9.07E-05	1.6	CCF TO OPERATE OF SQUIB VALVES ON SLCS-B
C51-ACT-CF-APRMSTUCK	2.10E-07	8.74E-05	417.05	CCF APRM DETECTORS STUCK AT POWER LEVEL
R13-LCB-CO-FR13A21	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13B21	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13A21	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13B21	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR13A2	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER TO R13-A2 OPENS SPURIOUSLY
R13-LCB-CO-TOR13B2	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER TO R13-B2 OPENS SPURIOUSLY
R16-LCB-CO-FROMR16BTA2	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER FROM R16-BTA2 OPENS SPURIOUSLY
R16-LCB-CO-FROMR16BTB2	1.44E-05	8.72E-05	7.05	CIRCUIT BREAKER FROM R16-BTB2 OPENS SPURIOUSLY
P51-ACV-CC-F008A	2.00E-03	8.67E-05	1.04	AIR OPERATED VALVE F008A FAILS TO OP. TO DEENERG. POSIT.
P51-ACV-CC-F010C	2.00E-03	8.67E-05	1.04	AOV F010C FAILS TO OPERATE TO NOT DEENERG. POSITION
P52-XHE-FO-IAS/SAS	1.61E-02	8.26E-05	1.01	OPER. FAILS TO REC. NEED FOR MANUAL INTERV. ON IAS/SAS
R16-BT_-CF-125NO1E	1.20E-05	8.07E-05	7.75	CCF OF 125 V NO 1E BATTERIES
R10-BAC-LP-500KVMAIN	4.80E-06	7.63E-05	16.9	500 KV MAIN DISTRIBUTION BUS FAILS DURING OPERATION
C62-VLU-CF-N1EALL	3.12E-05	7.44E-05	3.38	CCF OF VOTER LOGIC UNITS
B32-MOV-CF-2ICABCD	8.08E-06	7.02E-05	9.69	CCF TO OPEN 2/4 MOV VALVES TRAINS A,B,C,D
P51-CMP-FR-C001A	2.40E-03	6.15E-05	1.03	MOTOR-DRIVEN AIR COMPRESS. C001A FAILS TO CONT.OPER.
P51-CMP-FS-C001B	2.00E-02	6.15E-05	1	MOTOR-DRIVEN AIR COMPRESS. C001B FAILS TO START
C62-DTM-CF-DIDALL	5.50E-05	6.09E-05	2.11	COMMON CAUSE FAILURE 3/4 DTM DID LOGIC

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P41-FAN-CS-2ALL	7.20E-06	6.07E-05	9.43	CCF TO START 2 FAN UNITS
P21-UV_-CC-F001A	2.00E-04	5.76E-05	1.29	CHECK VALVE F001A FAILS TO OPEN
P21-UV_-CC-F001B	2.00E-04	5.76E-05	1.29	CHECK VALVE F001B FAILS TO OPEN
P21-UV_-CC-F005A	2.00E-04	5.76E-05	1.29	CHECK VALVE F005A FAILS TO OPEN
P21-UV_-CC-F005B	2.00E-04	5.76E-05	1.29	CHECK VALVE F005B FAILS TO OPEN
P21-UV_-CC-F007A	2.00E-04	5.76E-05	1.29	CHECK VALVE F007A FAILS TO OPEN
P21-UV_-CC-F007B	2.00E-04	5.76E-05	1.29	CHECK VALVE F007B FAILS TO OPEN
P41-MP_-CS-3ALL	6.26E-06	5.28E-05	9.43	CCF TO START PUMPS TRAINS A AND B
C12-XHE-FO-LEVEL2	3.22E-02	4.86E-05	1	MANUAL ACTUATION FAILURE
N21-LT_-CF-HWNO	4.38E-05	4.82E-05	2.1	CCF HOTWELL LEVEL TRANSMITTERS
E50-SQV-CF-4OPEN	1.50E-05	4.43E-05	3.95	CCF OF 4 OR MORE SQUIB VALVES TO OPEN
R16-BT_-CF-BATTA1B1	1.53E-06	4.43E-05	29.96	BATTERY A1 & B1 CCF
C12-MCB-CF-CLOSE	9.29E-05	4.24E-05	1.46	CIRCUIT BREAKER CCF TO CLOSE
R16-BT_-LP-R16BT11	5.00E-04	3.85E-05	1.08	BATTERY R16-BT11 FAILS TO PROVIDE OUTPUT
P51-CMP-CS-START	1.71E-03	3.75E-05	1.02	CCF OF P51 COMPRESSORS TO START
G21-UV_-CC-F331	1.60E-03	3.36E-05	1.02	CHECK VALVE F331 FAILS TO OPEN
G21-UV_-CC-F348	1.60E-03	3.36E-05	1.02	CHECK VALVE F348 FAILS TO OPEN
R13-INV-FC-R1311	4.80E-04	3.36E-05	1.07	INVERTER TO R13-11 FAILS
C12-MPC-FR-C001A	5.76E-05	3.17E-05	1.55	MOTOR-DRIVEN PUMP C001A FAILS TO RUN, GIVEN START
R13-XFL-LP-R13A11	1.92E-05	3.12E-05	2.63	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13B11	1.92E-05	3.12E-05	2.63	TRANSFORMER FAILS DURING OPERATION
C74-VLU-CF-ALL	3.12E-06	2.71E-05	9.69	CCF OF VOTER LOGIC UNITS
R13-XFL-LP-R13C13	1.92E-05	2.46E-05	2.28	TRANSFORMER FAILS DURING OPERATION
R13-BAC-LP-R13A2	4.80E-06	2.24E-05	5.66	BUS R13-A2 FAILS DURING OPERATION
R13-BAC-LP-R13A21	4.80E-06	2.24E-05	5.66	BUS R13-A2-1 FAILS DURING OPERATION

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-BAC-LP-R13B2	4.80E-06	2.24E-05	5.66	BUS R13-B2 FAILS DURING OPERATION
R13-BAC-LP-R13B21	4.80E-06	2.24E-05	5.66	BUS R13-B2-1 FAILS DURING OPERATION
R16-BDC-LP-R16A2	4.80E-06	2.24E-05	5.66	DC BUS R16-A2 FAILS DURING OPERATION
R16-BDC-LP-R16B2	4.80E-06	2.24E-05	5.66	DC BUS R16-B2 FAILS DURING OPERATION
R16-BDC-TM-R16A2	4.80E-06	2.24E-05	5.66	DC BUS R16-A2 IN MAINTENANCE
R16-BDC-TM-R16B2	4.80E-06	2.24E-05	5.66	DC BUS R16-B2 IN MAINTENANCE
U43-XHE-FO-LPCI	1.61E-03	2.20E-05	1.01	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE
C12-MPC-FR-C001B	5.76E-05	2.12E-05	1.37	MOTOR-DRIVEN PUMP C001B FAILS TO RUN, GIVEN START
R13-LCB-CO-FR13A11	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13B11	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13A11	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13B11	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R16A1R13A1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-A1 OPENS SPURIOUSLY
R13-LCB-CO-R16A1R13A2	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-A2 OPENS SPURIOUSLY
R13-LCB-CO-R16A1R13B1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-B1 OPENS SPURIOUSLY
R13-LCB-CO-R16A1R13B2	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-B2 OPENS SPURIOUSLY
R13-LCB-CO-TOR13A1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER TO R13-A1 OPENS SPURIOUSLY
R13-LCB-CO-TOR13B1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER TO R13-B1 OPENS SPURIOUSLY
R16-LCB-CO-FROMR16BTA1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-BTA1 OPENS SPURIOUSLY
R16-LCB-CO-FROMR16BTB1	1.44E-05	1.80E-05	2.25	CIRCUIT BREAKER FROM R16-BTB1 OPENS SPURIOUSLY
R10-SYS-FF-500KV	1.20E-06	1.70E-05	15.17	500KV SWITCHYARD FAILS DURING OPERATION
H23-EMS-CF-ALL	1.80E-06	1.56E-05	9.69	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
R16-BT_-TM-R16BT21	1.00E-03	1.52E-05	1.02	BATTERY R16-BT21 IN TEST
E50-SQV-CF-EQALLOPEN	3.00E-05	1.38E-05	1.46	CCF OF ALL 4 SQUIB VALVES TO OPEN
R16-BT_-CF-BATT11&21	9.50E-07	1.12E-05	12.77	BATTERY 11 & 21 CCF

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C31-VLU-FC-RUNBACK	7.80E-05	9.99E-06	1.13	C31 SYSTEM VOTER LOGIC UNIT FAILS
B21-UV_-OO-102B	7.96E-03	8.90E-06	1	CHECK VALVE F102B FAILS TO CLOSE
B21-UV_-OO-103B	7.96E-03	8.90E-06	1	CHECK VALVE F103B FAILS TO CLOSE
R13-XFL-LP-R13112	1.92E-05	8.54E-06	1.44	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13212	1.92E-05	8.54E-06	1.44	TRANSFORMER FAILS DURING OPERATION
C74-DTM-CF-ALL	1.20E-05	7.97E-06	1.66	CCF 3/4 DTM OF SSLC DIV1/2/3/4
G31-ACV-OO-F3A	2.00E-03	7.97E-06	1	AOV F3A FAILS TO CLOSE
T10-XHE-FO-CLOSEIVS	1.77E-02	7.97E-06	1	OPERATOR FAILS TO MANUALLY CLOSE ISOLATION VALVES
P21-MP_-FR-C001A	1.20E-04	7.83E-06	1.07	MOTOR DRIVEN PUMP C001A FAILS TO RUN
P21-MP_-FR-C001B	1.20E-04	7.83E-06	1.07	MOTOR DRIVEN PUMP C001B FAILS TO RUN
P21-MP_-FR-C002A	1.20E-04	7.83E-06	1.07	MOTOR-DRIVEN PUMP C002A FAILS TO RUN
P21-MP_-FR-C002B	1.20E-04	7.83E-06	1.07	MOTOR-DRIVEN PUMP C002B FAILS TO RUN
P21-MP_-FR-C003A	1.20E-04	7.83E-06	1.07	MOTOR-DRIVEN PUMP C0003A FAILS TO RUN
P21-MP_-FR-C003B	1.20E-04	7.83E-06	1.07	MOTOR-DRIVEN PUMP C003B FAILS TO RUN
H23-RMU-CF-ALL	9.00E-07	7.82E-06	9.69	CCF OF REMOTE MULTIPLEXING UNITS TO OPERATE
R16-BT_-CF-BATTA1A2	1.53E-06	7.13E-06	5.66	BATTERY A1 & A2 CCF
R16-BT_-CF-BATTA1B2	1.53E-06	7.13E-06	5.66	BATTERY A1 & B2 CCF
R16-BT_-CF-BATTA2B1	1.53E-06	7.13E-06	5.66	BATTERY A2 & B1 CCF
R16-BT_-CF-BATTA2B2	1.53E-06	7.13E-06	5.66	BATTERY A2 & B2 CCF
R16-BT_-CF-BATTA2C	1.53E-06	7.13E-06	5.66	BATTERY A2 & C CCF
R16-BT_-CF-BATTB1B2	1.53E-06	7.13E-06	5.66	BATTERY B1 & B2 CCF
R16-BT_-CF-BATTB2C	1.53E-06	7.13E-06	5.66	BATTERY B2 & C CCF
R13-LCB-CO-FR13112	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13212	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13112	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER OPENS SPURIOUSLY

Table 18-2

Internal Events Full Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Internal Event Full Power Core Damage Frequency = 2.82E-08				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-LCB-CO-R13212	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR1311	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER TO R13-11 OPENS SPURIOUSLY
R13-LCB-CO-TOR1321	1.44E-05	6.41E-06	1.44	CIRCUIT BREAKER TO R13-21 OPENS SPURIOUSLY
C41-SQV-CC-F003A	3.00E-03	4.01E-06	1	EXPLOSIVE VALVE F003A FAILS TO OPERATE
C41-SQV-CC-F003B	3.00E-03	4.01E-06	1	EXPLOSIVE VALVE F003B FAILS TO OPERATE
C41-SQV-CC-F003C	3.00E-03	4.01E-06	1	EXPLOSIVE VALVE F003C FAILS TO OPERATE
C41-SQV-CC-F003D	3.00E-03	4.01E-06	1	EXPLOSIVE VALVE F003D FAILS TO OPERATE
E50-SQV-CF-F002A/2E	3.60E-05	3.78E-06	1.1	CCF OF SQUIB VALVES F002A/ F002E
E50-SQV-CF-F002D/2H	3.60E-05	3.78E-06	1.1	CCF OF SQUIB VALVES F002D/ F002H
B21-XHE-FO-6OPEN	1.61E-03	3.66E-06	1	OPERATOR FAILS TO OPEN 6/10 SRVs
B32-PDT-CF-3ICBHIGH	9.71E-06	3.51E-06	1.36	CCF 3/4 PDT'S ISOLATION CONDENSER B SPURIOUS ACTUATION
B32-PDT-CF-3ICCHIGH	9.71E-06	3.51E-06	1.36	CCF 3/4 PDT'S ISOLATION CONDENSER C SPURIOUS ACTUATION
B32-PDT-CF-3ICDHIGH	9.71E-06	3.51E-06	1.36	CCF 3/4 PDT'S ISOLATION CONDENSER D SPURIOUS ACTUATION
R16-BT_-LP-R16BT21	5.00E-04	3.45E-06	1.01	BATTERY DE3BY001 FAILS TO PROVIDE OUTPUT

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
FIRE-TURBINE-BUILD	6.14E-02	8.02E-01	13.26	FIRE IN TURBINE BUILDING
XXX-XHE-FO-LPMAKEUP	1.61E-01	6.01E-01	4.13	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
E50-SQV-CF-GDCS7OPEN	1.50E-05	3.45E-01	2.30E+04	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	3.45E-01	2.30E+04	CCF OF ALL SQUIB VALVES TO OPEN
G21-XHE-MH-F334	4.80E-02	2.10E-01	5.17	MISPOSITION OF VALVE F334
C12-XHE-MH-F013A	4.80E-02	2.08E-01	5.13	MISPOSITION OF VALVE F013A
C12-XHE-MH-F015A	4.80E-02	2.08E-01	5.13	MISPOSITION OF VALVE F015A
C12-XHE-MH-F013B	4.80E-02	2.07E-01	5.11	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015B	4.80E-02	2.07E-01	5.11	MISPOSITION OF VALVE F015B
P30-XHE-MH-F015	4.80E-02	1.76E-01	4.48	MISPOSITION OF VALVE F01T
RB-DAMPER	7.43E-03	1.58E-01	22.11	FIRE BARRIER IN REACTOR BUILDING FAILS
XXX-XHE-FO-DEPRESS	1.61E-01	1.31E-01	1.68	OPERATOR FAILS TO RECOGNIZE NEED OF DEPRESSURIZATION
P22-ACV-FT-BYPASS	2.00E-03	8.67E-02	44.25	HEAT EXCHANGERS BYPASS VALVE FAILS TO REGULATE
B21-UV_-CC-F102B	1.60E-03	6.48E-02	41.48	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	6.48E-02	41.48	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	6.48E-02	41.48	CHECK VALVE F022 FAILS TO OPEN
FIRE-REACT-BUIL-DIVII	1.45E-02	6.42E-02	5.37	FIRE IN REACTOR BUILDING DIVISION II ZONE
FIRE-REACT-BUIL-DIVI	1.45E-02	6.14E-02	5.17	FIRE IN REACTOR BUILDING DIV I ZONE
N21-ACV-OC-F018	1.31E-03	5.51E-02	42.9	AIR OPERATED VALVE N21-F018 FAILS TO REMAIN OPEN
C12-XHE-MH-F018A	1.20E-02	4.62E-02	4.8	MISPOSITION OF VALVE F018A
C12-XHE-MH-F021A	1.20E-02	4.62E-02	4.8	MISPOSITION OF VALVE F021A
C12-XHE-MH-F003B	1.20E-02	3.79E-02	4.12	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018B	1.20E-02	3.79E-02	4.12	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021B	1.20E-02	3.79E-02	4.12	MISPOSITION OF VALVE F021B

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
FIRE-REACT-BUIL-DIVIV	1.45E-02	3.21E-02	3.18	FIRE IN REACTOR BUILDING DIVISION IV ZONE
FIRE-REACT-BUIL-DIVIII	1.45E-02	2.99E-02	3.03	FIRE IN REACTOR BUILDING DIVISION III ZONE
E50-SQV-CO-F009A	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]
E50-SQV-CO-F009H	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	2.56E-02	8.29	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
E50-SQV-CO-F009B	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009B SPUR. OPENING [#7]
E50-SQV-CO-F009C	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009C SPUR. OPENING [#7]
E50-SQV-CO-F009F	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009F SPUR. OPENING [#7]
E50-SQV-CO-F009G	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009G SPUR. OPENING [#7]
E50-SQV-CO-F009J	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]
E50-SQV-CO-F009K	3.50E-03	1.88E-02	6.37	SQUIB DELUGE VALVE F009K SPUR. OPENING [#7]
U43-SYS-FF-LPCI	2.40E-02	1.52E-02	1.62	U43 HARDWARE FAILURES
C12-MOV-CC-F014A	4.00E-03	1.39E-02	4.47	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F014B	4.00E-03	1.39E-02	4.46	MOTOR OPER. VALVE F014B FAILS TO OPEN
C12-MOV-CC-F020A	4.00E-03	1.38E-02	4.43	MOTOR OPER. VALVE F020A FAILS TO OPEN
H23-EMS-FC-DIV3	6.00E-04	1.38E-02	24.05	ESSENTIAL MULTIPLEXING SYSTEM DIV 3 FAILS TO FUNCTION
B21-SQV-CF-DPVOPEN	1.50E-05	1.31E-02	873.91	CCF OF DPV'S TO OPEN
C74-DTM-FC-DIV3	6.00E-04	1.29E-02	22.46	DTM OF SSLC DIV. 3 FAILS TO TRIP
C74-DTM-FC-DIV4	6.00E-04	1.29E-02	22.41	DTM OF SSLC DIV. 4 FAILS TO TRIP
H23-EMS-FC-DIV4	6.00E-04	1.29E-02	22.45	ESSENTIAL MULTIPLEXING SYSTEM DIV 4 FAILS TO FUNCTION
E50-SQV-CC-F002A	3.00E-03	1.14E-02	4.78	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	1.14E-02	4.78	SQUIB VALVE F002D FAILS TO OPERATE

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-SQV-CC-F002E	3.00E-03	1.14E-02	4.78	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	1.14E-02	4.78	SQUIB VALVE F002H FAILS TO OPERATE
C12-MOV-CC-F020B	4.00E-03	1.11E-02	3.76	MOTOR OPER. VALVE F020B FAILS TO OPEN
B21-SQV-CC-F004B	3.00E-03	1.07E-02	4.55	EXPLOSIVE VALVE DPV B FAILS TO OPERATE
B21-SQV-CC-F004D	3.00E-03	1.07E-02	4.55	EXPLOSIVE VALVE DPV D FAILS TO OPERATE
B21-SQV-CC-F004F	3.00E-03	1.07E-02	4.55	EXPLOSIVE VALVE DPV F FAILS TO OPERATE
B21-SQV-CC-F004H	3.00E-03	1.07E-02	4.55	EXPLOSIVE VALVE DPV H FAILS TO OPERATE
C12-MOV-FC-F020A	3.13E-03	1.07E-02	4.4	FLOW CONTROL A FAILS WIDE OPEN
B21-SQV-CC-F004A	3.00E-03	1.02E-02	4.4	EXPLOSIVE VALVE DPV A FAILS TO OPERATE
B21-SQV-CC-F004C	3.00E-03	1.02E-02	4.4	EXPLOSIVE VALVE DPV C FAILS TO OPERATE
B21-SQV-CC-F004E	3.00E-03	1.02E-02	4.4	EXPLOSIVE VALVE DPV E FAILS TO OPERATE
B21-SQV-CC-F004G	3.00E-03	1.02E-02	4.4	EXPLOSIVE VALVE DPV G FAILS TO OPERATE
C62-DTM-CF-N1EALL	5.50E-05	9.06E-03	165.69	CCF OF DIGITAL TRIP MODULES NO 1E
C12-MOV-FC-F020B	3.13E-03	8.56E-03	3.73	FLOW CONTROL B FAILS WIDE OPEN
C12-SYS-TM-TRAINB	3.00E-03	8.21E-03	3.73	TRAIN B IN MAINTENANCE
R16-BT_-CF-ALLBATT	9.00E-06	7.39E-03	822.31	BATTERY CCF #2
N21-ACV-CC-F023	1.58E-02	6.86E-03	1.43	AIR OPERATED VALVE N21-F023 FAILS TO OPEN
N21-ACV-CC-F026	1.58E-02	6.77E-03	1.42	AIR OPERATED VALVE N21-F026 FAILS TO OPEN
E50-UV_-OC-F003A	1.75E-03	6.64E-03	4.79	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	6.64E-03	4.79	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	6.64E-03	4.79	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	6.64E-03	4.79	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
C12-MP_-FS-C001BOIL	2.40E-03	6.54E-03	3.72	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	6.54E-03	3.72	MOTOR-DRIVEN PUMP C001B FAILS TO START
C71-SYS-FF-SCRAM	1.00E-08	6.35E-03	6.33E+05	SCRAM FAILURE

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
G21-ACV-CC-F332	2.00E-03	6.30E-03	4.14	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
H23-RMU-FC-DIV3	3.00E-04	6.01E-03	21.01	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-DIV4	3.00E-04	6.00E-03	20.98	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
B21-SYS-FF-1/9OPEN	5.85E-02	5.77E-03	1.09	1 OUT OF 9 SRV FAIL TO CLOSE AFTER OPENING
B21-UV_-CC-F102A	1.60E-03	5.03E-03	4.14	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	5.03E-03	4.14	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
G21-UV_-CC-F333	1.60E-03	5.03E-03	4.14	CHECK VALVE F333 FAILS TO OPEN
FIRE-NON-DIVISIONAL-REDA	5.57E-02	4.83E-03	1.08	FIRE IN ELECTRICAL BUILDING ZONE A
FIRE-NON-DIVISIONAL-REDB	5.57E-02	4.83E-03	1.08	FIRE IN ELECTRICAL BUILDING ZONE B
C62-VLU-CF-DIDALL	3.12E-05	4.80E-03	154.82	CCF OF VOTER LOGIC UNITS
EB-DAMPER	7.40E-03	4.08E-03	1.55	FIRE BARRIER IN ELECTRICAL BUILDING FAILS
P51-CMP-CR-RUN	1.49E-04	4.08E-03	28.35	CCF OF P51 COMPRESSORS TO RUN
N21-LT_-NO-FWTKA	8.71E-03	3.89E-03	1.44	LEVEL TRANSMITTER TRAIN A FAILS
N21-LT_-NO-FWTKB	8.71E-03	3.89E-03	1.44	LEVEL TRANSMITTER TRAIN B FAILS
N21-LT_-NO-FWTKC	8.71E-03	3.89E-03	1.44	LEVEL TRANSMITTER TRAIN C FAILS
R10-CBU-FC-PRE500KV	7.20E-05	3.62E-03	51.23	500KV TRANSMISSION LINE FAILS
N21-LT_-NO-HWA	8.71E-03	3.06E-03	1.35	LEVEL TRANSMITTER TRAIN A FAILS
N21-LT_-NO-HWB	8.71E-03	3.06E-03	1.35	LEVEL TRANSMITTER TRAIN B FAILS
N21-LT_-NO-HWC	8.71E-03	3.06E-03	1.35	LEVEL TRANSMITTER TRAIN C FAILS
C74-DTM-CF-ALL	1.20E-05	2.62E-03	219.16	CCF 3/4 DTM OF SSLC DIV1/2/3/4
C12-MCB-OO-C001B	1.00E-03	2.59E-03	3.59	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
B21-LT_-CF-N001ABCD	1.20E-07	2.44E-03	2.03E+04	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
G21-UV_-TM-F332/333	8.00E-04	2.43E-03	4.03	MAINTENANCE FOR CV F332 OR CV F333
N21-ACV-CF-MKUPA/B	1.08E-04	2.18E-03	21.16	CCF TO OPERATE AOVS TRAINS A & B
G21-XHE-FO-LPCIADS	1.61E-02	1.66E-03	1.1	OPERATOR FAILS TO ALIGN AND ACTUATE FAPCS IN LPCI MODE

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-STR-CF-SPPLUG	3.75E-04	1.60E-03	5.26	CCF FILTER/STRAINER IN PSP TO PLUG
C74-DTM-FC-DIV2	6.00E-04	1.55E-03	3.58	DTM OF SSLC DIV. 2 FAILS TO TRIP
H23-EMS-FC-DIV2	6.00E-04	1.55E-03	3.58	ESSENTIAL MULTIPLEXING SYSTEM DIV 2 FAILS TO FUNCTION
P41-MP_-CR-3ALL	1.17E-05	1.53E-03	131.98	CCF TO RUN 3 PUMPS TRAINS A AND B
C74-DTM-FC-DIV1	6.00E-04	1.48E-03	3.47	DTM OF SSLC DIV. 1 FAILS TO TRIP
H23-EMS-FC-DIV1	6.00E-04	1.48E-03	3.47	ESSENTIAL MULTIPLEXING SYSTEM DIV 1 FAILS TO FUNCTION
E50-OR_-CF-PLUGALL	7.20E-08	1.45E-03	2.01E+04	CCF OF ALL ORIFICES TO PLUG
P41-STR-CF-3ALL	1.07E-05	1.40E-03	131.98	CCF 3 STRAINERS PLUGGED
E50-OR_-CF-7PLUG	7.00E-08	1.35E-03	1.93E+04	CCF OF 7 ORIFICES TO PLUG
U43-SYS-FF-YARD	2.00E-03	1.25E-03	1.62	HARDWARE FAILURES IN YARD AREA
U43-XHE-FO-YARD	1.77E-03	1.09E-03	1.61	OPERATOR FAILS TO MAKE UP FROM YARD AREA
C12-OR_-PG-D007A	6.48E-04	1.00E-03	2.54	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
XXX-XHE-FO-ICPCCS	1.61E-03	9.89E-04	1.61	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
P51-CMP-FR-C001A	2.40E-03	9.88E-04	1.41	MOTOR-DRIVEN AIR COMPRESS. C001A FAILS TO CONT.OPER.
P51-CMP-FS-C001B	2.00E-02	9.88E-04	1.05	MOTOR-DRIVEN AIR COMPRESS. C001B FAILS TO START
N21-LT_-CF-FWTKNO	4.38E-05	9.54E-04	22.77	CCF FEEDWATER STORAGE TANK LEVEL TRANSMITTERS
N21-ACV-OC-F016	1.31E-03	8.96E-04	1.68	AIR OPERATED VALVE N21-F016 FAILS TO REMAIN OPEN
N21-MOV-CC-F061	3.13E-02	8.96E-04	1.03	MOTOR OPERATED VALVE N21-F061 FAILS TO OPEN
C74-VLU-CF-ALL	3.12E-06	8.39E-04	269.79	CCF OF VOTER LOGIC UNITS
N21-LT_-CF-HWNO	4.38E-05	7.57E-04	18.29	CCF HOTWELL LEVEL TRANSMITTERS
P51-XHE-FO-STDBYCOMP	1.77E-02	7.56E-04	1.04	OPERATOR FAILS TO ACTUATE STAND-BY COMPRESSOR
P41-FAN-CS-2ALL	7.20E-06	7.45E-04	104.39	CCF TO START 2 FAN UNITS
U43-XHE-FO-LPCIADS	1.61E-02	6.68E-04	1.04	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
FIRE-CONTROL-ROOM-TGEN	9.42E-03	6.60E-04	1.07	FIRE IN CONTROL ROOM
P51-ACV-CC-F008A	2.00E-03	6.55E-04	1.33	AIR OPERATED VALVE F008A FAILS TO OP. TO DEENERG. POSIT.

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P51-ACV-CC-F010C	2.00E-03	6.55E-04	1.33	AOV F010C FAILS TO OPERATE TO NOT DEENERG. POSITION -
C12-OR_-PG-D007B	6.48E-04	6.28E-04	1.97	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
H23-RMU-FC-DIV2	3.00E-04	5.95E-04	2.98	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-DIV1	3.00E-04	5.74E-04	2.91	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
P52-XHE-FO-IAS/SAS	1.61E-02	5.55E-04	1.03	OPER. FAILS TO REC. NEED FOR MANUAL INTERV. ON IAS/SAS
C51-ACT-CF-APRMSTUCK	2.10E-07	5.37E-04	2.56E+03	CCF APRM DETECTORS STUCK AT POWER LEVEL
P41-MP_-CS-3ALL	6.26E-06	5.19E-04	83.83	CCF TO START PUMPS TRAINS A AND B
P30-UV_-CC-CV01T	2.00E-04	4.22E-04	3.11	CHECK VALVE CV01T FAILS TO OPEN
R16-BT_-TM-R16BT21	1.00E-03	4.22E-04	1.42	BATTERY R16-BT21 IN TEST
H23-EMS-CF-ALL	1.80E-06	4.16E-04	232.06	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
H23-RMU-FC-ESF13	3.00E-04	3.71E-04	2.23	1ST DIV III ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF23	3.00E-04	3.71E-04	2.23	2ND DIVIII ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
B21-LT_-NO-N001C	2.40E-05	3.34E-04	14.93	WIDE RANGE LEVEL TRANSMITTER 1C (LEVEL 1&2) FAILS
B21-LT_-NO-N001D	2.40E-05	3.34E-04	14.93	WIDE RANGE LEVEL TRANSMITTER 1D (LEVEL 1&2) FAILS
C62-VLU-CF-N1EALL	3.12E-05	3.06E-04	10.79	CCF OF VOTER LOGIC UNITS
C12-MOV-CF-OPEN	1.78E-04	2.97E-04	2.67	CCF MOV TO OPEN
H23-EMS-CF-DIDALL	1.80E-06	2.74E-04	153.49	CCF OF ALL DIVISION OF THE EMS
B21-XHE-FO-6OPEN	1.61E-03	2.63E-04	1.16	OPERATOR FAILS TO OPEN 6/10 SRVS
U43-XHE-FO-LPCI	1.61E-03	2.63E-04	1.16	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE
C41-XHE-FO-INISLCS	1.77E-01	2.48E-04	1	OPERATOR FAILS TO MANUALLY INITIATE SLCS (SHORT TIME)
R10-BAC-LP-500KVMAIN	4.80E-06	2.41E-04	51.23	500 KV MAIN DISTRIBUTION BUS FAILS DURING OPERATION
R13-XFL-LP-R13111	1.92E-05	2.37E-04	13.35	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13211	1.92E-05	2.37E-04	13.35	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13311	1.92E-05	2.37E-04	13.35	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13411	1.92E-05	2.37E-04	13.35	TRANSFORMER FAILS DURING OPERATION

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R16-BT_-LP-R16BT21	5.00E-04	1.99E-04	1.4	BATTERY DE3BY001 FAILS TO PROVIDE OUTPUT
R11-BAC-LP-R11B2	4.80E-06	1.93E-04	41.26	BUS R11-B2 FAILS DURING OPERATION
R11-BAC-TM-R11B2	4.80E-06	1.93E-04	41.26	6.9 KV AC BUS R11-B2 IN MANTENANCE
H23-RMU-CF-ALL	9.00E-07	1.85E-04	206.21	CCF OF REMOTE MULTIPLEXING UNITS TO OPERATE
B21-OR_-PG-01A	1.44E-05	1.62E-04	12.23	ORIFICE INSTR. LINE 1A FAILS TO REMAIN OPEN (PLUG)
B21-OR_-PG-01B	1.44E-05	1.62E-04	12.23	ORIFICE INSTR. LINE 1B FAILS TO REMAIN OPEN (PLUG)
B21-OR_-PG-01C	1.44E-05	1.62E-04	12.23	ORIFICE INSTR. LINE 1C FAILS TO REMAIN OPEN (PLUG)
B21-OR_-PG-01D	1.44E-05	1.62E-04	12.23	ORIFICE INSTR. LINE 1D FAILS TO REMAIN OPEN (PLUG)
R13-LCB-CO-FR13111	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13211	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13311	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13411	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13111	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13211	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13311	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13411	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR1311	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER TO R13-11 OPENS SPURIOUSLY
R13-LCB-CO-TOR1321	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER TO R13-21 OPENS SPURIOUSLY
R13-LCB-CO-TOR1331	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER TO R13-31 OPENS SPURIOUSLY
R13-LCB-CO-TOR1341	1.44E-05	1.62E-04	12.23	CIRCUIT BREAKER TO R13-41 OPENS SPURIOUSLY
B32-SYS-TM-ICA	4.16E-02	1.53E-04	1	IC "A" UNAVAILABLE [# 7]
H23-RMU-CF-DIDALL	9.00E-07	1.37E-04	153.49	CCF OF REMOTE MULTIPLEXING UNITS (DID)
R13-XFL-LP-R13C13	1.92E-05	1.32E-04	7.89	TRANSFORMER FAILS DURING OPERATION
C62-DTM-CF-DIDALL	5.50E-05	1.28E-04	3.32	COMMON CAUSE FAILURE 3/4 DTM DID LOGIC
R13-LCB-CO-FR13C13	1.44E-05	9.93E-05	7.89	CIRCUIT BREAKER OPENS SPURIOUSLY

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-LCB-CO-R13C13	1.44E-05	9.93E-05	7.89	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR13C	1.44E-05	9.93E-05	7.89	CIRCUIT BREAKER TO R13-C OPENS SPURIOUSLY
P22-HX_-PG-B001A	5.28E-05	9.78E-05	2.85	HEAT EXCHANGER A FAILS
P22-XHE-FO-HXB	2.69E-01	9.78E-05	1	OPERATOR FAILS TO ALIGN HX B
P51-ACV-CF-OPEN	1.35E-05	9.31E-05	7.89	CCF OF AOV TO OPEN
N21-ACV-TM-F026	8.00E-04	8.74E-05	1.11	VALVE N21-F026 UNAVAILABLE DUE TO TEST OR MAINTENANCE
R11-MCB-CO-B2B3	1.20E-05	8.28E-05	7.89	CIRCUIT BREAKER FROM R11-B2 OPENS SPURIOUSLY
G21-ACV-CC-F321	2.00E-03	6.75E-05	1.03	AOV F321 FAILS TO OPERATE TO NOT DEENERG.POS.
G21-ACV-CC-F322	2.00E-03	6.75E-05	1.03	AOV F322 FAILS TO OPERATE TO NOT DEENERG.POS.
R10-SYS-FF-500KV	1.20E-06	6.03E-05	51.24	500KV SWITCHYARD FAILS DURING OPERATION
C41-XHE-MH-F002A	4.03E-03	5.89E-05	1.01	MISPOSITION OF VALVE F002A
C41-XHE-MH-F002B	4.03E-03	5.89E-05	1.01	MISPOSITION OF VALVE F002B
C41-UV_-CC-F004A	1.60E-03	5.30E-05	1.03	CHECK VALVE F004A FAILS TO OPEN
C41-UV_-CC-F004B	1.60E-03	5.30E-05	1.03	CHECK VALVE F004B FAILS TO OPEN
C41-UV_-CC-F005A	1.60E-03	5.30E-05	1.03	CHECK VALVE F005A FAILS TO OPEN
C41-UV_-CC-F005B	1.60E-03	5.30E-05	1.03	CHECK VALVE F005B FAILS TO OPEN
B32-ACV-CC-F006B	2.00E-03	5.11E-05	1.03	AIR OPERATED VALVE F006B FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006C	2.00E-03	5.11E-05	1.03	AIR OPERATED VALVE F006A FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006D	2.00E-03	5.11E-05	1.03	AIR OPERATED VALVE F006D FAILS TO OP. TO DEENERG. POSIT.
C12-MPC-FR-C001A	5.76E-05	5.10E-05	1.88	MOTOR-DRIVEN PUMP C001A FAILS TO RUN, GIVEN START
R13-BAC-LP-R1311	4.80E-06	4.57E-05	10.51	BUS R13-31 FAILS DURING OPERATION
R13-BAC-LP-R13111	4.80E-06	4.57E-05	10.51	BUS R13-11-1 FAILS DURING OPERATION
R13-BAC-LP-R1321	4.80E-06	4.57E-05	10.51	BUS R13-21 FAILS DURING OPERATION
R13-BAC-LP-R13211	4.80E-06	4.57E-05	10.51	BUS R13-21-1 FAILS DURING OPERATION
R13-BAC-LP-R1331	4.80E-06	4.57E-05	10.51	BUS R13-31 FAILS DURING OPERATION

Table 18-3

Internal Fire Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Full Power Core Damage Frequency = 1.21E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-BAC-LP-R13311	4.80E-06	4.57E-05	10.51	BUS R13-31-1 FAILS DURING OPERATION
R13-BAC-LP-R1341	4.80E-06	4.57E-05	10.51	BUS R13-41 FAILS DURING OPERATION
R13-BAC-LP-R13411	4.80E-06	4.57E-05	10.51	BUS R13-41-1 FAILS DURING OPERATION
C12-XHE-FO-LEVEL2	3.22E-02	4.35E-05	1	MANUAL ACTUATION FAILURE
C51-ACT-CF-1PRM	2.98E-04	4.26E-05	1.14	CCF APRM NEUTRON CHANNELS
E50-SQV-CF-4OPEN	1.50E-05	4.24E-05	3.83	CCF OF 4 OR MORE SQUIB VALVES TO OPEN
B32-ACV-CF-2ICABCD	1.55E-05	3.65E-05	3.36	CCF TO OPEN 2/4 ACV VALVES TRAINS A,B,C,D
C12-MPC-FR-C001B	5.76E-05	3.40E-05	1.59	MOTOR-DRIVEN PUMP C001B FAILS TO RUN, GIVEN START
C41-XHE-FO-OPENF002A	2.69E-01	2.74E-05	1	OPERATOR FAILS TO OPEN VALVE F002A (AFTER INADV.CLOS.)
C41-XHE-FO-OPENF002B	2.69E-01	2.74E-05	1	OPERATOR FAILS TO OPEN VALVE F002B (AFTER INADV.CLOS.)
C72-VLU-CF-DPSALL	3.12E-06	1.79E-05	6.74	CCF OF VOTER LOGIC UNITS
C41-SYS-FF-MAKEUP	1.00E-01	1.78E-05	1	INVENTORY MAKE-UP BORATION FAILURE
FIRE-CONTROL-BUILD-TGEN-DIVII	2.76E-03	1.10E-05	1	FIRE IN CONTROL BUILDING DIV I ZONE
R10-XFH-TM-XFRMA	1.00E-04	8.31E-06	1.08	TRANSFORMER XFRM-A IN MAINTENANCE
R10-XFH-TM-XFRMB	1.00E-04	8.31E-06	1.08	TRANSFORMER XFRM-B IN MAINTENANCE

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
RB-DAMPER	7.40E-03	8.29E-01	112.15	FIRE BARRIER IN REACTOR BUILDING FAILS
XXX-XHE-FO-DEPRESS	1.61E-01	6.34E-01	4.3	OPERATOR FAILS TO RECOGNIZE NEED OF DEPRESSURIZATION
N21-XHE-FO-CONDPUMPD	2.69E-01	5.30E-01	2.44	OPERATOR FAILS TO START CONDENSATE PUMP D
N21-XHE-FO-FWPUMPD	2.69E-01	4.38E-01	2.19	OPERATOR FAILS TO START FEEDWATER PUMP D
FIRE-REACT-BUILD-DIVII-M5	1.12E-03	3.32E-01	295.87	FIRE-REACT-BUILD-DIVII-M5
FIRE-REACT-BUILD-DIVI-M5	1.12E-03	3.11E-01	276.79	FIRE-REACT-BUILD-DIVI-M5
G21-XHE-MH-F334	4.80E-02	2.11E-01	5.18	MISPOSITION OF VALVE F334
FIRE-REACT-BUILD-DIVIV-M5	1.12E-03	1.73E-01	154.82	FIRE-REACT-BUILD-DIVIV-M5
FIRE-REACT-BUILD-DIVIII-M5	1.12E-03	1.56E-01	139.77	FIRE-REACT-BUILD-DIVIII-M5
C12-XHE-MH-F013A	4.80E-02	9.88E-02	2.96	MISPOSITION OF VALVE F013A
C12-XHE-MH-F015A	4.80E-02	9.88E-02	2.96	MISPOSITION OF VALVE F015A
P30-XHE-MH-F015	4.80E-02	9.24E-02	2.83	MISPOSITION OF VALVE F01T
U43-SYS-FF-LPCI	2.40E-02	8.95E-02	4.64	U43 HARDWARE FAILURES
C12-XHE-MH-F013B	4.80E-02	8.65E-02	2.71	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015B	4.80E-02	8.65E-02	2.71	MISPOSITION OF VALVE F015B
H23-EMS-FC-DIV3	6.00E-04	7.02E-02	117.99	ESSENTIAL MULTIPLEXING SYSTEM DIV 3 FAILS TO FUNCTION
B21-SQV-CF-DPVOPEN	1.50E-05	6.39E-02	4.26E+03	CCF OF DPV'S TO OPEN
C74-DTM-FC-DIV3	6.00E-04	6.34E-02	106.6	DTM OF SSLC DIV. 3 FAILS TO TRIP
C74-DTM-FC-DIV4	6.00E-04	6.29E-02	105.72	DTM OF SSLC DIV. 4 FAILS TO TRIP
H23-EMS-FC-DIV4	6.00E-04	6.29E-02	105.72	ESSENTIAL MULTIPLEXING SYSTEM DIV 4 FAILS TO FUNCTION
B21-SQV-CC-F004B	3.00E-03	5.20E-02	18.29	EXPLOSIVE VALVE DPV B FAILS TO OPERATE
B21-SQV-CC-F004F	3.00E-03	5.20E-02	18.29	EXPLOSIVE VALVE DPV F FAILS TO OPERATE
B21-SQV-CC-F004D	3.00E-03	5.13E-02	18.06	EXPLOSIVE VALVE DPV D FAILS TO OPERATE

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Fire Shutdown
Core Damage Frequency = 2.32E-08/year

Event Name	Probability	F-V	RAW	Description
B21-SQV-CC-F004H	3.00E-03	5.13E-02	18.06	EXPLOSIVE VALVE DPV H FAILS TO OPERATE
B21-SQV-CC-F004C	3.00E-03	4.96E-02	17.49	EXPLOSIVE VALVE DPV C FAILS TO OPERATE
B21-SQV-CC-F004G	3.00E-03	4.96E-02	17.49	EXPLOSIVE VALVE DPV G FAILS TO OPERATE
B21-SQV-CC-F004A	3.00E-03	4.89E-02	17.26	EXPLOSIVE VALVE DPV A FAILS TO OPERATE
B21-SQV-CC-F004E	3.00E-03	4.89E-02	17.26	EXPLOSIVE VALVE DPV E FAILS TO OPERATE
E50-SQV-CF-GDCS7OPEN	1.50E-05	3.34E-02	2.22E+03	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	3.34E-02	2.22E+03	CCF OF ALL SQUIB VALVES TO OPEN
H23-RMU-FC-DIV3	3.00E-04	3.14E-02	105.73	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-DIV4	3.00E-04	3.12E-02	104.92	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
XXX-XHE-FO-LPMAKEUP	1.61E-01	2.34E-02	1.12	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
C12-XHE-MH-F018A	1.20E-02	2.31E-02	2.9	MISPOSITION OF VALVE F018A
C12-XHE-MH-F021A	1.20E-02	2.31E-02	2.9	MISPOSITION OF VALVE F021A
C12-XHE-MH-F003B	1.20E-02	2.04E-02	2.68	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018B	1.20E-02	2.04E-02	2.68	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021B	1.20E-02	2.04E-02	2.68	MISPOSITION OF VALVE F021B
EB-DAMPER	7.40E-03	1.67E-02	3.24	FIRE BARRIER IN ELECTRICAL BUILDING FAILS
C74-DTM-CF-ALL	1.20E-05	1.33E-02	1.11E+03	CCF 3/4 DTM OF SSLC DIV1/2/3/4
H23-EMS-FC-DIV1	6.00E-04	1.32E-02	22.94	ESSENTIAL MULTIPLEXING SYSTEM DIV 1 FAILS TO FUNCTION
H23-EMS-FC-DIV2	6.00E-04	1.28E-02	22.26	ESSENTIAL MULTIPLEXING SYSTEM DIV 2 FAILS TO FUNCTION
C74-DTM-FC-DIV1	6.00E-04	1.17E-02	20.48	DTM OF SSLC DIV. 1 FAILS TO TRIP
C74-DTM-FC-DIV2	6.00E-04	1.13E-02	19.81	DTM OF SSLC DIV. 2 FAILS TO TRIP
XXX-XHE-FO-RPVLDE	1.61E-02	9.51E-03	1.58	OP. FAILS TO RECOG. OR CHECK THE RPV DECREASING LEVEL
FIRE-NON-DIVISIONAL-REDB-M6	5.54E-04	8.38E-03	16.12	FIRE-NON-DIVISIONAL-REDB-M6
FIRE-NON-DIVISIONAL-REDA-M6	5.45E-04	8.25E-03	16.12	FIRE-NON-DIVISIONAL-REDA-M6

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-MOV-CC-F014A	4.00E-03	7.10E-03	2.77	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F020A	4.00E-03	7.06E-03	2.76	MOTOR OPER. VALVE F020A FAILS TO OPEN
G21-ACV-CC-F332	2.00E-03	6.93E-03	4.46	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
C12-MOV-CC-F014B	4.00E-03	6.41E-03	2.6	MOTOR OPER. VALVE F014B FAILS TO OPEN
C12-MOV-CC-F020B	4.00E-03	6.37E-03	2.59	MOTOR OPER. VALVE F020B FAILS TO OPEN
C12-MOV-FC-F020A	3.13E-03	5.48E-03	2.75	FLOW CONTROL A FAILS WIDE OPEN
H23-RMU-FC-DIV1	3.00E-04	5.42E-03	19.06	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
B21-UV_-CC-F102B	1.60E-03	5.40E-03	4.37	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	5.40E-03	4.37	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	5.40E-03	4.37	CHECK VALVE F022 FAILS TO OPEN
B21-UV_-CC-F102A	1.60E-03	5.29E-03	4.3	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	5.29E-03	4.3	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
G21-UV_-CC-F333	1.60E-03	5.29E-03	4.3	CHECK VALVE F333 FAILS TO OPEN
H23-RMU-FC-DIV2	3.00E-04	5.27E-03	18.58	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
C12-MOV-FC-F020B	3.13E-03	4.98E-03	2.59	FLOW CONTROL B FAILS WIDE OPEN
U43-XHE-FO-LPCI	1.61E-03	4.87E-03	4.02	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE
B21-XHE-FO-6OPEN	1.61E-03	4.72E-03	3.93	OPERATOR FAILS TO OPEN 6/10 SRVS
C12-SYS-TM-TRAINB	3.00E-03	4.70E-03	2.56	TRAIN B IN MAINTENANCE
C51-ACT-CF-APRMSTUCK	2.10E-07	3.95E-03	1.88E+04	CCF APRM DETECTORS STUCK AT POWER LEVEL
C12-MP_-FS-C001BOIL	2.40E-03	3.76E-03	2.56	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	3.76E-03	2.56	MOTOR-DRIVEN PUMP C001B FAILS TO START
H23-RMU-FC-ESF13	3.00E-04	3.48E-03	12.59	1ST DIV III ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF23	3.00E-04	3.48E-03	12.59	2ND DIVIII ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
C74-VLU-CF-ALL	3.12E-06	3.46E-03	1.11E+03	CCF OF VOTER LOGIC UNITS
R16-BT_-CF-ALLBATT	9.00E-06	3.35E-03	373.65	BATTERY CCF #2

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
FIRE-REACT-BUILD-DIVIII-M6	2.80E-04	2.59E-03	10.23	FIRE-REACT-BUILD-DIVIII-M6
FIRE-REACT-BUILD-DIVIV-M6	2.80E-04	2.59E-03	10.23	FIRE-REACT-BUILD-DIVIV-M6
B21-LT_-NO-N001C	2.40E-05	2.31E-03	97.42	WIDE RANGE LEVEL TRANSMITTER 1C (LEVEL 1&2) FAILS
B21-LT_-NO-N001D	2.40E-05	2.31E-03	97.05	WIDE RANGE LEVEL TRANSMITTER 1D (LEVEL 1&2) FAILS
G21-UV_-TM-F332/333	8.00E-04	2.29E-03	3.86	MAINTENANCE FOR CV F332 OR CV F333
P22-ACV-FT-BYPASS	2.00E-03	2.21E-03	2.1	HEAT EXCHANGERS BYPASS VALVE FAILS TO REGULATE
H23-EMS-CF-ALL	1.80E-06	1.97E-03	1.10E+03	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
FIRE-CONTROL-ROOM-M6	9.43E-05	1.96E-03	21.8	FIRE-CONTROL-ROOM-M6
FIRE-REACT-BUILD-DIVII-M6	2.80E-04	1.95E-03	7.96	FIRE-REACT-BUILD-DIVII-M6
FIRE-REACT-BUILD-DIVI-M6	2.80E-04	1.95E-03	7.96	FIRE-REACT-BUILD-DIVI-M6
R13-XFL-LP-R13311	1.92E-05	1.94E-03	101.92	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13411	1.92E-05	1.82E-03	95.89	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13111	1.92E-05	1.76E-03	92.68	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13211	1.92E-05	1.64E-03	86.65	TRANSFORMER FAILS DURING OPERATION
E50-MP_-TM-POOLB	1.00E-02	1.53E-03	1.15	GDCS POOL B IN MAINTENANCE
C12-MCB-OO-C001B	1.00E-03	1.52E-03	2.52	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
R13-LCB-CO-FR13311	1.44E-05	1.45E-03	101.46	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13311	1.44E-05	1.45E-03	101.46	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR1311	1.44E-05	1.45E-03	101.46	CIRCUIT BREAKER TO R13-11 OPENS SPURIOUSLY
R13-LCB-CO-TOR1331	1.44E-05	1.45E-03	101.46	CIRCUIT BREAKER TO R13-31 OPENS SPURIOUSLY
B21-OR_-PG-01C	1.44E-05	1.36E-03	95.43	ORIFICE INSTR. LINE 1C FAILS TO REMAIN OPEN (PLUG)
B21-OR_-PG-01D	1.44E-05	1.36E-03	95.43	ORIFICE INSTR. LINE 1D FAILS TO REMAIN OPEN (PLUG)
R13-LCB-CO-FR13411	1.44E-05	1.36E-03	95.43	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13411	1.44E-05	1.36E-03	95.43	CIRCUIT BREAKER OPENS SPURIOUSLY

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-LCB-CO-TOR1321	1.44E-05	1.36E-03	95.43	CIRCUIT BREAKER TO R13-21 OPENS SPURIOUSLY
R13-LCB-CO-TOR1341	1.44E-05	1.36E-03	95.43	CIRCUIT BREAKER TO R13-41 OPENS SPURIOUSLY
R13-LCB-CO-FR13111	1.44E-05	1.31E-03	92.22	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13111	1.44E-05	1.31E-03	92.22	CIRCUIT BREAKER OPENS SPURIOUSLY
N21-ACV-OC-F018	1.31E-03	1.27E-03	1.97	AIR OPERATED VALVE N21-F018 FAILS TO REMAIN OPEN
B21-OR_-PG-01A	1.44E-05	1.23E-03	86.19	ORIFICE INSTR. LINE 1A FAILS TO REMAIN OPEN (PLUG)
B21-OR_-PG-01B	1.44E-05	1.23E-03	86.19	ORIFICE INSTR. LINE 1B FAILS TO REMAIN OPEN (PLUG)
R13-LCB-CO-FR13211	1.44E-05	1.23E-03	86.19	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13211	1.44E-05	1.23E-03	86.19	CIRCUIT BREAKER OPENS SPURIOUSLY
E50-SQV-CO-F009A	3.50E-03	1.06E-03	1.3	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	1.06E-03	1.3	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	1.06E-03	1.3	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
C12-OR_-PG-D007A	6.48E-04	9.66E-04	2.49	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
C12-OR_-PG-D007B	6.48E-04	9.24E-04	2.43	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
H23-RMU-CF-ALL	9.00E-07	8.96E-04	996.18	CCF OF REMOTE MULTIPLEXING UNITS TO OPERATE
H23-EMS-FC-DPSDIV3	6.00E-04	8.72E-04	2.45	ESSENTIAL MULTIPLEXING SYSTEM DPS DIV 3 FAILS TO FUNCTION
H23-EMS-FC-DPSDIV4	6.00E-04	8.72E-04	2.45	ESSENTIAL MULTIPLEXING SYSTEM DPS DIV 4 FAILS TO FUNCTION
U43-XHE-FO-LPCIADS	1.61E-02	8.60E-04	1.05	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
C72-DTM-FC-DPSDIV3	6.00E-04	8.39E-04	2.4	DTM OF DPS DIV. 3 FAILS TO TRIP
C72-DTM-FC-DPSDIV4	6.00E-04	8.39E-04	2.4	DTM OF DPS DIV. 4 FAILS TO TRIP
B21-SQV-CF-F004AB	3.60E-05	8.29E-04	24.03	CCF OF DPV A AND B TO OPEN
B21-SQV-CF-F004AD	3.60E-05	8.29E-04	24.03	CCF OF DPV A AND D TO OPEN
B21-SQV-CF-F004AF	3.60E-05	8.29E-04	24.03	CCF OF DPV A AND F TO OPEN
B21-SQV-CF-F004AH	3.60E-05	8.29E-04	24.03	CCF OF DPV A AND H TO OPEN
B21-SQV-CF-F004BC	3.60E-05	8.29E-04	24.03	CCF OF DPV B AND C TO OPEN

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Fire Shutdown
Core Damage Frequency = 2.32E-08/year

Event Name	Probability	F-V	RAW	Description
B21-SQV-CF-F004BE	3.60E-05	8.29E-04	24.03	CCF OF DPV B AND E TO OPEN
B21-SQV-CF-F004BG	3.60E-05	8.29E-04	24.03	CCF OF DPV B AND G TO OPEN
B21-SQV-CF-F004CD	3.60E-05	8.29E-04	24.03	CCF OF DPV C AND D TO OPEN
B21-SQV-CF-F004CF	3.60E-05	8.29E-04	24.03	CCF OF DPV C AND F TO OPEN
B21-SQV-CF-F004CH	3.60E-05	8.29E-04	24.03	CCF OF DPV C AND H TO OPEN
B21-SQV-CF-F004DE	3.60E-05	8.29E-04	24.03	CCF OF DPV D AND E TO OPEN
B21-SQV-CF-F004DG	3.60E-05	8.29E-04	24.03	CCF OF DPV D AND G TO OPEN
B21-SQV-CF-F004EF	3.60E-05	8.29E-04	24.03	CCF OF DPV E AND F TO OPEN
B21-SQV-CF-F004EH	3.60E-05	8.29E-04	24.03	CCF OF DPV E AND H TO OPEN
B21-SQV-CF-F004FG	3.60E-05	8.29E-04	24.03	CCF OF DPV F AND G TO OPEN
B21-SQV-CF-F004GH	3.60E-05	8.29E-04	24.03	CCF OF DPV G AND H TO OPEN
E50-SQV-CO-F009B	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009B SPUR. OPENING [#7]
E50-SQV-CO-F009C	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009C SPUR. OPENING [#7]
E50-SQV-CO-F009F	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009F SPUR. OPENING [#7]
E50-SQV-CO-F009G	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009G SPUR. OPENING [#7]
E50-SQV-CO-F009J	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]
E50-SQV-CO-F009K	3.50E-03	8.19E-04	1.23	SQUIB DELUGE VALVE F009K SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	8.06E-04	1.23	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009H	3.50E-03	8.06E-04	1.23	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	8.06E-04	1.23	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
H23-EMS-FC-DIVCN1E	6.00E-04	4.97E-04	1.83	ESSENTIAL MULTIPLEXING SYSTEM DIV C (N1E) FAILS TO FUNCTION
C62-VLU-CF-DIDALL	3.12E-05	4.44E-04	15.24	CCF OF VOTER LOGIC UNITS
C72-VLU-CF-DPSALL	3.12E-06	4.38E-04	141.33	CCF OF VOTER LOGIC UNITS
R13-BAC-LP-R1311	4.80E-06	4.31E-04	90.71	BUS R13-31 FAILS DURING OPERATION
R13-BAC-LP-R1321	4.80E-06	4.31E-04	90.71	BUS R13-21 FAILS DURING OPERATION

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Fire Shutdown
Core Damage Frequency = 2.32E-08/year

Event Name	Probability	F-V	RAW	Description
R13-BAC-LP-R1331	4.80E-06	4.31E-04	90.71	BUS R13-31 FAILS DURING OPERATION
R13-BAC-LP-R13311	4.80E-06	4.31E-04	90.71	BUS R13-31-1 FAILS DURING OPERATION
R13-BAC-LP-R1341	4.80E-06	4.31E-04	90.71	BUS R13-41 FAILS DURING OPERATION
R13-BAC-LP-R13411	4.80E-06	4.31E-04	90.71	BUS R13-41-1 FAILS DURING OPERATION
B21-SQV-CF-F004BD	3.60E-05	4.28E-04	12.89	CCF OF DPV B AND D TO OPEN
B21-SQV-CF-F004BF	3.60E-05	4.28E-04	12.89	CCF OF DPV B AND F TO OPEN
B21-SQV-CF-F004BH	3.60E-05	4.28E-04	12.89	CCF OF DPV B AND H TO OPEN
B21-SQV-CF-F004DF	3.60E-05	4.28E-04	12.89	CCF OF DPV D AND F TO OPEN
B21-SQV-CF-F004DH	3.60E-05	4.28E-04	12.89	CCF OF DPV D AND H TO OPEN
B21-SQV-CF-F004FH	3.60E-05	4.28E-04	12.89	CCF OF DPV F AND H TO OPEN
E50-XHE-FO-GDCS	1.61E-03	4.20E-04	1.26	OPERATOR FAILS TO ACTUATE GDCS
H23-RMU-FC-DPSDIV3	3.00E-04	4.11E-04	2.37	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-DPSDIV4	3.00E-04	4.11E-04	2.37	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
B21-SQV-CF-F004AC	3.60E-05	4.01E-04	12.14	CCF OF DPV A AND C TO OPEN
B21-SQV-CF-F004AE	3.60E-05	4.01E-04	12.14	CCF OF DPV A AND E TO OPEN
B21-SQV-CF-F004AG	3.60E-05	4.01E-04	12.14	CCF OF DPV A AND G TO OPEN
B21-SQV-CF-F004CE	3.60E-05	4.01E-04	12.14	CCF OF DPV C AND E TO OPEN
B21-SQV-CF-F004CG	3.60E-05	4.01E-04	12.14	CCF OF DPV C AND G TO OPEN
B21-SQV-CF-F004EG	3.60E-05	4.01E-04	12.14	CCF OF DPV E AND G TO OPEN
R13-BAC-LP-R13111	4.80E-06	3.86E-04	81.47	BUS R13-11-1 FAILS DURING OPERATION
R13-BAC-LP-R13211	4.80E-06	3.86E-04	81.47	BUS R13-21-1 FAILS DURING OPERATION
E50-SQV-CC-F002A	3.00E-03	3.41E-04	1.11	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	3.41E-04	1.11	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	3.41E-04	1.11	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	3.41E-04	1.11	SQUIB VALVE F002H FAILS TO OPERATE

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-MOV-CF-OPEN	1.78E-04	3.40E-04	2.91	CCF MOV TO OPEN
C12-XHE-FO-LEVEL2	3.22E-02	3.07E-04	1.01	MANUAL ACTUATION FAILURE
B21-LT_-NO-N001B	2.40E-05	2.96E-04	13.35	WIDE RANGE LEVEL TRANSMITTER 1B (LEVEL 1&2) FAILS
B21-LT_-NO-N001A	2.40E-05	2.79E-04	12.61	WIDE RANGE LEVEL TRANSMITTER 1A (LEVEL 1&2) FAILS
G21-UV_-OC-F331	2.16E-04	2.49E-04	2.15	CHECK VALVE F331 FAILS TO CLOSE
H23-RMU-FC-ESF14	3.00E-04	2.23E-04	1.74	1ST DIV IV ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF24	3.00E-04	2.23E-04	1.74	2ND DIVIII ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
B21-SRV-CF-6OPEN	1.90E-04	2.20E-04	2.15	CCF TO OPEN 6 SRVS
H23-EMS-CF-DPSALL	1.80E-06	2.12E-04	118.75	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
C62-DTM-CF-N1EALL	5.50E-05	1.83E-04	4.33	CCF OF DIGITAL TRIP MODULES NO 1E
P54-CPV-CF-CONTROL	1.57E-04	1.81E-04	2.15	CCF OF PRESSURE CONTROL VALVES FAILURES
P30-UV_-CC-CV01T	2.00E-04	1.79E-04	1.89	CHECK VALVE CV01T FAILS TO OPEN
R10-CBU-FC-PRE500KV	7.20E-05	1.36E-04	2.89	500KV TRANSMISSION LINE FAILS
B21-SQV-CF-F004ABC	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & C TO OPEN
B21-SQV-CF-F004ABD	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & D TO OPEN
B21-SQV-CF-F004ABE	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & E TO OPEN
B21-SQV-CF-F004ABF	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & F TO OPEN
B21-SQV-CF-F004ABG	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & G TO OPEN
B21-SQV-CF-F004ABH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,B & H TO OPEN
B21-SQV-CF-F004ACD	9.00E-06	1.34E-04	15.88	CCF OF DPV A,C & D TO OPEN
B21-SQV-CF-F004ACF	9.00E-06	1.34E-04	15.88	CCF OF DPV A,C & F TO OPEN
B21-SQV-CF-F004ACH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,C & H TO OPEN
B21-SQV-CF-F004ADE	9.00E-06	1.34E-04	15.88	CCF OF DPV A,D & E TO OPEN
B21-SQV-CF-F004ADF	9.00E-06	1.34E-04	15.88	CCF OF DPV A,D & F TO OPEN
B21-SQV-CF-F004ADG	9.00E-06	1.34E-04	15.88	CCF OF DPV A,D & G TO OPEN

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
B21-SQV-CF-F004ADH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,D & H TO OPEN
B21-SQV-CF-F004AEF	9.00E-06	1.34E-04	15.88	CCF OF DPV A,E & F TO OPEN
B21-SQV-CF-F004AEH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,E & H TO OPEN
B21-SQV-CF-F004AFG	9.00E-06	1.34E-04	15.88	CCF OF DPV A,F & G TO OPEN
B21-SQV-CF-F004AFH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,F & H TO OPEN
B21-SQV-CF-F004AGH	9.00E-06	1.34E-04	15.88	CCF OF DPV A,G & H TO OPEN
B21-SQV-CF-F004BCD	9.00E-06	1.34E-04	15.88	CCF OF DPV B,C & D TO OPEN
B21-SQV-CF-F004BCE	9.00E-06	1.34E-04	15.88	CCF OF DPV B,C & E TO OPEN
B21-SQV-CF-F004BCF	9.00E-06	1.34E-04	15.88	CCF OF DPV B,C & F TO OPEN
B21-SQV-CF-F004BCG	9.00E-06	1.34E-04	15.88	CCF OF DPV B,C & G TO OPEN
B21-SQV-CF-F004BCH	9.00E-06	1.34E-04	15.88	CCF OF DPV B,C & H TO OPEN
B21-SQV-CF-F004BDE	9.00E-06	1.34E-04	15.88	CCF OF DPV B,D & E TO OPEN
B21-SQV-CF-F004BDG	9.00E-06	1.34E-04	15.88	CCF OF DPV B,D & G TO OPEN
B21-SQV-CF-F004BEF	9.00E-06	1.34E-04	15.88	CCF OF DPV B,E & F TO OPEN
B21-SQV-CF-F004BEG	9.00E-06	1.34E-04	15.88	CCF OF DPV B,E & G TO OPEN
B21-SQV-CF-F004BEH	9.00E-06	1.34E-04	15.88	CCF OF DPV B,E & H TO OPEN
B21-SQV-CF-F004BFG	9.00E-06	1.34E-04	15.88	CCF OF DPV B,F & G TO OPEN
B21-SQV-CF-F004BGH	9.00E-06	1.34E-04	15.88	CCF OF DPV B,G & H TO OPEN
B21-SQV-CF-F004CDE	9.00E-06	1.34E-04	15.88	CCF OF DPV C,D & E TO OPEN
B21-SQV-CF-F004CDF	9.00E-06	1.34E-04	15.88	CCF OF DPV C,D & F TO OPEN
B21-SQV-CF-F004CDG	9.00E-06	1.34E-04	15.88	CCF OF DPV C,D & G TO OPEN
B21-SQV-CF-F004CDH	9.00E-06	1.34E-04	15.88	CCF OF DPV C,D & H TO OPEN
B21-SQV-CF-F004CEF	9.00E-06	1.34E-04	15.88	CCF OF DPV C,E & F TO OPEN
B21-SQV-CF-F004CEH	9.00E-06	1.34E-04	15.88	CCF OF DPV C,E & H TO OPEN
B21-SQV-CF-F004CFG	9.00E-06	1.34E-04	15.88	CCF OF DPV C,F & G TO OPEN

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
B21-SQV-CF-F004CFH	9.00E-06	1.34E-04	15.88	CCF OF DPV C,F & H TO OPEN
B21-SQV-CF-F004CGH	9.00E-06	1.34E-04	15.88	CCF OF DPV C,G & H TO OPEN
B21-SQV-CF-F004DEF	9.00E-06	1.34E-04	15.88	CCF OF DPV D,E & F TO OPEN
B21-SQV-CF-F004DEG	9.00E-06	1.34E-04	15.88	CCF OF DPV D,E & G TO OPEN
B21-SQV-CF-F004DEH	9.00E-06	1.34E-04	15.88	CCF OF DPV D,E & H TO OPEN
B21-SQV-CF-F004DFG	9.00E-06	1.34E-04	15.88	CCF OF DPV D,F & G TO OPEN
B21-SQV-CF-F004DGH	9.00E-06	1.34E-04	15.88	CCF OF DPV D,G & H TO OPEN
B21-SQV-CF-F004EFG	9.00E-06	1.34E-04	15.88	CCF OF DPV E,F & G TO OPEN
B21-SQV-CF-F004EFH	9.00E-06	1.34E-04	15.88	CCF OF DPV E,F & H TO OPEN
B21-SQV-CF-F004EGH	9.00E-06	1.34E-04	15.88	CCF OF DPV E,G & H TO OPEN
B21-SQV-CF-F004FGH	9.00E-06	1.34E-04	15.88	CCF OF DPV F,G & H TO OPEN
R13-XFL-LP-R13112	1.92E-05	1.16E-04	7.03	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13312	1.92E-05	1.16E-04	7.03	TRANSFORMER FAILS DURING OPERATION
N21-MPF-FS-C001A	4.70E-01	1.15E-04	1	MOTOR DRIVEN FDWTR PUMP A FAILS TO RUN, GIVEN START
N21-MPF-FS-C001B	4.70E-01	1.15E-04	1	MOTOR DRIVEN FDWTR PUMP B FAILS TO RUN, GIVEN START
N21-MPF-FS-C001C	4.70E-01	1.15E-04	1	MOTOR DRIVEN FDWTR PUMP C FAILS TO RUN, GIVEN START
P54-PS_-CO-PS001	1.19E-04	1.10E-04	1.92	PRESSURE SWITCH PS001 (PT001) OPERATES SPURIOUSLY
H23-RMU-FC-ESF1CN1E	3.00E-04	1.04E-04	1.35	1ST DIV C (N1E) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2CN1E	3.00E-04	1.04E-04	1.35	2ND DIV C (N1E) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
C72-DTM-FC-DPSDIV1	6.00E-04	8.93E-05	1.15	DTM OF DPS DIV. 1 FAILS TO TRIP
C72-DTM-FC-DPSDIV2	6.00E-04	8.93E-05	1.15	DTM OF DPV DIV. 2 FAILS TO TRIP
H23-EMS-FC-DPSDIV1	6.00E-04	8.93E-05	1.15	ESSENTIAL MULTIPLEXING SYSTEM DPS DIV 1 FAILS TO FUNCTION
H23-EMS-FC-DPSDIV2	6.00E-04	8.93E-05	1.15	ESSENTIAL MULTIPLEXING SYSTEM DPS DIV 2 FAILS TO FUNCTION
R13-LCB-CO-FR13112	1.44E-05	8.70E-05	7.03	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13312	1.44E-05	8.70E-05	7.03	CIRCUIT BREAKER OPENS SPURIOUSLY

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-LCB-CO-R13112	1.44E-05	8.70E-05	7.03	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13312	1.44E-05	8.70E-05	7.03	CIRCUIT BREAKER OPENS SPURIOUSLY
N21-ACV-CC-F023	1.58E-02	8.68E-05	1.01	AIR OPERATED VALVE N21-F023 FAILS TO OPEN
N21-ACV-CC-F026	1.58E-02	8.68E-05	1.01	AIR OPERATED VALVE N21-F026 FAILS TO OPEN
H23-RMU-CF-DPSALL	9.00E-07	8.16E-05	91.7	CCF OF REMOTE MULTIPLEXING UNITS TO OPERATE
B21-SQV-CF-F004ACE	9.00E-06	6.70E-05	8.44	CCF OF DPV A,C & E TO OPEN
B21-SQV-CF-F004ACG	9.00E-06	6.70E-05	8.44	CCF OF DPV A,C & G TO OPEN
B21-SQV-CF-F004AEG	9.00E-06	6.70E-05	8.44	CCF OF DPV A,E & G TO OPEN
B21-SQV-CF-F004BDF	9.00E-06	6.70E-05	8.44	CCF OF DPV B,D & F TO OPEN
B21-SQV-CF-F004BDH	9.00E-06	6.70E-05	8.44	CCF OF DPV B,D & H TO OPEN
B21-SQV-CF-F004BFH	9.00E-06	6.70E-05	8.44	CCF OF DPV B,F & H TO OPEN
B21-SQV-CF-F004CEG	9.00E-06	6.70E-05	8.44	CCF OF DPV C,E & G TO OPEN
B21-SQV-CF-F004DFH	9.00E-06	6.70E-05	8.44	CCF OF DPV D,F & H TO OPEN
E50-UV_-OC-F003A	1.75E-03	6.42E-05	1.04	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	6.42E-05	1.04	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	6.42E-05	1.04	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	6.42E-05	1.04	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
B21-LT_-CF-N001A/B/C/D	1.20E-07	6.03E-05	503.69	CCF OF DIVERSIFIED LEVEL 1 & 2 TRANSM. 10A/B/C/D
N21-MPF-FS-C001D	2.00E-03	5.76E-05	1.03	MOTOR-DRIVEN FEEDWATER PUMP D FAILS TO RESTART
N21-MPF-TM-C001D	2.00E-03	5.76E-05	1.03	FEEDWATER PUMP BRANCH D IN MAINTENANCE
B21-LT_-CF-N001ABCD	1.20E-07	4.20E-05	350.99	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
P51-CMP-CR-RUN	1.49E-04	4.13E-05	1.28	CCF OF P51 COMPRESSORS TO RUN
FIRE-NON-DIVISIONAL-REDA-M5	2.20E-03	3.39E-05	1.02	FIRE-NON-DIVISIONAL-REDA-M5
FIRE-NON-DIVISIONAL-REDB-M5	2.20E-03	3.39E-05	1.02	FIRE-NON-DIVISIONAL-REDB-M5

Table 18-4

Internal Fire Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Fire Shutdown Core Damage Frequency = 2.32E-08/year				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-OR_-CF-PLUGALL	7.20E-08	2.52E-05	350.99	CCF OF ALL ORIFICES TO PLUG
U43-SYS-FF-YARD	2.00E-03	2.52E-05	1.01	HARDWARE FAILURES IN YARD AREA
E50-OR_-CF-7PLUG	7.00E-08	2.45E-05	351.02	CCF OF 7 ORIFICES TO PLUG
R13-INV-FC-R1311	4.80E-04	2.34E-05	1.05	INVERTER TO R13-11 FAILS
R13-INV-FC-R1321	4.80E-04	2.34E-05	1.05	INVERTER TO R13-21 FAILS
R13-INV-FC-R1331	4.80E-04	2.34E-05	1.05	INVERTER TO R13-31 FAILS
R13-INV-FC-R1341	4.80E-04	2.34E-05	1.05	INVERTER TO R13-41 FAILS
R13-SEL-FT-A31R1311	7.88E-04	2.34E-05	1.03	AUTOMATIC SELECTOR FAILS TO TRANSFER
R13-SEL-FT-B31R1321	7.88E-04	2.34E-05	1.03	AUTOMATIC SELECTOR FAILS TO TRANSFER
R13-SEL-FT-C31R1331	7.88E-04	2.34E-05	1.03	AUTOMATIC SELECTOR FAILS TO TRANSFER
R13-SEL-FT-D31R1341	7.88E-04	2.34E-05	1.03	AUTOMATIC SELECTOR FAILS TO TRANSFER
U43-XHE-FO-YARD	1.77E-03	2.23E-05	1.01	OPERATOR FAILS TO MAKE UP FROM YARD AREA
XXX-XHE-FO-ICPCCS	1.61E-03	2.03E-05	1.01	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
P51-ACV-CC-F008A	2.00E-03	1.17E-05	1.01	AIR OPERATED VALVE F008A FAILS TO OP. TO DEENERG. POSIT.
P51-ACV-CC-F010C	2.00E-03	1.17E-05	1.01	AOV F010C FAILS TO OPERATE TO NOT DEENERG. POSITION
B21-LT_-NO-DPSWRC	2.40E-05	1.11E-05	1.46	DPS WIDE RANGE LEVEL TRANSMITTER C (LEVEL 1&2) FAILS
B21-LT_-NO-DPSWRD	2.40E-05	1.11E-05	1.46	DPS WIDE RANGE LEVEL TRANSMITTER D (LEVEL 1&2) FAILS
FIRE-CONTROL-ROOM-M5	3.80E-04	1.06E-05	1.03	FIRE-CONTROL-ROOM-M5

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
FLOOD-TB-ALL-POWER	2.80E-02	9.97E-01	35.59	FLOOD IN TURBINE BUILDING DUE TO BREAK IN CIRC SYSTEM
E50-SQV-CF-GDCS7OPEN	1.50E-05	4.13E-01	2.75E+04	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	4.13E-01	2.75E+04	CCF OF ALL SQUIB VALVES TO OPEN
C12-XHE-MH-F013A	4.80E-02	2.90E-01	6.76	MISPOSITION OF VALVE F013A
C12-XHE-MH-F013B	4.80E-02	2.90E-01	6.76	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015A	4.80E-02	2.90E-01	6.76	MISPOSITION OF VALVE F015A
C12-XHE-MH-F015B	4.80E-02	2.90E-01	6.76	MISPOSITION OF VALVE F015B
G21-XHE-MH-F334	4.80E-02	2.17E-01	5.29	MISPOSITION OF VALVE F334
B21-UV_-CC-F102B	1.60E-03	9.67E-02	61.41	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	9.67E-02	61.41	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	9.67E-02	61.41	CHECK VALVE F022 FAILS TO OPEN
E50-SQV-CO-F009A	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]
E50-SQV-CO-F009H	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	3.69E-02	11.52	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
C12-XHE-MH-F018A	1.20E-02	3.52E-02	3.89	MISPOSITION OF VALVE F018A
C12-XHE-MH-F021A	1.20E-02	3.52E-02	3.89	MISPOSITION OF VALVE F021A
E50-SQV-CO-F009B	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009B SPUR. OPENING [#7]
E50-SQV-CO-F009C	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009C SPUR. OPENING [#7]
E50-SQV-CO-F009F	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009F SPUR. OPENING [#7]
E50-SQV-CO-F009G	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009G SPUR. OPENING [#7]
E50-SQV-CO-F009J	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-SQV-CO-F009K	3.50E-03	2.71E-02	8.73	SQUIB DELUGE VALVE F009K SPUR. OPENING [#7]
C12-MOV-CC-F014A	4.00E-03	2.33E-02	6.8	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F014B	4.00E-03	2.33E-02	6.8	MOTOR OPER. VALVE F014B FAILS TO OPEN
C12-XHE-MH-F003B	1.20E-02	2.16E-02	2.78	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018B	1.20E-02	2.16E-02	2.78	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021B	1.20E-02	2.16E-02	2.78	MISPOSITION OF VALVE F021B
E50-SQV-CC-F002A	3.00E-03	1.61E-02	6.36	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	1.61E-02	6.36	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	1.61E-02	6.36	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	1.61E-02	6.36	SQUIB VALVE F002H FAILS TO OPERATE
C12-MOV-CC-F020A	4.00E-03	1.04E-02	3.59	MOTOR OPER. VALVE F020A FAILS TO OPEN
E50-UV_-OC-F003A	1.75E-03	9.42E-03	6.37	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	9.42E-03	6.37	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	9.42E-03	6.37	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	9.42E-03	6.37	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
C62-VLU-CF-DIDALL	3.12E-05	8.71E-03	280.03	CCF OF VOTER LOGIC UNITS
C12-MOV-FC-F020A	3.13E-03	8.12E-03	3.59	FLOW CONTROL A FAILS WIDE OPEN
G21-ACV-CC-F332	2.00E-03	7.47E-03	4.73	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
C12-MOV-CC-F020B	4.00E-03	6.35E-03	2.58	MOTOR OPER. VALVE F020B FAILS TO OPEN
B21-UV_-CC-F102A	1.60E-03	5.94E-03	4.71	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	5.94E-03	4.71	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
G21-UV_-CC-F333	1.60E-03	5.94E-03	4.71	CHECK VALVE F333 FAILS TO OPEN
C12-MOV-FC-F020B	3.13E-03	4.94E-03	2.58	FLOW CONTROL B FAILS WIDE OPEN
C12-SYS-TM-TRAINB	3.00E-03	4.75E-03	2.58	TRAIN B IN MAINTENANCE
E50-STR-CF-SPPLUG	3.75E-04	4.36E-03	12.59	CCF FILTER/STRAINER IN PSP TO PLUG

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-MP_-FS-C001BOIL	2.40E-03	3.76E-03	2.56	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	3.76E-03	2.56	MOTOR-DRIVEN PUMP C001B FAILS TO START
C71-SYS-FF-SCRAM	1.00E-08	3.35E-03	3.35E+05	SCRAM FAILURE
B21-LT_-CF-N001ABCD	1.20E-07	3.16E-03	2.63E+04	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
G21-UV_-TM-F332/333	8.00E-04	2.94E-03	4.67	MAINTENANCE FOR CV F332 OR CV F333
G21-XHE-FO-LPCIADS	1.61E-02	2.30E-03	1.14	OPERATOR FAILS TO ALIGN AND ACTUATE FAPCS IN LPCI MODE
U43-SYS-FF-LPCI	2.40E-02	2.08E-03	1.08	U43 HARDWARE FAILURES
E50-OR_-CF-PLUGALL	7.20E-08	1.85E-03	2.57E+04	CCF OF ALL ORIFICES TO PLUG
E50-OR_-CF-7PLUG	7.00E-08	1.80E-03	2.57E+04	CCF OF 7 ORIFICES TO PLUG
C12-OR_-PG-D007A	6.48E-04	1.60E-03	3.47	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
P30-XHE-MH-F015	4.80E-02	1.59E-03	1.03	MISPOSITION OF VALVE F01T
C41-XHE-FO-INISLCS	1.77E-01	1.54E-03	1.01	OPERATOR FAILS TO MANUALLY INITIATE SLCS (SHORT TIME)
C12-MCB-OO-C001B	1.00E-03	1.53E-03	2.53	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
U43-XHE-FO-LPCIADS	1.61E-02	1.38E-03	1.08	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
C12-OR_-PG-D007B	6.48E-04	9.59E-04	2.48	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
C41-SYS-FF-MAKEUP	1.00E-01	8.68E-04	1.01	INVENTORY MAKE-UP BORATION FAILURE
C12-MOV-CF-OPEN	1.78E-04	6.92E-04	4.89	CCF MOV TO OPEN
C41-UV_-CC-F004A	1.60E-03	4.49E-04	1.28	CHECK VALVE F004A FAILS TO OPEN
C41-UV_-CC-F004B	1.60E-03	4.49E-04	1.28	CHECK VALVE F004B FAILS TO OPEN
C41-UV_-CC-F005A	1.60E-03	4.49E-04	1.28	CHECK VALVE F005A FAILS TO OPEN
C41-UV_-CC-F005B	1.60E-03	4.49E-04	1.28	CHECK VALVE F005B FAILS TO OPEN
H23-EMS-CF-DIDALL	1.80E-06	4.10E-04	228.67	CCF OF ALL DIVISION OF THE EMS
N21-LT_-NO-FWTKA	8.71E-03	3.74E-04	1.04	LEVEL TRANSMITTER TRAIN A FAILS
N21-LT_-NO-FWTKB	8.71E-03	3.74E-04	1.04	LEVEL TRANSMITTER TRAIN B FAILS
N21-LT_-NO-FWTKC	8.71E-03	3.74E-04	1.04	LEVEL TRANSMITTER TRAIN C FAILS

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P22-ACV-FT-BYPASS	2.00E-03	3.68E-04	1.18	HEAT EXCHANGERS BYPASS VALVE FAILS TO REGULATE
FLOOD-RB-RWCU-POWER	3.40E-03	3.24E-04	1.09	FLOOD IN REACTOR BUILDING DUE TO BREAK IN RWCU SYSTEM
C62-DTM-CF-N1EALL	5.50E-05	3.18E-04	6.77	CCF OF DIGITAL TRIP MODULES NO 1E
C41-XHE-FO-OPENF002A	2.69E-01	3.04E-04	1	OPERATOR FAILS TO OPEN VALVE F002A (AFTER INADV.CLOS.)
C41-XHE-FO-OPENF002B	2.69E-01	3.04E-04	1	OPERATOR FAILS TO OPEN VALVE F002B (AFTER INADV.CLOS.)
C41-XHE-MH-F002A	4.03E-03	3.04E-04	1.08	MISPOSITION OF VALVE F002A
C41-XHE-MH-F002B	4.03E-03	3.04E-04	1.08	MISPOSITION OF VALVE F002B
C51-ACT-CF-1PRM	2.98E-04	3.02E-04	2.01	CCF APRM NEUTRON CHANNELS
C51-ACT-CF-SRNM	2.98E-04	3.02E-04	2.01	CCF OF SRNM CORE FLUX CHANNELS
B21-SYS-FF-1/9OPEN	5.85E-02	2.66E-04	1	1 OUT OF 9 SRV FAIL TO CLOSE AFTER OPENING
G21-ACV-CC-F321	2.00E-03	2.56E-04	1.13	AOV F321 FAILS TO OPERATE TO NOT DEENERG.POS.
G21-ACV-CC-F322	2.00E-03	2.56E-04	1.13	AOV F322 FAILS TO OPERATE TO NOT DEENERG.POS.
G31-ACV-OO-F3A	2.00E-03	2.47E-04	1.12	AOV F3A FAILS TO CLOSE
N21-ACV-OC-F018	1.31E-03	2.42E-04	1.18	AIR OPERATED VALVE N21-F018 FAILS TO REMAIN OPEN
T10-XHE-FO-CLOSEIVS	1.77E-02	2.12E-04	1.01	OPERATOR FAILS TO MANUALLY CLOSE ISOLATION VALVES
H23-RMU-CF-DIDALL	9.00E-07	2.05E-04	228.7	CCF OF REMOTE MULTIPLEXING UNITS (DID)
G21-UV_-CC-F331	1.60E-03	2.04E-04	1.13	CHECK VALVE F331 FAILS TO OPEN
G21-UV_-CC-F348	1.60E-03	2.04E-04	1.13	CHECK VALVE F348 FAILS TO OPEN
C74-DTM-CF-ALL	1.20E-05	1.56E-04	13.97	CCF 3/4 DTM OF SSLC DIV1/2/3/4
G21-STR-CF-SPPLUG	1.01E-03	1.30E-04	1.13	CCF FILTER/STRAINER IN PSP TO PLUG
E50-SQV-CF-4OPEN	1.50E-05	1.25E-04	9.33	CCF OF 4 OR MORE SQUIB VALVES TO OPEN
C12-MPC-FR-C001A	5.76E-05	1.20E-04	3.08	MOTOR-DRIVEN PUMP C001A FAILS TO RUN, GIVEN START
G31-ACV-OO-F006A	2.00E-03	1.11E-04	1.06	NOV F006A FAILS TO OPERATE TO DEENER. POSITION.
G31-MOV-OO-F005A	4.00E-03	1.11E-04	1.03	MOTOR OPER. VALVE F005A FAILS TO CLOSE
N21-LT_-CF-FWTKNO	4.38E-05	1.00E-04	3.28	CCF FEEDWATER STORAGE TANK LEVEL TRANSMITTERS

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-XHE-FO-LEVEL2	3.22E-02	9.86E-05	1	MANUAL ACTUATION FAILURE
N21-ACV-OC-F016	1.31E-03	9.39E-05	1.07	AIR OPERATED VALVE N21-F016 FAILS TO REMAIN OPEN
N21-MOV-CC-F061	3.13E-02	9.39E-05	1	MOTOR OPERATED VALVE N21-F061 FAILS TO OPEN
G21-ACV-TM-F321/F322	8.00E-04	8.84E-05	1.11	AOVs F321 OR F322 IN MAINTENANCE OR TEST
C62-DTM-CF-DIDALL	5.50E-05	8.44E-05	2.53	COMMON CAUSE FAILURE 3/4 DTM DID LOGIC
C12-MPC-FR-C001B	5.76E-05	8.10E-05	2.4	MOTOR-DRIVEN PUMP C001B FAILS TO RUN, GIVEN START
C31-VLU-FC-RUNBACK	7.80E-05	7.91E-05	2.01	C31 SYSTEM VOTER LOGIC UNIT FAILS
C62-VLU-CF-N1EALL	3.12E-05	7.13E-05	3.28	CCF OF VOTER LOGIC UNITS
R10-CBU-FC-PRE500KV	7.20E-05	3.71E-05	1.51	500KV TRANSMISSION LINE FAILS
R16-BT_-CF-ALLBATT	9.00E-06	3.71E-05	5.11	BATTERY CCF #2
H23-EMS-FC-DIVADID	6.00E-04	3.52E-05	1.06	ESSENTIAL MULTIPLEXING SYSTEM DIV A (DID) FAILS TO FUNCTION
C62-DTM-FC-N1EA	9.00E-04	2.77E-05	1.03	DIGITAL TRIP MODULE TRAIN A NO 1E FAILS
C62-DTM-FC-N1EB	9.00E-04	2.77E-05	1.03	DIGITAL TRIP MODULE TRAIN B NO 1E FAILS
C62-DTM-FC-N1EC	9.00E-04	2.77E-05	1.03	DIGITAL TRIP MODULE TRAIN C NO 1E FAILS
FLOOD-RB-CRD-POWER	3.40E-03	2.65E-05	1.01	FLOOD IN REACTOR BUILDING DUE TO BREAK IN CRD SYSTEM
T11-SYS-FF-OPEN	5.69E-02	2.65E-05	1	ALL OVERPRESSURE PROTECTION VALVES FAIL TO OPEN
XXX-XHE-FO-DEPRESS	1.61E-01	2.65E-05	1	OPERATOR FAILS TO RECOGNIZE NEED OF DEPRESSURIZATION
C74-VLU-CF-ALL	3.12E-06	2.62E-05	9.39	CCF OF VOTER LOGIC UNITS
XXX-XHE-FO-ICPCCS	1.61E-03	2.61E-05	1.02	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
R12-XFL-LP-R12A202A	1.92E-05	2.53E-05	2.32	TRANSFORMER TO R12-A2-02AFAILS TO OPERATE
R13-XFL-LP-R13A12	1.92E-05	2.53E-05	2.32	TRANSFORMER FAILS DURING OPERATION
R12-LCB-CO-A2R12A202A	1.44E-05	1.91E-05	2.32	CIRCUIT BREAKER IN R12-A2-02A OPENS SPURIOUSLY
R12-LCB-CO-FA2R12A202A	1.44E-05	1.91E-05	2.32	CIRCUIT BREAKER FROM BUS R11-A2 OPENS SPURIOUSLY
R13-LCB-CO-FR13A12	1.44E-05	1.91E-05	2.32	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13A12	1.44E-05	1.91E-05	2.32	CIRCUIT BREAKER OPENS SPURIOUSLY

Table 18-5

Internal Flooding Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Full Power Core Damage Frequency = 3.68E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R13-LCB-CO-TOR13A1	1.44E-05	1.91E-05	2.32	CIRCUIT BREAKER TO R13-A1 OPENS SPURIOUSLY
R12-XFL-LP-R12B202B	1.92E-05	1.69E-05	1.88	TRANSFORMER TO R12-B2-02B FAILS TO OPERATE
R13-XFL-LP-R13B12	1.92E-05	1.69E-05	1.88	TRANSFORMER FAILS DURING OPERATION
H23-EMS-CF-ALL	1.80E-06	1.51E-05	9.39	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
C72-DTM-CF-DPSALL	1.20E-05	1.42E-05	2.18	CCF 3/4 DTM OF DPS DIV 1/2/3/4
R12-LCB-CO-B2R12B202B	1.44E-05	1.28E-05	1.88	CIRCUIT BREAKER IN R12-B2-02B OPENS SPURIOUSLY
R12-LCB-CO-FB2R12B202B	1.44E-05	1.28E-05	1.88	CIRCUIT BREAKER FROM BUS R11-B2 OPENS SPURIOUSLY
R13-LCB-CO-FR13B12	1.44E-05	1.28E-05	1.88	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13B12	1.44E-05	1.28E-05	1.88	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR13B1	1.44E-05	1.28E-05	1.88	CIRCUIT BREAKER TO R13-B1 OPENS SPURIOUSLY
H23-RMU-FC-ESF1ADID	3.00E-04	1.23E-05	1.04	1ST DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2ADID	3.00E-04	1.23E-05	1.04	2ND DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
U43-SYS-FF-YARD	2.00E-03	9.87E-06	1	HARDWARE FAILURES IN YARD AREA
B32-MOV-CF-F72HADOPEN	2.00E-04	9.09E-06	1.05	CCF VALVES F72HA AND D TO OPEN
B32-MOV-CF-F72HBCOPEN	2.00E-04	9.09E-06	1.05	CCF VALVES F72HB AND C TO OPEN
E50-LT_-CF-N005ABCLOW	2.40E-07	8.79E-06	37.61	CCF 2/3 LEVEL TRANSMITTERS E50-N005A/B/C LOW
U43-XHE-FO-YARD	1.77E-03	8.73E-06	1	OPERATOR FAILS TO MAKE UP FROM YARD AREA
R11-BAC-TM-R11B2	4.80E-06	8.43E-06	2.76	6.9 KV AC BUS R11-B2 IN MANTENANCE
XXX-POL-RP-IC/PCC	3.00E-07	8.37E-06	28.89	LOSS OF IC/PCC POOL WATER DUE TO BREAK DURING ACCIDENT
G31-XHE-FO-MIBOC	5.32E-04	7.88E-06	1.01	OPERATOR FAILS IN MANUAL ISOLATION AFTER BOC IN RWCU
H23-RMU-CF-ALL	9.00E-07	4.75E-06	6.25	CCF OF REMOTE MULTIPLEXING UNITS TO OPERATE

Table 18-6

Internal Flooding Shutdown Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Flooding Shutdown
Core Damage Frequency = 1.64E-09

Event Name	Probability	F-V	RAW	Description
FLOOD-RB-CRD-PB6	1.44E-04	9.09E-01	6.31E+03	FLOOD DURING SHUTDOWN IN THE REACTOR BUILDING DUE TO BREAK IN CRD DURING MODE 6
XXX-XHE-FO-LPMAKEUP	1.61E-01	5.72E-01	3.98	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
E50-SQV-CF-GDCS7OPEN	1.50E-05	3.78E-01	2.52E+04	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	3.78E-01	2.52E+04	CCF OF ALL SQUIB VALVES TO OPEN
G21-XHE-MH-F334	4.80E-02	1.70E-01	4.38	MISPOSITION OF VALVE F334
U43-SYS-FF-LPCI	2.40E-02	8.52E-02	4.46	U43 HARDWARE FAILURES
E50-MP_-TM-POOLB	1.00E-02	7.85E-02	8.77	GDCS POOL B IN MAINTENANCE
U43-XHE-FO-LPCIADS	1.61E-02	5.71E-02	4.49	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
FLOOD-RB-U43-PB6	1.44E-04	5.31E-02	369.79	FLOOD DURING SHUTDOWN IN THE REACTOR BUILDING DUE TO BREAK IN FPS
E50-SQV-CO-F009A	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]
E50-SQV-CO-F009H	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	5.23E-02	15.92	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
FLOOD-FB-U43-PB6	1.08E-04	3.82E-02	354.88	FLOOD DURING SHUTDOWN IN THE FUEL BUILDING DUE TO BREAK IN FPS
C12-XHE-MH-F013A	4.80E-02	2.74E-02	1.54	MISPOSITION OF VALVE F013A
C12-XHE-MH-F013B	4.80E-02	2.74E-02	1.54	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015A	4.80E-02	2.74E-02	1.54	MISPOSITION OF VALVE F015A
C12-XHE-MH-F015B	4.80E-02	2.74E-02	1.54	MISPOSITION OF VALVE F015B
E50-SQV-CO-F009B	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009B SPUR. OPENING [#7]
E50-SQV-CO-F009C	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009C SPUR. OPENING [#7]
E50-SQV-CO-F009F	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009F SPUR. OPENING [#7]
E50-SQV-CO-F009G	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009G SPUR. OPENING [#7]

Table 18-6

Internal Flooding Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Shutdown Core Damage Frequency = 1.64E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
E50-SQV-CO-F009J	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]
E50-SQV-CO-F009K	3.50E-03	2.54E-02	8.23	SQUIB DELUGE VALVE F009K SPUR. OPENING [#7]
E50-SQV-CC-F002A	3.00E-03	2.29E-02	8.61	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	2.29E-02	8.61	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	2.29E-02	8.61	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	2.29E-02	8.61	SQUIB VALVE F002H FAILS TO OPERATE
E50-UV_-OC-F003A	1.75E-03	1.30E-02	8.39	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	1.30E-02	8.39	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	1.30E-02	8.39	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	1.30E-02	8.39	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
B21-UV_-CC-F102B	1.60E-03	8.26E-03	6.16	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	8.26E-03	6.16	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	8.26E-03	6.16	CHECK VALVE F022 FAILS TO OPEN
B21-UV_-CC-F102B	1.60E-03	8.26E-03	6.16	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	8.26E-03	6.16	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	8.26E-03	6.16	CHECK VALVE F022 FAILS TO OPEN
G21-ACV-CC-F332	2.00E-03	6.79E-03	4.38	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
E50-STR-CF-SPPLUG	3.75E-04	6.38E-03	17.97	CCF FILTER/STRAINER IN PSP TO PLUG
C51-ACT-CF-APRMSTUCK	2.10E-07	5.20E-03	2.47E+04	CCF APRM DETECTORS STUCK AT POWER LEVEL
B21-UV_-CC-F102A	1.60E-03	4.72E-03	3.95	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	4.72E-03	3.95	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
G21-UV_-CC-F333	1.60E-03	4.72E-03	3.95	CHECK VALVE F333 FAILS TO OPEN
B21-UV_-CC-F102A	1.60E-03	4.72E-03	3.95	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	4.72E-03	3.95	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
B21-LT_-CF-N001ABCD	1.20E-07	2.97E-03	2.47E+04	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D

Table 18-6

Internal Flooding Shutdown Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Flooding Shutdown
Core Damage Frequency = 1.64E-09

Event Name	Probability	F-V	RAW	Description
B21-LT_-CF-N001ABCD	1.20E-07	2.97E-03	2.47E+04	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
C12-XHE-MH-F018A	1.20E-02	2.91E-03	1.24	MISPOSITION OF VALVE F018A
C12-XHE-MH-F021A	1.20E-02	2.91E-03	1.24	MISPOSITION OF VALVE F021A
G21-UV_-TM-F332/333	8.00E-04	2.30E-03	3.87	MAINTENANCE FOR CV F332 OR CV F333
C12-MOV-CC-F014A	4.00E-03	1.85E-03	1.46	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F014B	4.00E-03	1.85E-03	1.46	MOTOR OPER. VALVE F014B FAILS TO OPEN
C12-MOV-CC-F014A	4.00E-03	1.85E-03	1.46	MOTOR OPER. VALVE F014A FAILS TO OPEN
C12-MOV-CC-F014B	4.00E-03	1.85E-03	1.46	MOTOR OPER. VALVE F014B FAILS TO OPEN
E50-OR_-CF-PLUGALL	7.20E-08	1.78E-03	2.47E+04	CCF OF ALL ORIFICES TO PLUG
C12-XHE-MH-F003B	1.20E-02	1.76E-03	1.14	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018B	1.20E-02	1.76E-03	1.14	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021B	1.20E-02	1.76E-03	1.14	MISPOSITION OF VALVE F021B
C12-XHE-MH-F003B	1.20E-02	1.76E-03	1.14	MISPOSITION OF VALVE F003B
E50-OR_-CF-7PLUG	7.00E-08	1.73E-03	2.47E+04	CCF OF 7 ORIFICES TO PLUG
C12-MOV-CC-F020A	4.00E-03	9.41E-04	1.23	MOTOR OPER. VALVE F020A FAILS TO OPEN
C12-MOV-CC-F020A	4.00E-03	9.41E-04	1.23	MOTOR OPER. VALVE F020A FAILS TO OPEN
C12-MOV-CF-OPEN	1.78E-04	8.21E-04	5.62	CCF MOV TO OPEN
C12-MOV-CF-OPEN	1.78E-04	8.21E-04	5.62	CCF MOV TO OPEN
P30-XHE-MH-F015	4.80E-02	7.68E-04	1.02	MISPOSITION OF VALVE F01T
C12-MOV-FC-F020A	3.13E-03	7.36E-04	1.23	FLOW CONTROL A FAILS WIDE OPEN
C12-MOV-FC-F020A	3.13E-03	7.36E-04	1.23	FLOW CONTROL A FAILS WIDE OPEN
C12-MOV-CC-F020B	4.00E-03	5.75E-04	1.14	MOTOR OPER. VALVE F020B FAILS TO OPEN
C12-MOV-CC-F020B	4.00E-03	5.75E-04	1.14	MOTOR OPER. VALVE F020B FAILS TO OPEN
G21-UV_-OC-F331	2.16E-04	5.70E-04	3.64	CHECK VALVE F331 FAILS TO CLOSE
C12-MOV-FC-F020B	3.13E-03	4.50E-04	1.14	FLOW CONTROL B FAILS WIDE OPEN

Table 18-6

Internal Flooding Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Shutdown Core Damage Frequency = 1.64E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-MOV-FC-F020B	3.13E-03	4.50E-04	1.14	FLOW CONTROL B FAILS WIDE OPEN
P22-ACV-FT-BYPASS	2.00E-03	4.44E-04	1.22	HEAT EXCHANGERS BYPASS VALVE FAILS TO REGULATE
C12-SYS-TM-TRAINB	3.00E-03	4.32E-04	1.14	TRAIN B IN MAINTENANCE
C12-SYS-TM-TRAINB	3.00E-03	4.32E-04	1.14	TRAIN B IN MAINTENANCE
C12-MP_-FS-C001BOIL	2.40E-03	3.45E-04	1.14	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	3.45E-04	1.14	MOTOR-DRIVEN PUMP C001B FAILS TO START
C12-MP_-FS-C001BOIL	2.40E-03	3.45E-04	1.14	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001B	2.40E-03	3.45E-04	1.14	MOTOR-DRIVEN PUMP C001B FAILS TO START
N21-ACV-OC-F018	1.31E-03	2.91E-04	1.22	AIR OPERATED VALVE N21-F018 FAILS TO REMAIN OPEN
C62-DTM-CF-N1EALL	5.50E-05	2.54E-04	5.62	CCF OF DIGITAL TRIP MODULES NO 1E
C62-VLU-CF-DIDALL	3.12E-05	2.27E-04	8.26	CCF OF VOTER LOGIC UNITS
E50-SQV-CF-F002A/2E	3.60E-05	1.66E-04	5.61	CCF OF SQUIB VALVES F002A/ F002E
E50-SQV-CF-F002D/2H	3.60E-05	1.66E-04	5.61	CCF OF SQUIB VALVES F002D/ F002H
R10-CBU-FC-PRE500KV	7.20E-05	1.57E-04	3.18	500KV TRANSMISSION LINE FAILS
R16-BT_-CF-ALLBATT	9.00E-06	1.57E-04	18.41	BATTERY CCF #2
E50-SQV-CF-4OPEN	1.50E-05	1.30E-04	9.64	CCF OF 4 OR MORE SQUIB VALVES TO OPEN
C12-MCB-OO-C001B	1.00E-03	1.11E-04	1.11	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
C12-MCB-OO-C001B	1.00E-03	1.11E-04	1.11	CIRCUIT BREAKER FOR C001B & AUX OIL PMP B FAILS TO CLOSE
C12-OR_-PG-D007A	6.48E-04	1.08E-04	1.17	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
C12-OR_-PG-D007A	6.48E-04	1.08E-04	1.17	ORIFICE D007A FAILS TO REMAIN OPEN (PLUG)
T10-XHE-FO-CLOSEIVS	1.77E-02	1.02E-04	1.01	OPERATOR FAILS TO MANUALLY CLOSE ISOLATION VALVES
G31-ACV-OO-F3A	2.00E-03	9.73E-05	1.05	AOV F3A FAILS TO CLOSE
E50-SQV-CF-EQALLOPEN	3.00E-05	9.59E-05	4.18	CCF OF ALL 4 SQUIB VALVES TO OPEN
C74-DTM-CF-ALL	1.20E-05	8.79E-05	8.3	CCF 3/4 DTM OF SSLC DIV1/2/3/4
FLOOD-RB-CRD-PB5	5.80E-04	8.08E-05	1.14	FLOOD DURING SHUTDOWN IN THE REACTOR BUILDING DUE TO BREAK IN CRD DURING MODE 5

Table 18-6

Internal Flooding Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Flooding Shutdown Core Damage Frequency = 1.64E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C12-OR_-PG-D007B	6.48E-04	7.22E-05	1.11	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
C12-OR_-PG-D007B	6.48E-04	7.22E-05	1.11	ORIFICE D007B FAILS TO REMAIN OPEN (PLUG)
P41-MP_-CR-3ALL	1.17E-05	5.43E-05	5.62	CCF TO RUN 3 PUMPS TRAINS A AND B
B32-ACV-CF-2ICABCD	1.55E-05	5.32E-05	4.42	CCF TO OPEN 2/4 ACV VALVES TRAINS A,B,C,D
B32-ACV-CF-2ICABCD	1.55E-05	5.32E-05	4.42	CCF TO OPEN 2/4 ACV VALVES TRAINS A,B,C,D
P41-STR-CF-3ALL	1.07E-05	4.94E-05	5.61	CCF 3 STRAINERS PLUGGED
B21-SQV-CF-DPVOPEN	1.50E-05	4.04E-05	3.69	CCF OF DPV'S TO OPEN
B21-SQV-CF-DPVOPEN	1.50E-05	4.04E-05	3.69	CCF OF DPV'S TO OPEN
P41-FAN-CS-2ALL	7.20E-06	3.34E-05	5.62	CCF TO START 2 FAN UNITS
P51-CMP-CR-RUN	1.49E-04	3.31E-05	1.22	CCF OF P51 COMPRESSORS TO RUN
P21-MP_-CS-5ALL	6.50E-06	3.01E-05	5.61	CCF TO START PUMPS DIVISIONS A AND B
P41-MP_-CS-3ALL	6.26E-06	2.90E-05	5.62	CCF TO START PUMPS TRAINS A AND B
B32-MOV-CF-2ICABCD	8.08E-06	2.77E-05	4.42	CCF TO OPEN 2/4 MOV VALVES TRAINS A,B,C,D
B32-MOV-CF-2ICABCD	8.08E-06	2.77E-05	4.42	CCF TO OPEN 2/4 MOV VALVES TRAINS A,B,C,D
E50-OR_-PG-D001A	1.44E-05	2.16E-05	2.48	ORIFICE 001A FAILS TO REMAIN OPEN (PLUG) [# 5]
E50-OR_-PG-D001D	1.44E-05	2.16E-05	2.48	ORIFICE 001D FAILS TO REMAIN OPEN (PLUG) [# 5]
E50-OR_-PG-D001E	1.44E-05	2.16E-05	2.48	ORIFICE 001E FAILS TO REMAIN OPEN (PLUG) [# 5]
E50-OR_-PG-D001H	1.44E-05	2.16E-05	2.48	ORIFICE 001H FAILS TO REMAIN OPEN (PLUG) [# 5]
XXX-XHE-FO-DEPRESS	1.61E-01	2.02E-05	1	OPERATOR FAILS TO RECOGNIZE NEED OF DEPRESSURIZATION
H23-EMS-FC-DIVADID	6.00E-04	1.65E-05	1.03	ESSENTIAL MULTIPLEXING SYSTEM DIV A (DID) FAILS TO FUNCTION
C74-VLU-CF-ALL	3.12E-06	1.44E-05	5.57	CCF OF VOTER LOGIC UNITS
G31-ACV-OO-F006A	2.00E-03	1.15E-05	1.01	NOV F006A FAILS TO OPERATE TO DEENER. POSITION.
G31-MOV-OO-F005A	4.00E-03	1.15E-05	1	MOTOR OPER. VALVE F005A FAILS TO CLOSE

Table 18-7

Tornado Full-Power Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Tornado Full Power
Core Damage Frequency = 4.77E-11

Event Name	Probability	F-V	RAW	Description
TORNADO-FP	2.77E-05	1.00E+00	3.61E+04	LOSS OF OFFSITE POWER DUE TO TORNADO
XXX-XHE-FO-LPMAKEUP	1.61E-01	7.82E-01	5.07	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
E50-SQV-CF-GDCS7OPEN	1.50E-05	4.84E-01	3.23E+04	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	4.84E-01	3.23E+04	CCF OF ALL SQUIB VALVES TO OPEN
G21-XHE-MH-F334	4.80E-02	1.86E-01	4.7	MISPOSITION OF VALVE F334
R21-DG_-FS-DGA	1.40E-02	5.81E-02	5.09	DIESEL GENERATOR "A" FAILS TO START
R21-DG_-FS-DGB	1.40E-02	5.81E-02	5.09	D/G "B" FAILS TO START AND LOAD
C12-XHE-MH-F003B	1.20E-02	4.98E-02	5.1	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018A	1.20E-02	4.98E-02	5.1	MISPOSITION OF VALVE F018A
C12-XHE-MH-F018B	1.20E-02	4.98E-02	5.1	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021A	1.20E-02	4.98E-02	5.1	MISPOSITION OF VALVE F021A
C12-XHE-MH-F021B	1.20E-02	4.98E-02	5.1	MISPOSITION OF VALVE F021B
R11-MCB-CC-XFRMAA2	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER FROM XFRM-A FAILS TO OPEN
R11-MCB-CC-XFRMBB2	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER FROM XFRM-B FAILS TO OPEN
R22-MCB-CC-1LOAD1	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-1LOAD2	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-1LOAD3	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-1LOAD4	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-1LOAD5	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN
R22-MCB-CC-2LOAD1	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-2LOAD2	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-2LOAD3	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-2LOAD4	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-2LOAD5	7.96E-03	3.30E-02	5.12	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN

Table 18-7

Tornado Full-Power Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Tornado Full Power Core Damage Frequency = 4.77E-11				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R16-BT_-CF-ALLBATT	9.00E-06	3.21E-02	3.56E+03	BATTERY CCF #2
R21-DG_-TM-DGA	6.00E-03	2.49E-02	5.13	STANDBY DIESEL GENERATOR "A" IN MAINTENANCE
R21-DG_-TM-DGB	6.00E-03	2.49E-02	5.13	STANDBY DIESEL GENERATOR "B" IN MAINTENANCE
C12-XHE-MH-F013A	4.80E-02	1.47E-02	1.29	MISPOSITION OF VALVE F013A
C12-XHE-MH-F013B	4.80E-02	1.47E-02	1.29	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015A	4.80E-02	1.47E-02	1.29	MISPOSITION OF VALVE F015A
C12-XHE-MH-F015B	4.80E-02	1.47E-02	1.29	MISPOSITION OF VALVE F015B
C12-MOV-CC-F020A	4.00E-03	1.28E-02	4.19	MOTOR OPER. VALVE F020A FAILS TO OPEN
C12-MOV-CC-F020B	4.00E-03	1.28E-02	4.19	MOTOR OPER. VALVE F020B FAILS TO OPEN
R21-SYS-FC-FUELDG4	4.00E-03	1.28E-02	4.19	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
R21-SYS-FC-FUELDG5	4.00E-03	1.28E-02	4.19	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
U43-SYS-FF-YARD	2.00E-03	1.19E-02	6.95	HARDWARE FAILURES IN YARD AREA
U43-XHE-FO-YARD	1.77E-03	1.06E-02	6.95	OPERATOR FAILS TO MAKE UP FROM YARD AREA
C12-MOV-FC-F020A	3.13E-03	1.00E-02	4.19	FLOW CONTROL A FAILS WIDE OPEN
C12-MOV-FC-F020B	3.13E-03	1.00E-02	4.19	FLOW CONTROL B FAILS WIDE OPEN
C12-SYS-TM-TRAINB	3.00E-03	9.60E-03	4.19	TRAIN B IN MAINTENANCE
XXX-XHE-FO-ICPCCS	1.61E-03	9.60E-03	6.95	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
C12-MP_-FS-C001AOIL	2.40E-03	7.68E-03	4.19	MOTOR-DRIVEN AUX. OIL PUMP FOR C001A FAILS TO RESTART
C12-MP_-FS-C001BOIL	2.40E-03	7.68E-03	4.19	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
C12-MPC-FS-C001A	2.40E-03	7.68E-03	4.19	MOTOR-DRIVEN PUMP C001A FAILS TO START
C12-MPC-FS-C001B	2.40E-03	7.68E-03	4.19	MOTOR-DRIVEN PUMP C001B FAILS TO START
B21-UV_-CC-F102B	1.60E-03	5.12E-03	4.19	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	5.12E-03	4.19	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
C12-UV_-CC-F022	1.60E-03	5.12E-03	4.19	CHECK VALVE F022 FAILS TO OPEN

Table 18-8

Tornado Shutdown Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) **Tornado Shutdown** **Core Damage Frequency = 8.67E-13**				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R16-BT_-CF-ALLBATT	9.00E-06	1.00E+00	1.11E+05	BATTERY CCF #2
TORNADO-SH6	9.63E-08	1.00E+00	1.04E+07	LOSS OF OFFISTE POWER DURING SHUTDOWN DUE TO TORNADO

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Shutdown PRA Core Damage Frequency = 5.56E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
SH-RLOC2	1.00E-02	5.26E-01	53.1	FAILURE TO CLOSE DRYWELL HATCHES (INSTR. LINES BREAK)
SH-LBTAF2F	2.35E-07	4.22E-01	1.80E+06	LOCA BELOW TAF (MODE 6, FLOODED), VALUE FOR INSTRUMENT LINES
SH-LOPP6	6.49E-04	3.14E-01	485.17	LOSS OF PREFERRED POWER (MODE 6, UNFLOODED)
R11-SYS-FF-NORS6	2.82E-01	3.03E-01	1.77	FAILURE IN OFFSITE POWER RECOVERY (MODE 6)
R16-BT_-CF-ALLBATT	9.00E-06	3.03E-01	3.37E+04	BATTERY CCF #2
SH-RLOC1	1.00E-01	1.51E-01	2.36	FAILURE TO CLOSE DRYWELL HATCHES (RWCU DRAINLINES BREAK)
SH-LBTAF1F	6.73E-09	1.21E-01	1.80E+07	LOCA BELOW TAF (MODE 6, FLOODED), VALUE FOR RWCU/SDC DRAINLINES
SH-LBTAF2	5.78E-08	1.04E-01	1.80E+06	LOCA BELOW TAF (MODE 6, UNFLOODED), VALUE FOR INSTRUMENT LINES
SH-LBTAF1	1.65E-09	2.97E-02	1.80E+07	LOCA BELOW TAF (MODE 6, UNFLOODED), VALUE FOR RWCU/SDC DRAINLINES
XXX-XHE-FO-LPMAKEUP	1.61E-01	1.46E-02	1.08	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP (LOCA)
E50-SQV-CF-GDCS7OPEN	1.50E-05	9.44E-03	629.95	CCF OF 7 SQUIB VALVES IN GDCS LINES TO OPEN
E50-SQV-CF-OPENALL	1.50E-05	9.44E-03	629.95	CCF OF ALL SQUIB VALVES TO OPEN
R11-SYS-FF-NORS5	3.00E-01	7.22E-03	1.02	FAILURE IN OFFSITE POWER RECOVERY (MODE 5)
SH-LOPP5	2.62E-03	7.22E-03	3.75	LOSS OF PREFERRED POWER (MODE 5)
G21-XHE-MH-F334	4.80E-02	3.84E-03	1.08	MISPOSITION OF VALVE F334
P21-XHE-FO-STDBYPUMP	2.69E-01	2.58E-03	1.01	OP. FAILS MAN. ACT. OF STDBY PUMP WHEN AUT. ACTUATION FAIL
U43-SYS-FF-YARD	2.00E-03	2.54E-03	2.27	HARDWARE FAILURES IN YARD AREA
U43-XHE-FO-YARD	1.77E-03	2.25E-03	2.27	OPERATOR FAILS TO MAKE UP FROM YARD AREA
XXX-XHE-FO-ICPCCS	1.61E-03	2.05E-03	2.27	OPERATOR FAILS TO RECOGNIZE NEED OF MAKE UP TO IC/PCCS POOLS
R21-DG_-FR-DGB	5.60E-02	1.99E-03	1.03	DIESEL GENERATOR "B" FAILS TO RUN GIVEN START
R21-DG_-FR-DGA	5.60E-02	1.97E-03	1.03	DIESEL GENERATOR "A" FAILS TO RUN GIVEN START
P21-ACV-FT-F022A	2.00E-03	1.65E-03	1.82	AIR OPERATED VALVE F022A FAILS TO TRANSFER
P21-ACV-FT-F022B	2.00E-03	1.65E-03	1.82	AIR OPERATED VALVE F022B FAILS TO TRANSFER
P21-ACV-FT-F025A	2.00E-03	1.65E-03	1.82	AIR OPERATED VALVE F025A FAILS TO TRANSFER

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Shutdown PRA
Core Damage Frequency = 5.56E-09

Event Name	Probability	F-V	RAW	Description
P21-ACV-FT-F025B	2.00E-03	1.65E-03	1.82	AIR OPERATED VALVE F025B FAILS TO TRANSFER
R21-DG_-CR-ALLDG	4.44E-03	1.19E-03	1.27	CCF OF DIESEL GENERATORS TO RUN
SH-RC6	2.18E-01	9.85E-04	1	FAILURE IN RCCWS/PSWS RECOVERY (MODE 6, UNFLOODED)
SH-SW6	3.25E-06	9.85E-04	303.87	LOSS OF RCCWS/PSWS (MODE 6, UNFLOODED)
C62-DTM-FC-N1EA	9.00E-04	7.04E-04	1.78	DIGITAL TRIP MODULE TRAIN A NO 1E FAILS
C62-DTM-FC-N1EB	9.00E-04	7.04E-04	1.78	DIGITAL TRIP MODULE TRAIN B NO 1E FAILS
E50-MP_-TM-POOLB	1.00E-02	5.77E-04	1.06	GDCS POOL B IN MAINTENANCE
U43-SYS-FF-LPCI	2.40E-02	4.90E-04	1.02	U43 HARDWARE FAILURES
R21-DG_-FS-DGA	1.40E-02	4.06E-04	1.03	DIESEL GENERATOR "A" FAILS TO START
R21-DG_-FS-DGB	1.40E-02	4.06E-04	1.03	D/G "B" FAILS TO START AND LOAD
R16-BT_-TM-R16BTA2	1.00E-03	4.03E-04	1.4	BATTERY R16-BTA2 IN TEST
R16-BT_-TM-R16BTB2	1.00E-03	4.03E-04	1.4	BATTERY R16-BTB2 IN TEST
G31-XHE-FO-SDC	1.77E-02	3.57E-04	1.02	OPERATOR FAILS TO ACTUATE SDC MODE
B32-SYS-TM-ICA	4.16E-02	3.17E-04	1.01	IC "A" UNAVAILABLE [# 7]
U43-XHE-FO-LPCIADS	1.61E-02	3.16E-04	1.02	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE AFTER ADS
SH-RW5	2.29E-01	2.69E-04	1	FAILURE IN RWCU/SDC RECOVERY (MODE 5)
SH-RWCU5	7.38E-05	2.69E-04	4.64	LOSS OF BOTH RWCU/SDCS TRAINS (MODE 5)
P30-XHE-MH-F015	4.80E-02	2.25E-04	1	MISPOSITION OF VALVE F01T
H23-RMU-FC-N038B	3.00E-04	2.19E-04	1.73	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-P21N038A	3.00E-04	2.19E-04	1.73	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
R21-DG_-CS-ALLDG	8.52E-04	2.10E-04	1.25	CCF OF DIESEL GENERATORS TO START AND LOAD
R11-MCB-CC-XFRMAA2	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER FROM XFRM-A FAILS TO OPEN
R11-MCB-CC-XFRMBB2	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER FROM XFRM-B FAILS TO OPEN
R16-BT_-TM-R16BTA1	1.00E-03	2.06E-04	1.21	BATTERY R16-BTA1 IN TEST
R16-BT_-TM-R16BTB1	1.00E-03	2.06E-04	1.21	BATTERY R16-BTB1 IN TEST

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Shutdown PRA Core Damage Frequency = 5.56E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
R22-MCB-CC-1LOAD1	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-1LOAD2	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-1LOAD3	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-1LOAD4	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-1LOAD5	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN
R22-MCB-CC-2LOAD1	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 1 FAILS TO OPEN
R22-MCB-CC-2LOAD2	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 2 FAILS TO OPEN
R22-MCB-CC-2LOAD3	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 3 FAILS TO OPEN
R22-MCB-CC-2LOAD4	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 4 FAILS TO OPEN
R22-MCB-CC-2LOAD5	7.96E-03	2.06E-04	1.03	CIRCUIT BREAKER TO LOAD 5 FAILS TO OPEN
R16-BT_-LP-R16BTA2	5.00E-04	2.01E-04	1.4	BATTERY R16-BTA2 FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB2	5.00E-04	2.01E-04	1.4	BATTERY R16-BTB2 FAILS TO PROVIDE OUTPUT
R13-INV-FC-R13A2	4.80E-04	1.93E-04	1.4	INVERTER TO R13-A2 FAILS
R13-INV-FC-R13B2	4.80E-04	1.93E-04	1.4	INVERTER TO R13-B2 FAILS
R22-RE_-FD-10A11	8.00E-04	1.64E-04	1.21	UNDERVOLTAGE RELAY FOR R22-10A11 FAILS TO OPERATE
R22-RE_-FD-10A21	8.00E-04	1.64E-04	1.21	UNDERVOLTAGE RELAY SENSING VOLTAGE ON BUS 10A21 FAILS
E50-SQV-CO-F009A	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]
E50-SQV-CO-F009H	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009I	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009I SPUR. OPENING [#7]
E50-SQV-CO-F009L	3.50E-03	1.57E-04	1.04	SQUIB DELUGE VALVE F009L SPUR. OPENING [#7]
R21-DG_-TM-DGA	6.00E-03	1.55E-04	1.03	STANDBY DIESEL GENERATOR "A" IN MAINTENANCE
R21-DG_-TM-DGB	6.00E-03	1.55E-04	1.03	STANDBY DIESEL GENERATOR "B" IN MAINTENANCE
C12-XHE-MH-F013A	4.80E-02	1.48E-04	1	MISPOSITION OF VALVE F013A

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Shutdown PRA
Core Damage Frequency = 5.56E-09

Event Name	Probability	F-V	RAW	Description
C12-XHE-MH-F013B	4.80E-02	1.48E-04	1	MISPOSITION OF VALVE F013B
C12-XHE-MH-F015A	4.80E-02	1.48E-04	1	MISPOSITION OF VALVE F015A
C12-XHE-MH-F015B	4.80E-02	1.48E-04	1	MISPOSITION OF VALVE F015B
P21-MP_-CS-TRAINAB	1.95E-04	1.43E-04	1.73	CCF TO START PUMPS TRAINS A AND B
H23-EMS-FC-DIVADID	6.00E-04	1.23E-04	1.21	ESSENTIAL MULTIPLEXING SYSTEM DIV A (DID) FAILS TO FUNCTION
H23-EMS-FC-DIVBDID	6.00E-04	1.23E-04	1.21	ESSENTIAL MULTIPLEXING SYSTEM DIV B (DID) FAILS TO FUNCTION
B32-ACV-CC-F006B	2.00E-03	1.21E-04	1.06	AIR OPERATED VALVE F006B FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006C	2.00E-03	1.21E-04	1.06	AIR OPERATED VALVE F006A FAILS TO OP. TO DEENERG. POSIT.
B32-ACV-CC-F006D	2.00E-03	1.21E-04	1.06	AIR OPERATED VALVE F006D FAILS TO OP. TO DEENERG. POSIT.
SH-LGDCS	3.20E-09	1.17E-04	3.65E+04	LOCA IN GDCS LINE (MODE 6, UNFLOODED)
C62-VLU-CF-DIDALL	3.12E-05	1.09E-04	4.5	CCF OF VOTER LOGIC UNITS
B21-UV_-CC-F102B	1.60E-03	1.06E-04	1.07	CHECK VALVE #1 IN FEEDWATER LINE B FAILS TO REOPEN
B21-UV_-CC-F103B	1.60E-03	1.06E-04	1.07	CHECK VALVE #2 IN FEEDWATER LINE B FAILS TO REOPEN
E50-STR-CF-SPPLUG	3.75E-04	1.03E-04	1.27	CCF FILTER/STRAINER IN PSP TO PLUG
R16-BT_-LP-R16BTA1	5.00E-04	1.03E-04	1.21	BATTERY R16-BTA1 FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB1	5.00E-04	1.03E-04	1.21	BATTERY R16-BTB1 FAILS TO PROVIDE OUTPUT
R13-INV-FC-R13A1	4.80E-04	9.87E-05	1.21	INVERTER TO R13-A1 FAILS
R13-INV-FC-R13B1	4.80E-04	9.87E-05	1.21	INVERTER TO R13-B1 FAILS
B21-UV_-CC-F102A	1.60E-03	9.50E-05	1.06	CHECK VALVE F102A IN FEEDWATER LINE A FAILS TO OPEN
B21-UV_-CC-F103A	1.60E-03	9.50E-05	1.06	CHECK VALVE F103A IN FEEDWATER LINE A FAILS TO OPEN
R21-SYS-FC-FUELDG4	4.00E-03	9.50E-05	1.02	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
R21-SYS-FC-FUELDG5	4.00E-03	9.50E-05	1.02	FUEL OIL STORAGE & TRANSFER SYSTEM FAILURE [#14]
G21-ACV-CC-F332	2.00E-03	9.15E-05	1.05	AOV F332 FAILS TO OPERATE TO NOT DEENERG.POS.
R10-CBU-FC-PRE500KV	7.20E-05	7.76E-05	2.08	500KV TRANSMISSION LINE FAILS
G21-UV_-CC-F333	1.60E-03	7.29E-05	1.05	CHECK VALVE F333 FAILS TO OPEN

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Shutdown PRA Core Damage Frequency = 5.56E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
C51-ACT-CF-APRMSTUCK	2.10E-07	6.09E-05	290.53	CCF APRM DETECTORS STUCK AT POWER LEVEL
H23-RMU-FC-10A11	3.00E-04	5.90E-05	1.2	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-10A21	3.00E-04	5.90E-05	1.2	REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF1ADID	3.00E-04	5.90E-05	1.2	1ST DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF1BDID	3.00E-04	5.90E-05	1.2	1ST DIV B (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2ADID	3.00E-04	5.90E-05	1.2	2ND DIV A (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-ESF2BDID	3.00E-04	5.90E-05	1.2	2ND DIV B (DID) ESF REMOTE MULTIPLEXING UNIT FAILS TO FUNCTION
H23-RMU-FC-R101	3.00E-04	5.90E-05	1.2	DTM/TLU 001 OR MUX INTERFACE FAIL TO TRIP (2Y TEST)
H23-RMU-FC-R102	3.00E-04	5.90E-05	1.2	DTM/TLU 002 OR MUX INTERFACE FAIL TO TRIP (2Y TEST)
E50-SQV-CC-F002A	3.00E-03	5.48E-05	1.02	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	5.48E-05	1.02	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	5.48E-05	1.02	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	5.48E-05	1.02	SQUIB VALVE F002H FAILS TO OPERATE
C12-UV_-CC-F022	1.60E-03	5.12E-05	1.03	CHECK VALVE F022 FAILS TO OPEN
C12-XHE-MH-F003B	1.20E-02	4.11E-05	1	MISPOSITION OF VALVE F003B
C12-XHE-MH-F018A	1.20E-02	4.11E-05	1	MISPOSITION OF VALVE F018A
C12-XHE-MH-F018B	1.20E-02	4.11E-05	1	MISPOSITION OF VALVE F018B
C12-XHE-MH-F021A	1.20E-02	4.11E-05	1	MISPOSITION OF VALVE F021A
C12-XHE-MH-F021B	1.20E-02	4.11E-05	1	MISPOSITION OF VALVE F021B
C62-DTM-CF-N1EALL	5.50E-05	4.02E-05	1.73	CCF OF DIGITAL TRIP MODULES NO 1E
R21-MP_-CS-FUELTRANS	1.71E-04	3.93E-05	1.23	CCF TO START MOTOR-DRIVEN FUEL TRANSFER PUMPS
P21-ACV-CF-F022/25A	5.00E-05	3.66E-05	1.73	CCF VALV ACV F022A/ F025A TRAIN A
P21-ACV-CF-F022/25B	5.00E-05	3.66E-05	1.73	CCF VALV ACV F022B/F025B TRAIN B
SH-LOTHER	4.45E-08	3.28E-05	738.19	LOCA OTHER THAN FW OR GDCS (MODE 6, UNFLOODED)
P41-MP_-CS-2ALL	4.29E-05	3.14E-05	1.73	CCF TO START 2 PUMPS TRAINS A AND B

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Shutdown PRA Core Damage Frequency = 5.56E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
B21-LT_-CF-N001ABCD	1.20E-07	2.94E-05	245.77	CCF OF DIVERSIFIED LEVEL 1& 2 TRANSM. 1A/B/C/D
E50-UV_-OC-F003A	1.75E-03	2.78E-05	1.02	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-03	2.78E-05	1.02	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-03	2.78E-05	1.02	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-03	2.78E-05	1.02	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
P21-MP_-TM-C002A	2.00E-03	2.76E-05	1.01	PUMP C002A IN MAINTENANCE
P21-MP_-TM-C002B	2.00E-03	2.76E-05	1.01	PUMP C002B IN MAINTENANCE
G21-UV_-TM-F332/333	8.00E-04	2.23E-05	1.03	MAINTENANCE FOR CV F332 OR CV F333
B32-ACV-CF-2ICABCD	1.55E-05	1.97E-05	2.27	CCF TO OPEN 2/4 ACV VALVES TRAINS A,B,C,D
R11-MCB-CF-69CLOSE	9.29E-05	1.92E-05	1.21	CCF CIRCUIT BREAKERS 6.9 KV TO CLOSE
P52-CMP-CS-C001AB	1.71E-03	1.70E-05	1.01	CCF TO START COMPRESSORS LINES 1 & 2
B32-ACV-CC-F006A	2.00E-03	1.53E-05	1.01	AIR OPERATED VALVE F006A FAILS TO OP. TO DEENERG. POSIT.
P21-MP_-FS-C001A	1.30E-03	1.16E-05	1.01	MOTOR DRIVEN PUMP C001A FAILS TO START
P21-MP_-FS-C001B	1.30E-03	1.16E-05	1.01	MOTOR-DRIVEN PUMP C001B FAILS TO START
P21-MP_-FS-C002A	1.30E-03	1.16E-05	1.01	MOTOR-DRIVEN PUMP (ALL TYPES) FAILS TO START
P21-MP_-FS-C002B	1.30E-03	1.16E-05	1.01	MOTOR-DRIVEN PUMP C002B FAILS TO START
P21-MP_-FS-C003A	1.30E-03	1.16E-05	1.01	MOTOR-DRIVEN PUMP C0003A FAILS TO START
P21-MP_-FS-C003B	1.30E-03	1.16E-05	1.01	MOTOR-DRIVEN PUMP C003B FAILS TO START
E50-OR_-CF-PLUGALL	7.20E-08	1.09E-05	151.77	CCF OF ALL ORIFICES TO PLUG
R13-XFL-LP-R13A21	1.92E-05	1.09E-05	1.56	TRANSFORMER FAILS DURING OPERATION
R13-XFL-LP-R13B21	1.92E-05	1.09E-05	1.56	TRANSFORMER FAILS DURING OPERATION
E50-OR_-CF-7PLUG	7.00E-08	1.05E-05	151.51	CCF OF 7 ORIFICES TO PLUG
B32-MOV-CF-2ICABCD	8.08E-06	1.03E-05	2.27	CCF TO OPEN 2/4 MOV VALVES TRAINS A,B,C,D
SH-LFWA	2.50E-09	1.02E-05	4.03E+03	LOCA IN FW-A (MODE 6, UNFLOODED)
P21-MP_-CR-TRAINAB	1.80E-05	1.01E-05	1.56	CCF TO RUN PUMPS TRAINS A AND B

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) Shutdown PRA Core Damage Frequency = 5.56E-09				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P21-MCB-OO-C001A	1.00E-03	8.94E-06	1.01	CIRCUIT BREAKER OF PUMP C001A FAILS TO CLOSE
P21-MCB-OO-C001B	1.00E-03	8.94E-06	1.01	CIRCUIT BREAKER OF PM C001B FAILS TO CLOSE
P21-MCB-OO-C002A	1.00E-03	8.94E-06	1.01	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C002B	1.00E-03	8.94E-06	1.01	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C003A	1.00E-03	8.94E-06	1.01	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
P21-MCB-OO-C003B	1.00E-03	8.94E-06	1.01	MEDIUM VOLTAGE CIRCUIT BREAKER FAILS TO CLOSE
R16-BT_-TM-R16BTA	1.00E-03	8.94E-06	1.01	BATTERY R16-BTA IN TEST
R16-BT_-TM-R16BTB	1.00E-03	8.94E-06	1.01	BATTERY R16-BTB IN TEST
R21-MCB-OO-DGAR11A2	1.00E-03	8.94E-06	1.01	CIRCUIT BREAKER FROM DG-A TO R11-A2 FAILS TO CLOSE
R21-MCB-OO-DGBR11B2	1.00E-03	8.94E-06	1.01	CIRCUIT BREAKER FROM DG-B TO R11-B2 FAILS TO CLOSE
R21-SYS-FC-AIRDG4	1.00E-03	8.94E-06	1.01	AIR STARTING SYSTEM FAILURE [#13]
R21-SYS-FC-AIRDG5	1.00E-03	8.94E-06	1.01	AIR STARTING SYSTEM FAILURE
P52-CMP-FS-C001A	2.00E-02	8.54E-06	1	MOTOR-DRIVEN AIR COMPRESS. C001A FAILS TO START
P52-CMP-FS-C001B	2.00E-02	8.54E-06	1	MOTOR-DRIVEN AIR COMPRESS. C001B FAILS TO START
R13-LCB-CO-FR13A21	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-FR13B21	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13A21	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-R13B21	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER OPENS SPURIOUSLY
R13-LCB-CO-TOR13A2	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER TO R13-A2 OPENS SPURIOUSLY
R13-LCB-CO-TOR13B2	1.44E-05	8.14E-06	1.56	CIRCUIT BREAKER TO R13-B2 OPENS SPURIOUSLY
G31-MOV-CC-F009B	4.00E-03	7.18E-06	1	MOTOR OPER. VALVE F009B FAILS TO OPEN
G31-MOV-CC-F020B	4.00E-03	7.18E-06	1	MOTOR OPER. VALVE F020B FAILS TO OPEN
G31-MOV-CC-F030B	4.00E-03	7.18E-06	1	AIR OPER. VALVE F030B FAILS TO OPEN
P21-MOV-CC-F039B	4.00E-03	7.18E-06	1	MOTOR OPERATED VALVE P21-F039B FAILS TO OPEN
P21-MOV-CC-F040B	4.00E-03	7.18E-06	1	MOTOR OPERATED VALVE P21-F040B FAILS TO OPEN

Table 18-9

Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report (F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure) **Shutdown PRA** **Core Damage Frequency = 5.56E-09**				
Event Name	**Probability**	**F-V**	**RAW**	**Description**
P52-XHE-FO-IAS/SAS	1.61E-02	6.86E-06	1	OPER. FAILS TO REC. NEED FOR MANUAL INTERV. ON IAS/SAS
H23-EMS-CF-DIDALL	1.80E-06	6.31E-06	4.5	CCF OF ALL DIVISION OF THE EMS
P41-STR-CF-2ALL	1.07E-05	6.07E-06	1.56	CCF 2 STRAINERS PLUGGED
R21-MP_-CR-FUELTRANS	3.72E-05	5.91E-06	1.16	CCF TO RUN MOTOR-DRIVEN FUEL TRANSFER PUMPS
R10-BAC-LP-500KVMAIN	4.80E-06	5.07E-06	2.05	500 KV MAIN DISTRIBUTION BUS FAILS DURING OPERATION
P21-TT_-NO-N038B	8.40E-06	4.79E-06	1.57	TEMPERATURE XMTR FAILS TO RESPOND TO CHANGE IN TEMPERATURE
P21-TT_-NO-P21N038A	8.40E-06	4.79E-06	1.57	TEMPERATURE XMTR FAILS TO RESPOND TO CHANGE IN TEMPERATURE
C12-MOV-CC-F020A	4.00E-03	4.47E-06	1	MOTOR OPER. VALVE F020A FAILS TO OPEN
C12-MOV-CC-F020B	4.00E-03	4.47E-06	1	MOTOR OPER. VALVE F020B FAILS TO OPEN
R16-BT_-LP-R16BTA	5.00E-04	4.47E-06	1.01	BATTERY R16-BTA FAILS TO PROVIDE OUTPUT
R16-BT_-LP-R16BTB	5.00E-04	4.47E-06	1.01	BATTERY R16-BTB FAILS TO PROVIDE OUTPUT
C74-VLU-CF-ALL	3.12E-06	3.99E-06	2.27	CCF OF VOTER LOGIC UNITS
H23-EMS-CF-ALL	1.80E-06	2.31E-06	2.27	CCF OF ESSENTIAL MULTIPLEXING SYSTEM DIV 1/2/3/4
C12-MOV-FC-F020A	3.13E-03	1.96E-06	1	FLOW CONTROL A FAILS WIDE OPEN
C12-MOV-FC-F020B	3.13E-03	1.96E-06	1	FLOW CONTROL B FAILS WIDE OPEN
C12-SYS-TM-TRAINB	3.00E-03	1.88E-06	1	TRAIN B IN MAINTENANCE