RG&E

R.E. Ginna Nuclear Power Plant

Internal Flooding

Probabilistic Safety Assessment Final Report

Rochester Gas and Electric Corporation

TABLE OF CONTENTS

TABLES

FIGURES

1.0 EXECUTIVE SUMMARY

This report contains the Ginna Station Probabilistic Safety Assessment (PSA) with respect to internal flooding risk considerations. The report is formatted to allow easy insertion into the Ginna Station PSA Final Report [Reference 120]. As such, the numbering, format, and structure of this report is based on the PSA Final Report and may not necessarily be in the expected sequence of a standalone document.

1.3.2 Analysis for Internal Flooding Events

Similar to the Level 1 internal event analysis, the flooding evaluation was performed based on the standard small event tree/large linked fault tree approach using the CAFTA code. The event trees and fault trees developed for the existing Level 1 analysis were used with initiators and logic flags incorporated to address specific flooding considerations (e.g., consequence assumptions) such that only limited system modeling was necessary.

The same component failure data as used in the existing internal event analysis was also used in the flooding model except where new components were identified, or the existing data was known to not be applicable during flooding events. In these instances, generic (or industry) data was used.

Human events were also evaluated similarly to the existing Level 1 analysis in that a screening process was used during initial quantification (i.e., conservative human failure rates were initially used). For those human failure events which were shown to be critical in the initial quantification effort, a more detailed evaluation was performed such that only risk significant human failure events were addressed in detail.

It should be noted that no detailed Level 2 analysis of internal flooding events was performed. However, a qualitative assessment of containment integrity is provided.

1.4.2 Internal Flooding Findings

The calculated CDF for internal floods was 3.375E-05/yr. The dominating flooding scenarios are related to battery room floods (caused from floods both internal and external to the rooms), screenhouse floods, relay room floods, and floods in the auxiliary building basement. The most risk significant systems with respect to flood CDF are AC Power and RCS (failure of the PORVs and safeties to re-close). Other important systems include the reactor trip system, service water, DC electrical power, diesel generators, auxiliary feedwater, and main steam (suction for TDAFW and blowdown isolation). Significant operator actions include the ability to provide cooling to the TDAFW lube oil pump from the diesel fire pump, ability to successfully use ER-FIRE.1 for floods in the relay room (including all local operation), and ability to close a PORV block valve for a stuck open PORV prior to needing inventory makeup capability.

Several vulnerabilities were identified as a result of the internal flooding PSA evaluation and are described later in this report.

2.0 EXAMINATION DESCRIPTION

2.3.8 Internal Flooding Analysis

The internal flooding analysis was performed consistent with the Level 1 analysis. That is, initiating events were identified, and the existing success criteria, event trees, and fault tree models were used in the quantification (with necessary modifications as documented within this report). In those instances where simplifying assumptions were used to support quantification needs (e.g., limit the potential scenarios to be evaluated), the impact of the assumptions is provided.

3.0 INITIATING EVENT ANALYSIS

3.4.3 Internal Flooding Events

The internal flooding initiating events analysis initially involved the qualitative screening of all Ginna Station plant buildings and areas as listed in Table 3-7. Qualitative screening criteria were implemented to eliminate buildings and areas that pose negligible risk due to internal flooding events on the basis that:

a. The building or area contained no equipment whose failure could cause a reactor trip;
b. The building or area contained no equipment modeled within the PSA that would be necessary to mitigate an accident or transient; and
c. There is no credible potential for floods spreading to other buildings or areas which could cause a reactor trip or affect accident mitigation related equipment.

A building or area had to meet all three criteria in order to be eliminated by the first qualitative screen. As summarized in Table 3-7, the following buildings were screened from further analysis:

a. Butler Building
b. Nitrogen Storage Area
c. Bob Smith Engineering Building
d. Project QC Storage
e. Receiving Dock
f. Radwaste Storage Building
g. Security Building
h. Steam Generator Building
i. Storage Building Southwest
j. Contaminated Storage Building

After completing the qualitative screening, a database of historical internal flooding initiating events for U.S. nuclear power plants was reviewed, as well as the records for flooding events that have occurred at Ginna Station, as discussed in Appendix I. This review allowed initiating event categories pertinent to Ginna Station to be identified, and enabled all relevant historical events to be matched with the appropriate category specific for Ginna Station. This categorization also allowed the initiating event frequency calculations to be performed as discussed in Section 7.3.2.

Table 3-8 shows the summary of the historical internal flooding research organized by major building. Each flood event was categorized with respect to submerging or spraying equipment, along with whether or not the flood created a steam environment. Each flood was also sorted by size (i.e., very large, large, or small) and the potential for a reactor trip. See Appendix I for further details.

The next step was to better define internal flooding zones for the retained plant buildings and areas. The zone designation was performed by building, by building elevation, or by plant area on the basis that flooding events would have distinct consequences for each zone. Initially, flooding zones were categorized based on fire zones and areas since this provided a standardized approach for evaluation. Also, fire zones and areas are typically isolated from one another to prevent fire propagation. This could be expected to be sufficient to limit the flooding consequences between zones. Plant walkdowns were conducted to ensure that this assumption was valid with modifications to the fault tree models as necessary (see Section 8.3.1.1). Plant equipment contained in each flood zone was also assessed with respect to flooding and spray potential. The listing of internal flooding zones is provided in Table 3-9.

Once internal flooding zones were selected for Ginna Station, individual initiating events were identified using the initiating event categories from Table 3-8, supplemented by information obtained from the plant walkdowns to account for initiating events judged to be unique to Ginna Station and not adequately reflected by the data population. The following guidelines were used to identify the final listing of initiating events:

a. For some internal flooding zones, initiating event categories were combined into one event if no unique consequences were identified. For example, two initiating event categories apply to the diesel generator building - a spraying event and a submergence event. These two categories were combined into a single initiating event since the consequences for the events were postulated to be the same (i.e., loss of the diesel generator).

b. One initiating event was identified as part of plant walkdowns that was judged to not be adequately reflected by historical data: leakage or rupture of the RWST located in the auxiliary building (since RWSTs are installed external to plant buildings at most U.S. nuclear power plants). This initiator was retained for evaluation; its initiator frequency is addressed in Section 7.3.2.

3.6 Summary List Of Initiating Events

The final listing of internal flooding initiating events identified for Ginna Station and a brief summary of the rationale for their selection is provided in Table 3-10.

TABLE 3-7
Qualitative Screening of Ginna Station Plant Buildings and Areas

Building Code	Description	PSA Equipment Inside the Building	Reactor Trip Potential	Propagation to other Buildings	Retained for Further Analysis
AB	Auxiliary Building	Yes	Yes	No	Yes
AF	Standby Auxiliary Feedwater	Yes	Yes	No	Yes
BB	Butler Building	No	No	No	No
CB	Control Building	Yes	Yes	Yes	Yes
AVT	Condensate Demineralizer Bldg	No	No	Yes	Yes
CT	Cable Tunnel	Yes	Yes	Yes	Yes
DG	Diesel Generator Building	Yes	Yes	Yes	Yes
HS	Hydrogen Storage Area	No	Yes	No	Yes
IB	Intermediate Building	Yes	Yes	No	Yes
NS	Nitrogen Storage Area	No	No	No	No
PO	Bob Smith Engineering Bldg	No	No	No	No
QS	Project QC Storage	No	No	No	No
RC	Reactor Containment Structure	Yes	Yes	No	Yes
RD	Receiving Dock	No	No	No	No
RS	Radwaste Storage Building	No	No	No	No
SB	Service Building	Yes	Yes	Yes	Yes
SC	Security Building	No	No	No	No
SG	Steam Generator Building	No	No	No	No
SH	Screen House	Yes	Yes	No	Yes
TB	Turbine Building	Yes	Yes	Yes	Yes
TO	Turbine Oil Storage Area	No	Yes	No	Yes
TS	Technical Support Center	No	No	Yes	Yes
TY	Transformer Yard	Yes	Yes	No	Yes
WH	Storage Building Southwest	No	No	No	No
WS	Contaminated Storage Building	No	No	No	No

TABLE 3-8
Categorization of Historical Internal Flooding Events at U.S. Nuclear Power Plants

Flooding Location	Bldg Code	Total Events[1]	Breakdown by Event Type			Breakdown by Flood Size			Reactor Trip Resulted or Postulated[2]	
			Submerge	Spray	Steam	Very Large (Circ Water)	Large	Small	Yes	No
Auxiliary Building/ Intermediate Building/ SAFW Building	AB[3]/ IB/ SAF	48	27	21	0	0	6	42	13	35
Control Building	CB	4	0	4	0	0	0	4	3	1
Diesel Generator Building	DG	2	1	1	0	0	0	2	0	2
Reactor Containment	RC	24	16	8	0	0	0	24	17	7
Service Building	SB	2	2	0	0	0	0	2	0	2
Service Water / Circ Water Bldg (Screen House)	SH	6	3	3	0	2	0	4	3	3
Turbine Building	TB[4]	34	17	10	7	4	10	20	23	11
All Other Buildings and Plant Areas	OT	3	3	0	0	0	1	2	2	1

Notes:

1 Includes all historical Ginna Station flooding events that pertain to power operation, as well as all reportable flooding events at U.S. nuclear power plants (with the exception of events that could only occur during plant shutdown, events that occurred before the plant had an operating license, or events that are unique to plant features that don't exist at Ginna).

2 Judgement was required in some instances to designate the potential for reactor trip. Some flooding events, for example, that occurred during plant shutdown were judged to be pertinent to power operation. Reactor trip potential was therefore based on judgment for these events, as well as for other historical events for which no record of reactor trip occurrence was available.

3 Of the 42 small floods, eight caused reactor trip.

4 Of the 20 small floods, 13 were spray or submergence events. Of these 13 events, two caused reactor trip.

TABLE 3-9
Ginna Station Internal Flooding Zones

Flood Zone	Description	Elevation
ABB	AUXILIARY BUILDING BASEMENT LEVEL	235' 8"
ABM	AUXILIARY BUILDING MEZZANINE LEVEL	253'
ABO	AUXILIARY BUILDING OPERATING LEVEL	271'
AHR	AIR HANDLING ROOM	253'
AVT	CONDENSATE DEMINERALIZER BUILDING	All
BR1A	BATTERY ROOM 1A, CONTROL ROOM	253' 6"
BR1B	BATTERY ROOM 1B, CONTROL ROOM	253' 6"
BRRM	COMPUTER (MUX) ROOM, CONTROL ROOM	271'
CHG	CHARGING PUMP ROOM, AUXILIARY BUILDING	235' 8"
CR-3	CONTROL ROOM, CONTROL BUILDING	289' 6"
CT	CABLE TUNNEL	260' 6" & 261' 10"
DG-ST	DIESEL GENERATOR STORAGE TANK AREA	Below Grade
EDG1A	DIESEL GENERATOR ROOM 1A	253' 6"
EDG1B	DIESEL GENERATOR ROOM 1B	253' 6"
H2	HYDROGEN STORAGE ROOM	256' 6"
IB	INTERMEDIATE BUILDING	All
RC	REACTOR CONTAINMENT BASEMENT	235' 8"
RR	RELAY ROOM, CONTROL BUILDING	271'
RRA	RELAY ROOM EXTENSION, CONTROL BUILDING	271'
SAF	STANDBY AUXILIARY FEEDWATER PUMP BUILDING	271'
SB	SERVICE BUILDING	All
SH	SCREEN HOUSE BASEMENT LEVEL	All
TB-1	TURBINE BUILDING BASEMENT LEVEL	253' 6"
TB-2	TURBINE BUILDING MEZZANINE LEVEL	271'
TB-3	TURBINE BUILDING OPERATING LEVEL	289' 6"
TO	TURBINE OIL STORAGE ROOM	253' 6"
TSC	TECH SUPPORT CENTER	271'
TY	TRANSFORMER YARD	Grade

TABLE 3-10
Final Flooding Initiators

Initiating Event	Description	Discussion
FL000AB1	Large internal flood in zone ABB, ABM, or ABO that damages equipment only in the auxiliary building basement	This initiator accounts for 1) large floods that originate in the auxiliary building basement, and 2) large floods that originate on upper levels of the auxiliary building that propagate to the basement via stairwells without damaging equipment on the upper levels
FL000AB3	Small internal flood in zone ABB, ABM or ABO	This initiator accounts for all small floods occurring in the auxiliary building.
FL000AB4	RWST rupture in Auxiliary Building.	This initiator was designated as an event unique from other auxiliary building initiators since an interior RWST installation is not typical of most U.S. nuclear power plants and therefore judged to not be adequately represented by the historical flooding data.
FL000AB5	Large internal flood in zone ABM that damages equipment in zone ABM as well as the auxiliary building basement	This initiator accounts for floods that originate on the auxiliary building mezzanine and damage equipment on that elevation. Propagation down stairwells causes accumulation in the auxiliary building basement and subsequently damages equipment on that level.
FL000AB7	Large internal flood in zone ABO that damages equipment in zone ABO as well as the auxiliary building basement	This initiator accounts for floods that originate on the auxiliary building operating floor and damage equipment on that elevation. Propagation down stairwells causes accumulation in the auxiliary building basement and subsequently damages equipment on that level.
FL000CR1[1]	Internal flooding event occurs in main control room.	This initiator accounts for all internal floods occurring in the main control room.
FL000CT1[1]	Internal flooding event occurs in the cable tunnel.	This initiator accounts for all internal floods occurring in the cable tunnel.
FL000H21	Internal flood in the hydrogen storage room.	This initiator accounts for all internal floods occurring in the hydrogen storage building.
FL000IB1	Large internal flood in intermediate building	This initiator accounts for all large floods occurring in the intermediate building.
FL000IB3	Small internal flood in intermediate building	This initiator accounts for all small floods occurring in the intermediate building.
FL000RC1	Internal flood in reactor containment	This initiator accounts for internal flooding initiating events occurring in reactor containment.
FL000RR1	Internal flood in relay room (zone RR), from sources within the relay room as well as the relay room extension (zone RRA) and technical support center.	This initiator accounts for all internal flooding initiating events postulated to impact the relay room.
FL000SB1	Internal flood event originating in the service building	This initiator accounts for internal flooding initiating events occurring in the service building.
FL000SH1	Large internal flood in screen house	This initiator accounts for large floods that occur in the screen house.

TABLE 3-10
Final Flooding Initiators

Initiating Event	Description	Discussion
FL000TB1	Very large flood in turbine building (circulating water leak)	This initiator accounts for circulating water floods that occur in the turbine building. This initiator was differentiated from other turbine building floods due to potentially large leakage flow rates and the installation of an automatic shut-off of the system initiated by flooding sensors.
FL000TB3	Steam flooding event in turbine building	This initiator accounts for steam floods that occur in the turbine building.
FL000TB6	Large flood originating in turbine building basement (zone TB-1)	This initiator accounts for large floods that occur in the turbine building basement.
FL000TB7	Large flood originating in turbine building mezzanine (zone TB-2)	This initiator accounts for large floods that occur in the turbine building mezzanine. No large internal flooding sources were identified to be present on the operating level of the turbine building and therefore no large flood event category was assigned for that elevation.
FL000TO1	Flood in turbine oil storage room	This initiator accounts for internal floods that originate in the turbine oil storage room.
FL00AHR1	Internal flood originating in the air handling room	This initiator accounts for all internal floods that originate in the air handling room.
FL00AVT1	Internal flood originating in the condensate demineralizer building	This initiator accounts for all internal floods that originate in the condensate demineralizer building.
FL00CHG1	Internal flood originating in the charging pump room (zone CHG)	This initiator accounts for all internal floods that originate in the charging pump room.
FL00SAF1	Internal flood in standby auxiliary feedwater pump room (zone SAF)	This initiator accounts for all internal floods that originate in the standby auxiliary feedwater pump room
FL00TB12	Small flood in turbine building (zone TB-1, TB-2 or TB-3)	This initiator accounts for all small internal floods that originate in the turbine building.
FL00TYD1[1]	Internal flood occurs in transformer yard (inadvertent actuation of fire sprinklers).	This initiator accounts for all internal floods that occur in the transformer yard.
FL0BR1A1	Internal flood originating in battery room 1A (zone BR1A)	This initiator accounts for all internal floods that originate in battery room 1A
FL0BR1B1	Internal flood originating in battery room 1B (zone BR1B)	This initiator accounts for all internal floods that originate in battery room 1B
FL0DG1A1	Internal flood originating in diesel generator room 1A (zone EDG1A)	This initiator accounts for all internal floods that originate in the diesel generator room 1A
FL0DG1B1	Internal flood originating in diesel generator room 1B (zone EDG1B)	This initiator accounts for all internal floods that originate in the diesel generator room 1B
FL0DGST1[1]	Internal flood in diesel fuel oil storage area	This initiator accounts for all internal floods that originate in the diesel fuel oil storage area

1 Later deleted per Table 7-16.

4.0 SUCCESS CRITERIA DETERMINATION

4.5 Internal Flooding Events

The internal flooding events were evaluated using the same success criteria and event trees as for the existing internal events analysis. The fault tree models were modified as necessary to include the flooding initiating events and necessary logic flags to support quantification. These changes are documented in Section 6.0.

5.0 EVENT TREES

N/A

6.0 SYSTEM ANALYSIS

6.20 Internal Flooding Systems Analysis

The following changes to the existing Level 1 PSA fault trees were made to account for internal flooding accident sequences.

1. As discussed in detail in Section 8.3 and Appendix I, one flood damage state was modeled assuming that plant shutdown from outside the control room was required. This flood damage state is RRFL (internal flood causes significant damage to relay room equipment). The following fault tree changes were made to account for the operator actions associated with shutdown from outside of the control room:

    - A cognitive human failure was modeled for failure to initiate the control room evacuation procedure (ER-FIRE.1). The applicable operator error event is IFHFDEVACR. All remaining human errors described below relate to failure to perform specific activities within the ER procedures.

    - Disconnection of loads from Buses 14 and 18 and alignment of Diesel Generator (DG) A (including alignment of Service Water Pump A). The applicable operator error events are IFHFDDGAXX, IFHFDDGAXY, and IFHFDDGAXZ.

    - Reconnection of offsite power to Buses 14 and 18 within one hour in the event that DG A is unavailable. The applicable operator error event is IFHFDLOSP1.

    - Local alignment of the turbine-driven AFW pump by the opening of MOVs 3996, 3505A and control of AOV 4297. The applicable operator error event is IFHFDAFWXX (this error event replaces the analogous event, AFHFDTDAFW, used for the existing Level 1 PSA). Fault tree development was also added to model the IBELIP and local pump panels required for local turbine-driven AFW (TDAFW) pump operation.

    - Alignment of the Technical Support Center (TSC) diesel generator to provide a long-term source of DC electrical power for operation of the TDAFW pump (this action applies only to flood damage state RRFL since the TDAFW pump is unavailable for flood damage states BRFL and TBFL1-3). The applicable operator error event is IFHFDTSCDC.

    - Local alignment of SW to AFW pump suction prior to CST depletion. The applicable operator error event is IFHFDAFWSW. CST level would be determined locally.

- Local alignment of the SAFW Pump C. The applicable operator error event is IFHFDSAFWY.

- Local alignment of the AFW Pump A by starting the pump and opening MOV 4007. The applicable operator error event is IFHFDAFW1A.

- Manual loading of Charging Pump A. The applicable operator error event is IFHFDCHG1A.

- Through the use of logic flags, the following components or systems are assigned to be unavailable due to procedural actions: Charging Pump A (except for emergency boration), Charging Pumps B and C, Instrument Air supply to containment, RHR trains for injection, feed-and-bleed cooling, automatic start signal to the AFW pumps, ability to close block valves within three minutes (to mitigate a PORV LOCA due to a stuck open PORV) and DC power supplies to racks SIA1 and SIB1.

- Local verification of the RWST level would be required long-term. The applicable operator error event is IFHFDRWSTX.

2. The following operator actions are modeled for flood state SHFL-1 (damage of all SW equipment in the screen house and a loss of offsite power due to a SW flood) as defined in Appendix I:

   - Alignment of the TSC DG to provide AC electrical power to the reactor shroud fans. The applicable operator error event is IFHFDACPWR.

   - Alignment of the TSC DG to provide a long-term source of DC electrical power for operation of the TDAFW pump. The applicable operator error event is IFHFDDCPWR.

   - Alignment of the TSC DG to provide source of power for Charging Pumps B and C. The applicable operator error event is IFHFDCVCSX.

   - A correction factor is applied to the operator action to restore offsite power within ten hours. This factor accounts for a lower failure probability for recovering offsite power since the offsite power loss for this damage state arises from bus protective trips rather than from failures of the power supply to the plant. The correction factor event is labeled AAAA00RECSHFL.

3. The following human error probabilities were added to the model to account for potential flood isolation, as discussed in Section 8.3.1.2.

- IFHFDABISOL Failure to isolate auxiliary building flood prior to submergence of charging system
- IFHFDIBISOL Failure to isolate intermediate building flood prior to damage of all intermediate building equipment
- IFHFDSLISOL Failure to isolate large screen house flood prior to loss of the service water system
- IFHFDSSISOL Failure to isolate small screen house flood prior to loss of the service water system
- IFHFDTBISOL Failure to isolate large turbine building flood (not related to circulating water) prior to submergence and disabling of equipment in turbine building basement, turbine oil storage building, service building and diesel generator rooms
- IFHFDBRISLL Failure to isolate large SW leak in Battery Room prior to failing all DC power (sump pump succeeds)
- IFHFDBRISLS Failure to isolate large SW leak in Battery Room prior to failing all DC power (sump pump fails)
- IFHFDBRISNS Failure to isolate small SW leak prior to disabling both battery rooms prior to failing all DC power (spray provides cue)
- IFHFDBRISOL Failure to isolate large SW leak in Battery Room prior to failing all DC power (spray provides cue)
- IFHFDBRISOLS Failure to isolate small SW leak in battery room prior to disabling both battery rooms
- IFHFDCIRCW Operators fail to trip circ water pumps upon indication of flood with no auto trip

7.0 DATA ANALYSIS

7.3.2 Internal Flooding Initiators

Ginna Station internal flooding initiating event frequencies are based on nuclear industry experience and actual Ginna experience and were quantified using a two-stage Bayesian data update technique. Historical event data used for the frequency calculations was compiled and binned as discussed in Section 3.4.3 and was then used to generate initiating event frequencies using the following guidelines:

a. Historical flooding events were binned based on general plant locations as discussed in Section 3.4.3 and summarized in Table 3-8. The bins are: AB/IB/SAF - auxiliary building, intermediate building, and standby auxiliary feedwater pump room; CB – control building; DG – diesel generator building; RC – reactor containment; SB – service building; SH – service water/circulating water screen house and pump area; TB – turbine building; OT–all other plant areas. Initiating event frequencies for each of these bins were calculated using a two-stage Bayesian data update technique as discussed in Appendix I.

b. The frequency bins were then further apportioned to apply the data to the actual internal flooding initiating events identified for Ginna Station. This apportioning was performed to further delineate flood locations, flood types and sizes, as well as damage likelihood where applicable.

c. In one instance, the historical flooding data was judged to not be representative of Ginna Station's specific equipment configuration. This instance pertains to the installation of the RWST within the auxiliary building (the tanks are typically installed outside of plant buildings at U.S. nuclear power plants). The initiating event frequency for floods involving this source was calculated based on the frequency of tank leakage/rupture.

Appendix I contains all relevant details. A list of all internal flooding initiating event frequencies is provided in Table 7-16.

7.4.2 Post-Initiator Operator Errors

7.4.2.1 Internal Flooding Human Reliability Analysis

As part of the internal flooding human reliability analysis, the applicability of the Ginna Station internal events PSA human error probabilities (HEPs) to internal flooding accident sequences was evaluated as follows:

a. Internal events PSA operator actions requiring entry into areas where significant flood accumulation occurs were assigned a failure probability of 1.0, with the exception that operators were assumed to be capable of gaining access to containment isolation valves for local closure. Such actions would not be required until several hours after an initiator, which was found to provide sufficient time for flooding effects to be cleared from the areas that require entry.

b. All other internal events PSA human error probabilities were examined for their applicability to internal flooding scenarios. This evaluation considered the impacts of potential degradation of control room indication due to flood damage, the inability to perform local actions due to flooding effects, and increased stress due to the potential for significant flood-related impacts to plant systems. The human error probabilities were raised where applicable.

As part of the internal flooding human reliability analysis, human error events pertaining specifically to internal flooding accident sequences were modeled as described in Section 6.20. These actions involve the potential isolation of floods, actions performed for sequences requiring control room evacuation, and recovery actions. Similar to the existing PSA model, for the initial sequence quantification, a conservative probability (typically 1.0E-01) was assigned as a screening value for all flooding human errors. For those human events which were considered important (i.e., were found among the top cutsets for the initial quantification), detailed human error probabilities were derived.

The changes to the existing HEPs and the derivation of the HEPs for flooding scenarios are documented in Appendix I. Table 7-17 lists the final values used for all human error events utilized in the internal flooding quantification (i.e., both those events modified from the existing PSA and those specifically added for floods).

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL000AB1	Large internal flood in zone ABB, ABM, or ABO that damages equipment in the auxiliary building basement. Zone apportionment--21/32 is derived from: 3/8 of large AB/IB/SAF floods assumed to occur in basement based on the relative amounts of piping; the remainder is derived from the complement of large floods originating in the mezzanine and operating levels that do not damage equipment on those elevations but instead accumulate only in the basement. The complement was calculated on the basis that nine-tenths of floods occurring on upper elevations were judged to damage equipment only on the auxiliary building basement level (0.9*1/8+0.9*3/16). Flood size apportionment—6 of 48 AB/IB/SAF floods are large floods (see Table 3-8).	AB/IB/SAF	9.4E-02	21/32	6/48	1	7.73E-03
FL000AB3	Small internal flood in zone ABB, ABM or ABO Zone apportionment—3/4 of small AB/IB/SAF floods are assumed to occur in auxiliary building based on the relative amounts of piping. Flood size apportionment—42 of 48 AB/IB/SAF floods are small floods (Table 3-8). Damage apportionment—8 of 42 of small floods result in plant trip (Appendix I), the remainder are assumed to have negligible impact	AB/IB/SAF	9.4E-02	3/4	42/48	8/42	1.18E-02
FL000AB4	RWST rupture in Auxiliary Building. This initiating event was added to the analysis in addition to the initiators that are based on historical internal flooding events since RWSTs are typically installed outside of the plant buildings and therefore the historical data was judged to not be representative.	n/a	8.8E-06 (Ref. 51)	n/a	n/a	n/a	8.8E-06

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL000AB5	Large internal flood in zone ABM that damages equipment in zone ABM as well as the auxiliary building basement Zone apportionment--1/8 of large AB/IB/SAF floods assumed to occur on mezzanine level based on the relative amounts of piping Flood size apportionment—6 of 48 AB/IB/SAF floods are large floods (Table 3-8). Damage apportionment—The probability for damage occurring to ABM equipment is treated in the quantification phase of the study as discussed in Section 8.0.	AB/IB/SAF	9.4E-02	1/8	6/48	1	1.47E-03
FL000AB7	Large internal flood in zone ABO that damages equipment in zone ABO as well as the auxiliary building basement Zone apportionment—3/16 of large AB/IB/SAF floods assumed to occur on mezzanine level based on the relative amounts of piping Flood size apportionment—6 of 48 AB/IB/SAF floods are large floods (Table 3-8). Damage apportionment—The probability for damage occurring to ABM equipment is treated in the quantification phase of the study as discussed in Section 8.0.	AB/IB/SAF	9.4E-02	3/16	6/48	1	2.21E-03
FL000CR1	Internal flood originating in the main control room Zone apportionment - 1/12 of CB floods are assumed to occur in the control room based on the relative amounts of piping. Damage apportionment - Not applicable. Flooding caused by a leak in domestic water line (one-inch) assumed to be isolable prior to damage of any equipment since zone is manned at all times.	CB	3.5B-03	1/12	1	n/a	n/a

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL000CT1	Internal flood originating in the cable tunnel. Zone apportionment - 1/12 of CB floods are assumed to occur in the cable tunnel based on the credible flood source in the area (dry-pipe sprinkler system). Damage apportionment - Not applicable. The only credible flooding source for this zone is the inadvertent actuation of fire sprinklers. Previous inadvertent actuation events have caused no impacts to plant operation, therefore, no credible internal flooding scenarios exist.	CB	3.5E-03	1/12	1	n/a	n/a
FL000H21	Internal flood in hydrogen storage building Zone apportionment—1/10 of OT floods assumed to occur in hydrogen storage building based on the relative amounts of piping.	OT	2.7E-03	1/10	1	1	2.67E-04
FL000IB1	Large internal flood in intermediate building Zone apportionment—1/4 of large AB/IB/SAF floods assumed to occur in the intermediate building based on relative amounts of piping Flood size apportionment—6 of 48 AB/IB/SAF floods are large floods (Table 3-8).	AB/IB/SAF	9.4E-02	1/4	6/48	1	2.94E-03
FL000IB3	Small internal flood in intermediate building Zone apportionment—1/4 of small AB/IB/SAF floods are assumed to occur in intermediate building based on the relative amounts of piping Flood size apportionment—42 of 48 AB/IB/SAF floods are small floods (Table 3-8). Damage apportionment—8 of 42 of small AB/IB/SAF floods result in plant trip (Appendix I), the remainder are assumed to have negligible impact.	AB/IB/SAF	9.4E-02	1/4	42/48	8/42	3.92E-03
FL000SB1	Internal flood event originating in the service building.	SB	5.2E-04	1	1	1	5.2E-04

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL000RC1	Internal flood in reactor containment. Damage apportionment—17/24 of reactor containment floods resulted in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	RC	5.8E-02	1	17/24	1	4.13E-02
FL000RR1	Internal flood in relay room (zone RR), from sources within the relay room as well as propagation from the relay room extension (zone RRA), and technical support center. Zone apportionment—1/6 of CB floods are assumed to occur in the relay room, relay room extension or technical support center based on the relative amounts of piping. Damage apportionment—3/4 of CB floods result in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	CB	3.5E-03	1/6	1	3/4	4.4E-04
FL000SH1	Internal flood occurs in the screen house service water pump area. Zone apportionment—The 4/6 portion applied to this initiator involve service water leaks which are a credible internal flooding source in the service water pump area. Excluded are the 2/6 SH floods which involved circulating water leaks. Circulating water leaks are not credible internal flooding iniators due to the permanent installation of berms that divert such leaks away of the service water pump area, and losses of circulating water due to flood damage are implicitly covered by reactor trip internal events initiator. Damage apportionment - Of the 4 floods involving service water leaks, two are damaging (Appendix I).	SH	3.9E-03	4/6	1	2/4	1.29E-03
FL000TB1	Very large flood in turbine building (circulating water leak). Flood size apportionment – 4/34 of TB floods involve circulating water leaks.	TB	3.1E-02	1	4/34	1	3.61E-03

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL000TB3	Steam flooding event in turbine building. Flood apportionment—7/34 of TB floods are steam floods.	TB	3.1E-02	1	7/34	1	6.32E-03
FL000TB6	Large flood originating in turbine building basement (zone TB-1). Zone apportionment—1/2 of large TB floods assumed to occur on the basement level based on the relative amounts of piping Flood size apportionment—10 of 34 TB floods are large floods (Table 3-8).	TB	3.1E-02	1/2	10/34	1	4.51E-03
FL000TB7	Large flood originating in turbine building mezzanine (zone TB-2). Zone apportionment—1/2 of large TB floods assumed to occur on the mezzanine level based on the relative amounts of piping Flood size apportionment—10 of 34 TB floods are large floods (Table 3-8).	TB	3.1E-02	1/2	10/34	1	4.51E-03
FL000TO1	Flood in Turbine Oil Storage Room Zone apportionment - 1/10 of OT floods assumed to occur in turbine oil storage room based on the relative amounts of piping.	OT	2.7E-03	1/10	1	1	5.34E-04
FL00AHR1	Internal flood originating in the air handling room Zone apportionment—1/2 of CB floods are assumed to occur in the air handling room based on the relative amounts of piping Damage apportionment—3/4 of CB floods result in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	CB	3.5E-03	1/2	1	3/4	1.30E-03
FL00AVT1	Internal flood originating in the condensate demineralizing building. Zone apportionment—1/2 of OT floods assumed to occur in condensate demineralizing building based on the relative amounts of piping.	OT	2.7E-03	1/2	1	1	1.3E-03

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL00CHG1	Internal flood originating in the charging pump room (zone CHG).	AB/IB/SAF	9.4E-02	1/32	1	1	2.94E-03
FL00SAF1	Internal flood in standby auxiliary feedwater pump room (zone SAF).	AB/IB/SAF	9.4E-02	1/32	1	1	2.94E-03
FL00TB12	Small spray or submergence flood in turbine building (zone TB-1, TB-2 or TB-3) Flood size apportionment—13 of 34 TB floods are small floods (Table 3-8). Damage apportionment—2 of 13 of small spray or submergence floods result in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	TB	3.1E-02	1	13/34	2/13	1.81E-03
FL00TYD1	Internal flood occurs in transformer yard (inadvertent actuation of fire sprinklers). Zone apportionment – 1/10 of OT floods assumed to occur in the transformer yard based on the credible flood source in the area (fire sprinkler system). Damage apportionment – Not applicable. Inadvertent actuation of fire sprinklers is the only credible flooding source applicable to the internal flooding study; no credible damage would occur since equipment is normally exposed to wet conditions, such as rain.	OT	2.7E-03	1/10	1	n/a	n/a
FL0BR1A1	Internal flood originating in battery room A (zone BR1A) Zone apportionment—1/12 of CB floods are assumed to occur in battery room A based on the relative amounts of piping Damage apportionment—3/4 of CB floods result in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	CB	3.5E-03	1/12	1	3/4	2.2E-04

TABLE 7-16
Summary of Internal Flooding Initiating Event Frequency Calculations

Initiating Event Label	Description	Frequency Bin[1]	Base Frequency[2] (yr)	Zone Apportionment	Flood Size Apportionment	Damage Apportionment	Frequency[3] (yr)
FL0BR1B1	Internal flood originating in battery room B (zone BR1B) Zone apportionment—1/12 of CB floods are assumed to occur in battery room B based on the relative amounts of piping. Damage apportionment—3/4 of CB floods result in plant trip (Table 3-8), the remainder are assumed to have negligible impact.	CB	3.5E-03	1/12	1	3/4	2.2E-04
FL0DG1A1	Internal flood originating in diesel generator room A (zone EDG1A). Zone apportionment – ½ of DG floods occur in diesel generator room 1A based on the relative amounts of piping.	DG	1.3E-03	1/2	1	1	6.34E-04
FL0DG1B1	Internal flood originating in diesel generator room B (zone EDG1B). Zone apportionment – ½ of DG floods occur in diesel generator room 1B based on the relative amounts of piping.	DG	1.3E-03	1/2	1	1	6.34E-04
FL0DGST1	Internal flood in diesel fuel oil storage area Zone apportionment—1/5 of OT floods assumed to occur in diesel fuel oil storage area (ground water leakage into the area). Damage apportionment – Not applicable. Use two independent tanks with tank level monitored twice per shift. Either tank can supply DGs.	OT	2.7E-03	1/5	1	n/a	n/a

Notes

1 These frequency bins were assigned as discussed in Section 3.4.3 and summarized in Table 3-8. The bins are: AB/IB/SAF - auxiliary building, intermediate building and standby auxiliary feedwater pump room; CB – control building; DG – diesel generator building; RC – reactor containment; SB – service building; SH – service water/circulating water screen house and pump area; TB – turbine building; OT – all other plant areas.

2 Except where otherwise noted in this table, all initiating base frequencies are based on nuclear industry experience and actual Ginna experience using a two-stage Bayesian data update technique as discussed in Appendix I.

3 Frequency values are the product of base frequency, zone apportionment, flood size apportionment, and damage apportionment.

TABLE 7-17
Internal Flooding Post-Initiative Human Errors

Event Label	Description	Failure Probability[1]
IFHFDABISOL	Failure to isolate auxiliary building flood prior to submergence of charging system	1.0E-01
IFHFDACPWR	Following a flood in the screenhouse that damages all four SW pumps, failure to align the TSC DG to operate reactor shroud fans within ten hours	1.0E-02
IFHFDAFW1A	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally start and control MDAFW Pump A when the TDAFW pump fails to function using ER-FIRE.1	5.0E-01
IFHFDAFWSW	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally align service water to the TDAFW pump suction per ER-FIRE.1, or to MDAFW Pump A or SAFW Pump C	1.0E-02
IFHFDAFWXX	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, HCO fails to locally open MOV 3996 and MOV 3505A per ER-FIRE.1	5.0E-03
IFHFDCHG1A	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CO fails to line up alternate DC to charging pump 1A and start the pump per ER-FIRE.1	1.0E-01
IFHFDCVCSX	Following a flood in the screenhouse that damages all four SW pumps, operators fail to align TSC DG to supply either charging pump B or C to maintain RCP seal integrity per ER-ELEC.4	1.0E-01
IFHFDDCPWR	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to align TSC DC supply to Battery B for TDAFW pump per ER-FIRE.1	1.0E-03
IFHFDDGAXX	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, STA fails to start DG A per ER-FIRE.1	5.0E-03
IFHFDDGAXY	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CRF fails to strip Bus 18 loads and manually close breaker for DG A per ER-FIRE.1	5.0E-03
IFHFDDGAXZ	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CO fails to strip Bus 14 loads and manually close breaker for DG A and SW Pump A per ER-FIRE.1	5.0E-03

TABLE 7-17
Internal Flooding Post-Initiative Human Errors

Event Label	Description	Failure Probability[1]
IFHFDIBISOL	Failure to isolate intermediate building flood prior to damage of all intermediate building equipment	1.0E-01
IFHFDLOSP1	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to reconnect offsite power following control room evacuation if DG A is unavailable, using plant emergency operating procedures	1.0E-01
IFHFDBRISLL	Failure to isolate large service leak in battery room A or B prior to failing all DC power (sump pump succeeds)	9.2E-01
IFHFDSAFWY	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally align SAFW using ER-FIRE.1	5.0E-01
IFHFDSLISOL	Failure to isolate large screen house flood prior to loss of the service water system	5.0E-01
IFHFDSSISOL	Failure to isolate small screen house flood prior to loss of the service water system	1.0E-03
IFHFDTBISOL	Failure to isolate large turbine building flood not related to circ water prior to submergence and disabling of equipment in turbine building basement, turbine oil storage building, service building and diesel generator rooms	1.0E-04
IFHFDBRISLS	Failure to isolate large SW leak in battery room prior to failing all DC power (sump pump fails)	9.20E-01
IFHFDBRISNS	Failure to isolate small SW leak prior to failing all DC power	3.00E-03
IFHFDBRISOL	Failure to isolate large SW leak in battery room prior to failing all DC power (spray provides cue)	2.50E-01
IFHFDBRISOLS	Failure to isolate small SW leak in battery room prior to failing all DC power (spray provides cue)	1.00E-03
IFHFDCIRCW	Operators fail to trip circulating water pumps upon indication of flood with no auto trip	1.00E-01
IFHFDEVACR	Operators fail to use ER-FIRE.1 following relay room flood that requires control room evacuation	5.00E-03
IFHFDRWSTX	Operators fail to locally verify RWST level for cases where MCB indication is lost	1.00E-01

Note:
1 Derivation of human error probabilities related to internal flooding events is documented in Appendix I.

8.0 QUANTIFICATION

8.3 Internal Flooding Solution

A comprehensive set of flooding scenarios was developed for each of the internal flooding initiating events identified for Ginna Station (Table 3-10). For each scenario, an internal flooding damage state was defined based on the components postulated to be directly damaged by the flood. Flooding initiators and logic flags were then incorporated into the internal events PSA to model the accident sequences for each flooding scenario and corresponding flooding damage state. Each of these steps is discussed in more detail in the following subsections. A complete list and description of internal flooding scenarios developed for Ginna Station is presented in Appendix I.

8.3.1 Development of Internal Flooding Scenarios

The flooding scenarios were developed for the Ginna Station internal flooding initiators identified in Table 3.10 by assuming a flood within the defined zone and considering the potential for flood propagation beyond the origin of the flood, potential mitigating operator actions, and the postulated impacts to plant equipment and systems. The consideration of each of these items is described below.

8.3.1.1 Flood Propagation

The potential for flood propagation was examined and accounted for in the modeling of flood scenarios as follows:

<u>Auxiliary Building</u>–Flooding on the basement elevation will accumulate on that level and then propagate to the sub-basement if sufficient depth is reached to exceed the height of installed berms. Flooding on upper elevations will flow down stairwells and accumulate in the basement and sub-basement. The auxiliary building stairwells are open to each elevation, and therefore flow from upper elevations is not obstructed. There are no flow pathways or floor drain connections to other plant buildings.

<u>Intermediate Building</u>–Flooding on any elevation will ultimately accumulate in the intermediate building basement as a result of flow through doorways and potentially through ventilation ducts. A floor grate is installed in the basement floor that leads to a large, empty sub-basement area which will significantly delay flood accumulation on the basement level. Significant accumulations on the basement level would ultimately propagate to the turbine building and service buildings through doorways. However, the turbine floor is a large open area that would require several hours prior to significant accumulation for all flooding sources present in the intermediate building. Flow through floor drains accumulates in an outdoor retention tank.

Control Room–Flooding potentially can propagate to the relay room and turbine building through doors and fire seals. However, due to the small potential flood source (one-inch domestic water line), and the 24-hour presence of operators, no significant flooding or propagation was postulated to occur.

Relay Room–Floods occurring in the relay room were postulated to damage all equipment in the adjacent relay room annex due to propagation through a doorway. Propagation to the turbine building can also occur via doorways; however, no additional impacts would occur to safe shutdown equipment beyond those that occur in the relay room. Flow through floor drains accumulates in an outdoor retention tank.

Technical Support Center–Floods occurring in the technical support center were postulated to propagate to the relay room annex and relay room via doorways. Flow through floor drains accumulates in an outdoor retention tank.

Control Building Air Handling Room–Propagation to the turbine building basement occurs via a de-watering valve; however, due to the large area of the turbine building and adjacent service building, additional impacts to plant equipment beyond those that occur in the air handling room were judged not to be credible.

Battery Rooms–Propagation between the battery rooms is postulated to occur via a doorway. Propagation to the turbine building basement occurs via a sump pump; however, due to the large area of the turbine building and adjacent service building, additional impacts to plant equipment beyond those that occur in the battery rooms were judged not to be credible.

Cable Tunnel–Propagation to the intermediate building and turbine building can occur via floor drains, and to the air handling room and auxiliary building mezzanine level via fire seals. The potential flooding source located within the tunnel is a dry-pipe fire water line. However, no adverse plant impacts were postulated to occur since: (1) operators are alerted immediately in the event of spurious actuations; (2) a significant time interval would be required prior to any significant accumulation in adjacent areas due to large floor areas; (3) minimal flow is expected past fire seals; and (4) previous spurious actuations of the fire system have caused no damage to plant equipment.

Diesel Generator Rooms–Propagation between the two diesel generator rooms is postulated to occur if the backflow-prevention device fails to function. Propagation to the turbine building basement can occur via doorways; however, due to the large area of the turbine building and adjacent service building, additional impacts to plant equipment beyond those that occur in the diesel generator rooms were judged not to be credible.

Service Building–Propagation to the turbine building was postulated to occur via doorways. Propagation to the intermediate building can also occur via doorways; however since flow would have to pass two sets of doors and then fill a large empty sub-basement prior to damage of plant equipment, additional impacts to plant equipment beyond those that occur in the turbine building and service building were judged not to be credible.

Screen House–A previously installed dam prevents flow of circulating water to the service water area. Propagation of water from the service water area to circulating water area does not result in risk significant impacts (such propagation at most would disable the circulating water system and cause a plant trip; however plant trip is already assumed to occur for all floods).

Standby Auxiliary Feedwater Building–Propagation to the auxiliary building operating level can occur via fire seals; however, significant time would elapse prior to significant accumulation in the auxiliary building. Therefore, this propagation pathway was judged to have negligible impacts. Flow through floor drains accumulates in an outside storage tank.

Turbine Building–Propagation was postulated to occur to the service building, turbine oil storage room, diesel generator rooms and the yard via doorways. Large accumulations are postulated to propagate beyond eighteen-inch flood curbs to the battery rooms, air handling room and intermediate building. Flow through floor drains accumulates in an outside storage tank.

Condensate Demineralizer Building–Propagation through doorways to the turbine building was postulated to occur.

8.3.1.2 Mitigating Operator Actions

The potential isolation of internal flood sources was postulated for the following cases (see also Table 7-17):

a. The potential isolation of a large auxiliary building flood before sufficient accumulation could damage the charging pumps (located in a normally isolated room in the auxiliary building basement) was postulated for flood scenarios occurring on the auxiliary building mezzanine and operating levels in which equipment on those levels is damaged. Although no flood detection equipment is installed in the area, flood damage to equipment installed on the mezzanine and operating elevations would alert operators to investigate the cause of the trouble (i.e., MCB alarms). This was modeled as event IFHFDABISOL.

b. The potential isolation of floods occurring in the intermediate building before sufficient accumulation could damage equipment due to submersion was postulated for intermediate building floods. Floods occurring in the intermediate building accumulate initially in a large empty sub-basement, providing a delay before submergence of safety-related equipment and the potential for the flood to be detected by the hourly surveillance made by security personnel. Spray effects were considered separately. This was modeled as event IFHFDIBISOL.

c. The potential isolation of floods occurring in the screen house before sufficient accumulation could damage service water equipment was postulated for screen house floods. Disabling of equipment located in the lowest elevations of the screen house due to flood damage would be alarmed in the control room. Such an alarm would alert operators to investigate the cause of the trouble, and therefore potential flood isolation was postulated. This was modeled as events IFHFDSLISOL and IFHFDSSISOL for large and small floods respectively.

d. The potential isolation of large floods occurring in the turbine building before sufficient accumulation could damage equipment in the diesel generator rooms and service building was postulated. There would be numerous control room alarms indicating problems within the turbine building. This was modeled as events IFHFDTBISOL and IFHFDCIRCW (circ water floods only).

e. The potential isolation of SW leaks in the battery rooms prior to the damage of DC power equipment was postulated. Due to the significance of this scenario, the potential floods were broken down into several categories based on piping failure location and size, along with the potential to generate control room alarms. This was modeled as events IFHFDBRISLL, IFHFDBRISLS, IFHFDBRISNS, IFHFDBRISOL and IFHFDBRISOLS.

8.3.1.3 Impacts to Plant Equipment and Systems

Considerations regarding flooding impacts to plant equipment consisted of physical separation, component fragilities and failure modes, flooding event categories and secondary impacts. Each of these is described below.

8.3.1.3.1 Physical Separation

The flooding evaluation was initially based on fire zones with the adequacy of fire penetrations and door seals providing a flood barrier evaluated during plant walkdowns. The results of these walkdowns are summarized in Section 8.3.1.1. Within a given fire zone, all flood susceptible equipment was assumed to be failed with no consideration of physical separation except as follows (see Section 9.5.3.4 for consideration of their risk significance):

Auxiliary Building Operating Level (ABO)
Due to the nine-foot separation between the component cooling pumps installed in zone ABO, a 0.01 probability was assigned that spray causing a flood occurring in the vicinity would disable both CCW pumps. This was modeled as event ABFL-CCW.

Screen House (SH)
Circulating water leaks occurring in the screen house are not credible sources of flood damage to the service water system equipment installed in the building due to the permanent installation of berms that divert such leaks away of the service water pump area. There are also two trains of flood detection equipment in the circ water bay area that automatically trip the circulating water pumps.

8.3.1.3.2 Component Fragilities and Failure Modes

Equipment and cable damage assumed to occur for postulated floods were obtained from a database that tracked the routing of cables and the locations of equipment associated with components modeled in the PSA. Two types of flooding damage inventories were developed: (1) cable damage inventories and, (2) equipment damage inventories.

Power and Control Cable Damage
Submersion of power and control cables was postulated to cause electrical short circuits due to the potential for leakage into cable junction boxes. The following consequences were postulated:

a. Motor operated valves fail as-is.
b. Solenoid valves transfer to the de-energized state.
c. Air-operated valves transfer to the state that corresponds to the de-energized state of the associated flood-damaged solenoid control valves.
d. Damage to circuit breaker control cables causes the breakers to fail as-is.
e. Damage to control and power cables associated with pumps, motors, and fans causes the equipment to fail to start and run.
f. Damage to cables associated with dampers causes the dampers to fail in the de-energized state.

Instrumentation Cable Damage
Submersion was postulated to damage instrumentation cables and to make the associated indication unavailable. The impacts of such indication losses are considered as part of the human reliability analysis discussed in Appendix I.

Equipment Damage

Equipment susceptible to flood damage was postulated to be damaged if located in the zone in which the flood occurs. All equipment modeled in the PSA was considered susceptible to such damage except for: piping, tanks, heat exchangers, check valves, and manual valves (since these components utilize no electrical motive power). The following equipment impacts were postulated as a result of damage caused by submersion, spray, dripping or steam flooding:

a. Pumps, motors, fans and air compressors fail to start and run.
b. Electrical cabinets and electrical buses fail to function.
c. Solenoid valves transfer to the de-energized state.
d. Air operated valves transfer to the state that corresponds to the de-energized state of the associated flood-damaged solenoid control valves.
e. Motor operated valves fail as-is.
f. Ventilation dampers fail in the de-energized state.

8.3.1.3.3 Flooding Event Categories

The modeling of flooding events and impacts varied depending on the category involved as described below.

Submersion, Spray, Dripping and Steam Flooding

Submersion, spray, dripping and steam flooding were postulated to damage all flood-susceptible equipment, as discussed in Section 8.3.1.3.2.

Inadvertent Actuation of Fire Sprinklers

Flooding events involving the inadvertent actuation of fire sprinklers are included in the database used to develop the initiation frequencies for the Ginna internal flooding PSA. This category of floods is therefore judged to be reflected in the Ginna internal flooding analysis results.

High Energy Line Breaks

The impacts and consequences of high energy line breaks are modeled as part of the internal events PSA.

Maintenance-Induced Flooding Events

Flooding events induced by maintenance activities can lead to the damage of plant equipment. The historical database utilized to model the Ginna flooding scenarios accounts for such events and, therefore, the Ginna internal flooding model adequately accounts for these.

8.3.1.3.4 Secondary Impacts Resulting from System Leaks

In addition to impacts caused by flooding damage, degradation of the system from which a leak originates can arise due to the failure of the pressure boundary. These effects were considered as follows:

Component Cooling Water System

Termination of leaks occurring in most sections of the CCW system can be accomplished by isolating specific CCW loads and then replenishing system volume using connections to the component cooling water surge tank. The secondary impacts arising from such leaks were found by the PSA analysis to be bounded by the primary impacts (that is, flooding damage to other equipment). For example, leaks occurring in the line that supplies CCW flow to SI Pump A require this portion of the system to be isolated. The primary effects postulated to occur in the flooding PSA as a result of this scenario include the unavailability of the SI Pump A due to flood damage, and thus the secondary impacts are bounded.

CCW leaks that are not successfully isolated can result in a loss of CCW and potentially cause flood damage to other plant systems. Such events are judged to be adequately modeled by the loss of the CCW initiating event modeled in the internal events PSA, since the systems or subsystems postulated by the analysis to be unavailable due to flood-related reasons are failed regardless of reason that component cooling water is lost.

Service Water System

Leaks occurring in many sections of the SW system installed in the auxiliary building and all sections installed in the screen house require the isolation of one SW header for termination. Such isolation typically removes the availability of two of the four SW pumps. For this reason, one SW header was assumed unavailable for auxiliary building and screen house flood scenarios due to secondary impacts.

Isolation of leaks occurring in sections of the SW system installed in other areas of the plant can be accomplished by isolating specific SW system loads. The secondary impacts arising from such leaks were found to be bounded by the primary impacts. For example, leaks occurring in portions of the SW system installed in the standby auxiliary feedwater pump room can be terminated by isolating this portion of the system. For this scenario, the secondary impacts caused by the isolation (i.e., standby auxiliary feedwater system unavailability) are bounded by the primary impacts failure of all equipment housed in the room, including the standby auxiliary feedwater system pumps.

Fire Water System

Leakage in the plant's fire water system may require a portion of the system to be isolated, and thus fire protection coverage may be reduced for portions of the plant. Plant procedures are in place to implement fire prevention measures in response to fire water system unavailabilities, and thus the secondary impacts are judged to be adequately addressed.

Other Systems

The secondary impacts arising from floods caused by other internal flooding sources were found to be bounded by the primary impacts. For example, a rupture of the RWST is postulated to cause the unavailability of SI due to the unavailability of a suction source. However, the primary effects postulated to occur in the flooding PSA as a result of RWST rupture include the unavailability of the safety injection pumps due to flood damage, and thus the secondary impacts are bounded.

8.3.2 Defining Flood Damage States

Based on the information presented in Section 8.3.1, flood damage states were developed and quantified based on the equipment assumed to be damaged by flooding effects. The following considerations were made as part of defining and quantifying the states:

a. All internal flooding initiating events for Ginna Station were identified as having the same initial consequences as either a reactor trip initiator or a loss of main feedwater initiator. Therefore, each internal flooding initiating event was categorized for the accident sequence quantification with respect to being either reactor trip equivalent or loss of main feedwater equivalent (see Appendix I).

b. All equipment assumed to be disabled for each damage state was assumed to be unavailable for the accident sequence quantification through the use of logic flags. A total of 33 damage states were considered within the model.

8.3.3 Accident Sequence Quantification

The event trees and fault trees developed for the existing internal events analysis with respect to reactor trip and loss of main feedwater initiators were used with new initiators, human error probabilities, and logic flags incorporated to quantify each flooding scenario and flood damage state. Table 8-7 provides a summary of each of the flood states that were solved. The results of the analysis are discussed in Section 9.0.

TABLE 8-7
Flood Quantification Summary

Flood State	Truncation	Flag File	Class	# Cutsets	CDF (1/yr)
AB-1	1.00E-10	ABFL-1.FRE	FLOOD	184	1.05E-06
AB-10	1.00E-10	ABFL-10.FRE	FLOOD	0	0
AB-2	1.00E-10	ABFL-2.FRE	FLOOD	80	1.14E-07
AB-4	1.00E-10	ABFL-4.FRE	FLOOD	6	2.77E-09
AB-5	1.00E-10	ABFL-5.FRE	FLOOD	41	1.80E-07
AB-6	1.00E-10	ABFL-6.FRE	FLOOD	3	1.45E-09
AB-7	1.00E-10	ABFL-7.FRE	FLOOD	53	1.03E-07
AB-8	1.00E-10	ABFL-8.FRE	FLOOD	2	6.47E-10
AB-9	1.00E-10	ABFL-9.FRE	FLOOD	5	1.78E-08
BR	1.00E-10	BRFL.FRE	FLOOD	32	2.34E-05
CHG	1.00E-10	CHGFL.FRE	FLOOD	76	6.18E-08
EDG	1.00E-10	EDGFL.FRE	FLOOD	0	0
EDG1A	1.00E-10	EDG1AFL.FRE	FLOOD	2	3.27E-10
EDG1B	1.00E-10	EDG1BFL.FRE	FLOOD	5	1.34E-09
FBR1A	1.00E-10	BR1AFL.FRE	FLOOD	22	1.81E-08
FBR1B	1.00E-10	BR1BFL.FRE	FLOOD	4	1.95E-09
FDIVA	1.00E-10	DIVAFL.FRE	FLOOD	28	5.17E-08
FLOMFW	1.00E-10	LOMFWFL.FRE	FLOOD	140	1.07E-07
FLOSP	1.00E-10	LOSPFL.FRE	FLOOD	507	2.37E-07
FRXTRIP	1.00E-10	RXTRIPFL.FRE	FLOOD	6	1.92E-09
FSH-1	1.00E-10	SHFL-1.FRE	FLOOD	87	3.15E-06
FSH-2	1.00E-10	SHFL-2.FRE	FLOOD	0	0
IB-1	1.00E-10	IBFL-1.FRE	FLOOD	112	9.08E-08
IB-2	1.00E-10	IBFL-2.FRE	FLOOD	60	2.20E-08
RCXF	1.00E-10	RCFL.FRE	FLOOD	87	8.98E-08
RRXF	1.00E-10	RRFL.FRE	FLOOD	192	2.044E-06
SAFX	1.00E-10	SAFFL.FRE	FLOOD	21	6.27E-09
TB1	1.00E-10	TBFL1-1.FRE	FLOOD	77	4.11E-08
TB2	1.00E-10	TBFL1-2.FRE	FLOOD	2	3.68E-10

TABLE 8-7
Flood Quantification Summary

Flood State	Truncation	Flag Fire	Class	# Cutsets	CDF (1/yr)
TB3	1.00E-10	TBFL1-3.FRE	FLOOD	2	2.78E-06
TB4	1.00E-10	TBFL1-4.FRE	FLOOD	0	0
AB-3A	1.00E-10	ABFL-3A.FRE	FLOOD	47	1.18E-07
AB-3B	1.00E-10	ABFL-3B.FRE	FLOOD	111	8.25E-08
Total				1994	3.375E-05

9.0 LEVEL 1 ANALYSIS

9.5 Internal Flooding Results

Similar to the internal events PSA, the internal flooding results were assessed with respect to sensitivities and importance measures. The results are summarized below.

9.5.1 Internal Flooding Results

The listing of the top 50 final cutsets is shown in Table 9-7 (note - these account for 95% of the core damage frequency (CDF)). From this listing, a summary of the top flooding scenarios is provided below.

9.5.1.1 Battery Room Floods

The most significant flooding scenario at Ginna Station is the loss of both battery rooms which was assumed to directly lead to core damage (77% of CDF). There are two basic scenarios as described below:

a. *Flooding within Battery Rooms A and B (Tag BRFL - 69% of CDF)* - This flooding is caused by failure of non-safety related Service Water (SW) lines which run through both battery rooms. The 1" SW lines provide both supply and return cooling water for a room cooler located in the relay room directly above the battery rooms. The SW lines are designed to normally supply approximately 16 gpm through use of a temperature control valve located in the relay room. A break in the SW line would be expected to exceed this flow rate (> 200 gpm for a clean pipe with guillotine break). Only battery room A has a sump pump which was designed based on a crack of the moderate energy SW line versus a full break (~ 50 gpm). However, there exists a small ½" gap under a fire door connecting the two battery rooms which would allow a flood from one room to propagate to the other room. This scenario is dominated by the assumed frequency of the SW line break and the ability of operators to identify and isolate the break before flooding both battery rooms.

b. *Flooding within Turbine Building Flooding Battery Rooms A and B (Tag TBFL1-3 - 8%)* - This scenario has similar consequences as the SW line break described above expect that it is caused by a large flood in the turbine building basement (i.e., circulating water line break) that is not isolated before the battery rooms are affected. As described in Section 8.3.1.1, there is an 18" curb between the battery rooms and the turbine building basement. In addition, there are flood detection (i.e., float) switches installed in the condenser bays that trip the circulating water pumps. However, failure of the circulating water pump breakers to open would require operator action to close the discharge valves or de-energize buses to terminate the flood prior to failing both battery rooms.

9.5.1.2 Screenhouse Floods

The second most significant flood scenario is one which occurs in the screenhouse and subsequently fails all four SW pumps (via failing Buses 17 and 18) which are all located near one another (Tag SHFL-1 - 9% of CDF). Since SW supplies cooling water to most plant systems, the failure cascades to many other functions. The success criteria for responding to this plant trip must then rely on a limited selection of equipment which subsequently fails. This remaining equipment is dominated by losses of the TDAFW pump such that no feedwater supply is available to the steam generators.

9.5.1.3 Relay Room Floods

The next most significant flooding scenario is the loss of the relay room due to floods from the SW piping supplying the relay room coolers (Tag RRFL - 6% of CDF). While only comprising two cutsets among the top 50, it is found in almost 10% of all cutsets. In this case, a flood of the relay room is expected to directly result in core damage unless operators successfully implement station procedures for loss of the relay room (i.e., ER-FIRE series). This includes local operation of auxiliary feedwater and charging pumps.

9.5.1.4 Auxiliary Building Floods

The final most significant flooding scenario is a flood in the auxiliary building basement with a reactor trip that requires RCS makeup (e.g., stuck open PORV). Since most mitigation equipment is in the auxiliary building basement (assumed to be failed by the flood) this results in core damage. This scenario represents ~3% of the CDF (Tag ABFL-1).

9.5.2 Internal Flooding Sensitivity Analysis

As described in Section 9.3.1, sensitivity analyses were performed for 8 types of basic events within the internal events PSA models (i.e., human errors, test and maintenance, common cause failures, initiating events, MOVs, AOVs, DGs, and pumps) . Since the flooding analysis used the same fault tree models and event trees as the internal events PSA, only the new basic events need to be assessed. Also, every cutset contains a similar flooding initiating event (versus the internal events PSA which addressed LOCAs, steam line breaks, reactor trips). As such, no sensitivity was performed of the flooding initiators. Therefore, of the 8 basic event types, only human errors were considered as described below.

9.5.2.1 Human Errors

Two sensitivity studies were performed with respect to human error events. First, all human errors were set to "false" (i.e., all human actions were assumed to be successfully performed). As a result of this change, the CDF decreased by 93% to 2.291E-06. This shows that sequences are relatively sensitive to human reliability failure rates (as is expected). However, it was interesting to note that of the top four flooding scenarios described in Section 9.5.1, only the last scenario remains (Tag ABFL-1), indicating that the top scenarios are very dependent on successful operator intervention.

The second study was to set all human errors to "true". As a result of this change, the CDF increased by a factor of 40 to 1.424E-03.

9.5.2.2 Internal Flooding Truncation Limit Evaluation

As a final sensitivity study, the truncation limit was evaluated with respect to its impact on the final results. This was performed by generating a figure which shows the contribution of the cutsets in each "decade" (e.g., 1E-05, 1E-06, etc) to the final CDF. As can be seen from Figure 9-7, the CDF contained in each decade creates a "step ladder" effect with the cutsets over 1E-08 contributing over 95% of the final CDF. Also, as noted on the figure, over 80% of the cutsets are located between 1E-09 and 1E-10; however, these contribute less than 5% of the final CDF. Consequently, lowering the truncation limit should not significantly impact the CDF. This same "step ladder" effect and location of data was also evident for internal events (see Figure 9-1). Therefore, it can be concluded that the truncation limit of 1E-10 as used for the internal flooding analysis was appropriate.

It should be noted that the total number of cutsets (1994) is attributed to the method of performing an internal flooding evaluation. As described earlier, a flooding scenario was developed assuming a certain set of equipment was failed by the flooding initiator. These events are set to "true" (i.e., assumed to fail with a probability of 1.00) and the fault tree model is solved. Depending on the set of assumed failed equipment, there may only be one train of equipment available to perform a required function such that the potential number of equipment failure combinations is limited. Consequently, the number of cutsets will also be limited.

9.5.3 Importance Analysis

As described in Section 9.3.2, two types of importance measures were generated for most basic events contained in the final cutsets: (1) Fussell-Vesely (F-V), and (2) Risk Achievement Worth (RAW). These importance measures were combined as follows:

a. If the F-V value is > 0.05 at the system level (> 0.005 at the component level) and the RAW > 10 at the system level (> 2 at the component level), then the system or component will be identified as being "high" risk significant.

b. If the F-V value is > 0.05 at the system level (> 0.005 at the component level) or the RAW > 10 at the system level (> 2 at the component level), then the system or component will be identified as being "medium" risk significant.

c. If the F-V value is < 0.05 at the system level (< 0.005 at the component level) and the RAW < 10 at the system level (< 2 at the component level), then the system or component will be identified as being "low" risk significant.

The F-V and RAW importance measures were generated for flooding initiating events, human errors, test and maintenance activities, flooding modeling assumptions, and on a system and component basis. Each of these is described below in detail. Included within these discussions is a reference to a table and figure containing the specific F-V and RAW values. The table is self-explanatory; however, additional information with respect to the figure is necessary to ensure correct interpretation.

In order to provide a visual depiction of the risk profile associated with various events modeled within the Ginna Station PSA, the F-V and RAW importance measures were plotted against one another. In this manner, it can be easily identified which events are of higher risk than others. For example, all human error F-V and RAW values plotted are on Figure 9-9. A "cross-hair" was provided on the figure for F-V values equal to 0.005 (vertical line) and RAW values equal to 2 (horizontal line). Any event to the left of the F-V line or below the RAW line is not risk significant with respect to that specific importance measure. However, an event to the left of the F-V line but above the RAW line is risk significant with respect to RAW only. Similarly, an event to the right of the F-V line but below the RAW line is risk significant with respect to F-V only (e.g., IFHFDAFW1A). Events which are to the right of the F-V line and above the RAW line are risk significant with respect to both importance measures (e.g., IFHFDEVACR).

In summary, an event in the upper left hand corner or lower right hand corner is of medium risk significance. An event in the upper right hand corner is of high risk significance while events in the lower left hand corner are of low risk significance. Further insights can also be obtained by which "corner" a given event is in as described below:

a. An event in the upper left hand corner is generally of high reliability; consequently, the event did not contribute significantly to the final CDF. However, if the component were to fail, the impact on the final CDF would be significant. Typically, this corner contains passive components, highly redundant systems, or events which are easily performed by operators.

b. An event in the lower right hand corner is typically of lower reliability than is justified by the fault tree model. That is, the event contributes to the final CDF; however, if the event were assumed to always fail, it is not expected to further affect the final results. Generally, this is due to the fact that the event's failure probability is already close to 1.0 such that increasing its value to 1.0 would not have much of an effect on the CDF. It should be noted that an event's failure probability may have been a conservative value selected by the PSA analyst due to limited data and is not necessarily reflective of the specific component history. If so, this is noted in the descriptive text below.

c. An event in the upper right hand corner contributes significantly to the final results and would significantly affect the CDF if it were assumed to always fail. Therefore, this event is very important with respect to the risk profile.

d. An event in the lower left hand corner does not contribute to the final result, and even if it were assumed to fail with a probability of 1.0, would not significantly impact the CDF.

9.5.3.1 Internal Flooding Initiating Events

Figure 9-8 and Table 9-8 show the F-V and RAW importance measures for the internal flooding initiating events. As can be seen from the figure and table, the initiating events of highest importance are:

a. FL0BR1A1 - Large Flood in Battery Room A
b. FL0BR1B1 - Large Flood in Battery Room B
c. FL000SH1 - Large Flood in Screenhouse (SW Pump Area)
d. FL000TB1 - Large Flood in Turbine Building Basement (Circulating Water System)
e. FL000RR1 - Flood in Relay Room.

These initiators were of high importance since they substantially contributed to the final results (i.e., had a F-V value > 5.0E-02) and if the initiator were assumed to be "true" would have a significant impact on CDF (i.e., had a RAW value > 10). The basis for classifying these initiators as high risk significant is described in detail in Section 9.5.1.

The only initiating event of medium importance is FL000AB4 - RWST Rupture in Auxiliary Building. This initiator is of medium importance since if it were set to "true", it would significantly impact CDF (i.e., had a RAW value > 10). This initiator currently has a low frequency; however, if it were to occur it would have significant consequences since it would affect the safety injection pumps, charging pumps, and residual heat removal pumps.

9.5.3.2 Human Errors

Figure 9-9 and Table 9-9 show the F-V and RAW importance measures for the human error events. As can be seen from the figure and table, the human error events of highest importance are:

a. AFHFDALTTD Operators fail to provide cooling to TDAFW lube oil from diesel fire pump
b. IFHFDEVACR Operators fail to use ER-FIRE.1 following relay room flood that requires Control Room evacuation
c. IFHFDAFWSW Failure to locally align SW to TDAFW and SAFW suction following CR evacuation for floods (ER-FIRE)

These human errors were of high importance since they substantially contributed to the final results (i.e., had a F-V value > 5.0E-03) and if the initiator were assumed to be "true" would have a significant impact on CDF (i.e., had a RAW value > 2). Two of the three human errors (items a and c) are directly related to the turbine-driven AFW pump which is AC power independent and thus unaffected by most flooding scenarios (i.e., would be required). It should be noted that event AFHFDALTTD was of medium importance for the internal events PSA (see Section 9.3.2.2). The remaining item, IFHFDEVACR is the failure to use the ER-FIRE procedures for cases when control room evacuation is required. This was a procedural change implemented as a result of the flooding evaluation which allows the operators to use procedures originally developed for fire events for worst case floods in the control building.

The human errors of medium importance are:

a. IFHFDSAFWY Failure to control MDAFW and SAFW locally
b. RCHFDPLOCA Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Min
c. IFHFDAFW1A Failure to locally start and control MDAFW Pump A (CR evacuation - flood)

These human errors were of medium importance if they were set to "true" since they would significantly impact CDF (i.e., had a RAW value > 2). Two of the three events relate to use of the AFW and SAFW motor-driven pumps (items a and c). Event RCHFDPLOCA addresses the ability of operators to isolate a PORV that sticks open as a result of a reactor trip (note - several floods were assumed to result in a loss of main feedwater which is predicted to cause a PORV lift).

9.5.3.3 Test and Maintenance Activities

Figure 9-10 and Table 9-10 show the F-V and RAW importance measures for the test and maintenance events. As can be seen from the figure and table, the test and maintenance events of highest importance are:

a. AFTM0TDAFW TDAFW Pump Train out-of-service for maintenance
b. AFHFLTDAFW Failure to restore TDAFW pump train to service post test/maintenance

These test and maintenance events were of high importance since they substantially contributed to the final results (i.e., had a F-V value > 5.0E-03) <u>and</u> if the initiator were assumed to be "true" would have a significant impact on CDF (i.e., had a RAW value > 2). Both items are directly related to the turbine-driven AFW pump which is AC power independent and thus unaffected by most flooding scenarios (i.e., would be required).

There were no test and maintenance activities in the medium importance range.

9.5.3.4 Internal Flooding Modeling Assumptions

Figure 9-11 and Table 9-11 show the F-V and RAW importance measures for the internal flooding model assumptions that were incorporated into the model as basic events. As can be seen from the figure and table, no assumptions fell within highest importance range. However, the assumptions of medium importance were:

a. BRFL-LG - Large SW Leak in Battery Room
b. SHFL-LG - Large Flood in Screenhouse
c. RRFL-LG - Large Flood in Relay Room
d. IFBRLSPRAX - No spray damage from large leak in Battery Room A or B
e. IFHFDBRISLL- Failure to isolate large SW Leak in Battery Room (no CR cue)
f. IFHFDBRISOL - Failure to Isolate Large SW Leak in Battery Room
g. IFHFDSLISOL - Failure to Isolate Large Screenhouse Flood
h. IFHFDCIRCW - Operators fails to trip circ water pumps upon indication of flood with no auto trip

These flooding modeling assumptions were of medium importance since they substantially contributed to the final results (i.e., had a F-V value > 5.0E-02). The first three items relate to the percentage of floods within the battery room, screenhouse, and relay room which were assumed to be large in nature (all assumed 10% of area flood frequency). The next item (IFBRLSPRAX) is the percentage of floods within the battery room which are assumed to generate sufficient spray that would cause main control board alarms before significant flooding damage would occur (probability of 0.5). The last four items relate to the ability of operators to isolate a flood once it has occurred. While these events could be considered human error events, there is no procedure for these actions and as such, they were grouped within the flooding modeling assumptions. These events all used a probability of 0.5. The only exception is for event IFHFDCIRCW which uses 0.1 and concerns the ability of operators to trip the circulating water pumps (or otherwise terminate flow) in the event that the pump breaker fails to open as a result of an automatic trip signal from the flooding detection circuitry installed in the turbine building.

9.5.3.5 System Level

Figure 9-12 and Table 9-12 show the F-V and RAW importance measures on a system basis. As can be seen from the figure and table, the systems of highest importance are:

a. AC Power
b. RCS (PORVs, safety valves)

These systems were of high importance since they substantially contributed to the final results (i.e., had a F-V value > 5.0E-02) <u>and</u> if the initiator were assumed to be "true" would have a significant impact on CDF (i.e., had a RAW value > 10). AC Power is dominated by bus failures and the ability of the circulating water pump breakers to open on a flooding trip signal. The RCS is dominated by the successful re-closing of the PORVs (and safety valves) upon a reactor trip. If these valves were to fail open, the mitigation equipment required would be significantly different than a typical reactor trip. It is noted that neither system is identified as being risk significant in the internal events PSA evaluation.

The following systems were identified as medium risk significant:

a. Reactor Trip System (RTS)
b. Service Water (SW)
c. DC Electrical
d. Diesel Generators (DGs)
e. Auxiliary Feedwater (AFW)
f. Main Steam (MS)

These systems are of medium importance since they would significantly contribute to core damage frequency if they were assumed to occur with a probability of 1.0 (i.e., had a RAW value > 10). Since all 6 systems had a F-V value < 5.0E-02, this indicates that the systems are reliable; however, they would impact the CDF if their failure rates were to increase. This would be expected of the above systems due to their design. The main steam system is dominated by common cause failures of the turbine-driven AFW pump supply valves from opening and the SG blowdown lines from closing. It is noted that with the exception of AFW, all systems in the medium risk significance category for floods were either in the high or medium category for the internal events PSA models.

9.5.3.6 Components

Figure 9-13 and Table 9-13 show the F-V and RAW importance measures on a component basis (note that some "components" are actually modularized events or "super components"). As can be seen from the figure and table, the components of highest importance can be directly related to the system risk significance described above (as would be expected). That is, the circulating pump trip breakers, PORV and safety valves, and TDAFW pump all dominate risk with respect to internal floods.

TABLE 9-7
Cutsets with Description Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
1	FL0BR1A1	Flood in Zone BR1A (Scenario 1-7)		2.20E-04	2.20E-04	1.01E-05
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAX	No spray damage from large leak in Battery Room A or B		5.00E-01	5.00E-01	
	IFHFDBRISLL	Failure to isolate large SW Leak in Battery Room (17 min avail; no CR cue)		9.20E-01	9.20E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
2	FL0BR1B1	Flood in Zone BR1B (Scenario 1-7)		2.20E-04	2.20E-04	1.01E-05
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAX	No spray damage from large leak in Battery Room A or B		5.00E-01	5.00E-01	
	IFHFDBRISLL	Failure to isolate large SW Leak in Battery Room (17 min avail; no CR cue)		9.20E-01	9.20E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
3	FL0BR1A1	Flood in Zone BR1A (Scenario 1-7)		2.20E-04	2.20E-04	2.75E-06
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAY	Spray from large SW leak in battery room disables contents		5.00E-01	5.00E-01	
	IFHFDBRISOL	Failure to Isolate Large SW Leak in Battery Room		2.50E-01	2.50E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
4	FL000TB1	Very large flood in turbine building (circulating water leak)		3.61E-03	3.61E-03	1.39E-06
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ACCBN52CWA	AC BREAKER 52/CWP1A FAILS TO OPEN	3.85E-03	1.00E+00	3.85E-03	
	IFHFDCIRCW	Operators fails to trip circ water pumps upon indication of flood with no auto		1.00E-01	1.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	TBFL1-3	Flood State TBFL1-3		1.00E+00	1.00E+00	
5	FL000TB1	Very large flood in turbine building (circulating water leak)		3.61E-03	3.61E-03	1.39E-06
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ACCBN52CWB	AC BREAKER 52/CWP1B FAILS TO OPEN	3.85E-03	1.00E+00	3.85E-03	
	IFHFDCIRCW	Operators fails to trip circ water pumps upon indication of flood with no auto		1.00E-01	1.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	TBFL1-3	Flood State TBFL1-3		1.00E+00	1.00E+00	
6	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	1.34E-06
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	APTM0TDAFW	TDAFW Pump Train out-of-service for maintenance		2.08E-02	2.08E-02	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
7	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	8.19E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFMMOTDAFW	Failure of TDAFW pump train components		1.27E-02	1.27E-02	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
8	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	4.32E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFHFDALTTD	OPERATORS FAIL TO PROVIDE COOLING TO TDAFW LUBE OIL FROM DIESEL FIRE PUMP		6.70E-03	6.70E-03	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
9	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	1.93E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFHFLTDAFW	Failure to restore TDAFW pump train to service post test/maintenance		3.00E-03	3.00E-03	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
10	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.68E-07
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage		9.67E-01	9.67E-01	
	RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
11	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.68E-07
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage		9.67E-01	9.67E-01	
	RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
12	FL0BR1B1	Flood in Zone BR1B (Scenario 1-7)		2.20E-04	2.20E-04	1.10E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAX	No spray damage from large leak in Battery Room A or B		5.00E-01	5.00E-01	
	IFMPABTPMP	Battery Room Sump Pump A fails to start		1.00E-02	1.00E-02	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
13	FLOBR1A1	Flood in Zone BR1A (Scenario 1-7)		2.20E-04	2.20E-04	1.01E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAX	No spray damage from large leak in Battery Room A or B		5.00E-01	5.00E-01	
	IFHFDBRISLS	Failure to isolate large SW leak in Battery Room (13 min avail; no CR cue)		9.20E-01	9.20E-01	
	IFMPABTPMP	Battery Room Sump Pump A fails to start		1.00E-02	1.00E-02	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
14	FLOBR1B1	Flood in Zone BR1B (Scenario 1-7)		2.20E-04	2.20E-04	1.01E-07
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAY	Spray from large SW leak in battery room disables contents		5.00E-01	5.00E-01	
	IFHFDBRISLS	Failure to isolate large SW leak in Battery Room (13 min avail; no CR cue)		9.20E-01	9.20E-01	
	IFMPABTPMP	Battery Room Sump Pump A fails to start		1.00E-02	1.00E-02	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
15	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	8.45E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00515	Motor-Operated Valve 515 Is Closed Due to PORV Leakage		3.26E-02	3.26E-02	
	RCRYT00434	Pressurizer Safety Valve PCV-434 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
16	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	8.45E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00515	Motor-Operated Valve 515 Is Closed Due to PORV Leakage		3.26E-02	3.26E-02	
	RCRYT00435	Pressurizer Safety Valve PCV-435 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
17	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	8.45E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00516	Motor-Operated Valve 516 Is Closed Due To PORV Leakage		3.26E-02	3.26E-02	
	RCRYT00434	Pressurizer Safety Valve PCV-434 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	

TABLE 9-7
Cutsets with Description Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
18	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	8.45E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00516	Motor-Operated Valve 516 Is Closed Due To PORV Leakage		3.26E-02	3.26E-02	
	RCRYT00435	Pressurizer Safety Valve PCV-435 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
19	FL000AB3	Small internal flood in zone ABB / ABM or ABO		1.13E-02	1.13E-02	5.73E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ABFL-3A	Flood State ABFL-3A		1.00E+00	1.00E+00	
	ABFL-SDIVA	Aux Bldg Flood--One electrical division disabled by small flood		1.00E-01	1.00E-01	
	ACMVMCC01C	480 VAC Motor Control Center MCCC Faults		5.07E-05	5.07E-05	
	ACTRAINB	Failure of Train B (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
20	FL000AB5	Large internal flood in ABM that damages equipment in ABM as well as ABB		1.47E-03	1.47E-03	5.48E-08
	ABFL-5	Flood State ABFL-5		1.00E+00	1.00E+00	
	ABFL-DIVA	Aux Bldg Flood--Bus 14 Disabled by Spray		1.00E-01	1.00E-01	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCRYT00434	Pressurizer Safety Valve PCV-434 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
21	FL000AB5	Large internal flood in ABM that damages equipment in ABM as well as ABB		1.47E-03	1.47E-03	5.48E-08
	ABFL-5	Flood State ABFL-5		1.00E+00	1.00E+00	
	ABFL-DIVA	Aux Bldg Flood--Bus 14 Disabled by Spray		1.00E-01	1.00E-01	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCRYT00435	Pressurizer Safety Valve PCV-435 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
22	FL000AB7	Large internal flood in ABO that that damages equipment in ABO as well as ABB		2.21E-03	2.21E-03	5.34E-08
	ABFL-7	Flood State ABFL-7		1.00E+00	1.00E+00	
	ABFL-DIVB	Aux Bldg Flood--Bus 16 Disabled by Spray		1.00E-01	1.00E-01	
	ACTRAINB	Failure of Train B (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage		9.67E-01	9.67E-01	
	RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
23	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	5.03E-08
	ACAA0TDAFW	Offsite power recovered within 1 hour (1 - 0.355)		6.45E-01	6.45E-01	
	ACLOPNOSI2	CORRECTION FACTOR FOR NO SI CONDITION		1.21E-01	1.21E-01	
	ACLOPRTALL	Loss of All Off-Site Power Following Reactor Trip		1.00E-02	1.00E-02	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	ACTRAINB	Failure of Train B (tagging event)		1.00E+00	1.00E+00	
	AFAA1TDAFW	TDAFW Pump operates successfully		1.00E+00	1.00E+00	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	SBO	STATION BLACKOUT SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
24	FL000AB3	Small internal flood in zone ABB / ABM or ABO		1.13E-02	1.13E-02	4.02E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ABFL-3A	Flood State ABFL-3A		1.00E+00	1.00E+00	
	ABFL-SDIVA	Aux Bldg Flood--One electrical division disabled by small flood		1.00E-01	1.00E-01	
	ACTRAINB	Failure of Train B (tagging event)		1.00E+00	1.00E+00	
	DCMMMAIN1A	Failure of Circuit E14 (To Main DC Distribution Panel 1A)		3.56E-05	3.56E-05	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
25	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	3.58E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	MSCCCSGBLO	Common Cause Failure of Steam Generator Blowdown AOVs to Close		5.56E-04	5.56E-04	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
26	FL000AB5	Large internal flood in ABM that damages equipment in ABM as well as ABB		1.47E-03	1.47E-03	3.56E-08
	ABFL-5	Flood State ABFL-5		1.00E+00	1.00E+00	
	ABFL-DIVA	Aux Bldg Flood--Bus 14 Disabled by Spray		1.00E-01	1.00E-01	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage		9.67E-01	9.67E-01	
	RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
27	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	3.18E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFTMTDAFWA	TDAFW Pump Train injection line to S/G A out-of-service for maintenance		2.22E-02	2.22E-02	
	AFTMTDAFWB	TDAFW Pump Train injection line to S/G B out-of-service for maintenance		2.22E-02	2.22E-02	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
28	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	3.12E-08
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage		9.67E-01	9.67E-01	
	RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
29	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	3.12E-08
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage		9.67E-01	9.67E-01	
	RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
30	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	3.07E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFMMXXCSTS	Failure of Condensate Storage Tanks		4.76E-04	4.76E-04	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
31	FL000IB1	Large internal flood in intermediate building		2.94E-03	2.94E-03	2.73E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFHFDSAFWX	OPERATORS FAIL TO CORRECTLY ALIGN SAFW		5.19E-03	5.19E-03	
	IBFL-1	Flood State IBFL-1		1.00E+00	1.00E+00	
	IFHFDIBISOL	Failure to Isolate Intermediate Bldg Flood Prior to Damage of all IB Equipment		1.00E-01	1.00E-01	
	MFHFDMF100	Operator Fails To Reestablish Main Feedwater Flow		1.20E-02	1.20E-02	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	HFDCORREC3				1.49E+00	
32	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	2.41E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFTMOTDAFW	TDAFW Pump Train out-of-service for maintenance		2.08E-02	2.08E-02	
	IFHFDSSISOL	Failure to Isolate Small SH Flood		1.00E-03	1.00E-03	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-SM	Small Flood in SH		9.00E-01	9.00E-01	
33	FL000RR1	Flood in Zone RR (Scenario 1 and 2)		4.40E-04	4.40E-04	2.01E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ACMMCC01D	480 VAC Motor Control Center MCCD Faults		5.07E-05	5.07E-05	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	DIVAFL	Flood State DIVAFL		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RRFL-SM	Relay Room Small Flood		9.00E-01	9.00E-01	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
34	FLOBR1A1	Flood in Zone BR1A (Scenario 1-7)		2.20E-04	2.20E-04	1.98E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-SM	Small SW Leak in Battery Room		9.00E-01	9.00E-01	
	IFBRSSPRAY	Spray from small SW leak in battery room disables contents		1.00E-01	1.00E-01	
	IFHFDBRISOLS	Failure to isolate small SW leak in battery room prior to disabling both batte		1.00E-03	1.00E-03	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
35	FL000RC1	Internal flood in reactor containment		4.13E-02	4.13E-02	1.88E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCFL	Flood State RCFL		1.00E+00	1.00E+00	
	RCMM00SRVS	Either Pressurizer Safety Valve Fails to Open		2.80E-04	2.80E-04	
	RCMVD00515	Motor-Operated Valve 515 Is Closed Due to PORV Leakage		3.26E-02	3.26E-02	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
36	FL000RC1	Internal flood in reactor containment		4.13E-02	4.13E-02	1.88E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCFL	Flood State RCFL		1.00E+00	1.00E+00	
	RCMM00SRVS	Either Pressurizer Safety Valve Fails to Open		2.80E-04	2.80E-04	
	RCMVD00516	Motor-Operated Valve 516 Is Closed Due To PORV Leakage		3.26E-02	3.26E-02	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
37	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.87E-08
	ABFL-2	Flood State ABFL-2		1.00E+00	1.00E+00	
	ABFL-CHG	Aux Bldg Flood is sufficiently large to fill ABB to critical height to disable		1.00E-01g	1.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage		9.67E-01	9.67E-01	
	RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
38	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.87E-08
	ABFL-2	Flood State ABFL-2		1.00E+00	1.00E+00	
	ABFL-CHG	Aux Bldg Flood is sufficiently large to fill ABB to critical height to disable		1.00E-01g	1.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage		9.67E-01	9.67E-01	
	RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
39	FL000AB3	Small internal flood in zone ABB / ABM or ABO		1.13E-02	1.13E-02	1.59E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ABFL-3B	Flood State ABFL-3B		1.00E+00	1.00E+00	
	AFTM0TDAFW	TDAFW Pump Train out-of-service for maintenance		2.08E-02	2.08E-02	
	CABFL-SDIVA	Aux Bldg Flood--Reactor trip caused by small flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SW173FX	NO UNDERVOLTAGE CONDITIONS ON BUS 17		1.00E+00	1.00E+00	
	SWMM0SWPAR	FAILURES OF SERVICE WATER PUMP A TO RUN		7.50E-05	7.50E-05	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
40	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	1.47E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	AFMM0TDAFW	Failure of TDAFW pump train components		1.27E-02	1.27E-02	
	IFHFDSSISOL	Failure to Isolate Small SH Flood		1.00E-03	1.00E-03	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-SM	Small Flood in SH		9.00E-01	9.00E-01	
41	FL000RR1	Flood in Zone RR (Scenario 1 and 2)		4.40E-04	4.40E-04	1.41E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ACTRAINA	Failure of AC Train A (tagging event)		1.00E+00	1.00E+00	
	DCMMMAIN1B	Failure of Circuit E76 (To Main DC Distribution Panel B)		3.56E-05	3.56E-05	
	DIVAFL	Flood State DIVAFL		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RRFL-SM	Relay Room Small Flood		9.00E-01	9.00E-01	
42	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	1.29E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	MSXVK3570E	Manual valve 3570E transfers closed	1.79E-07	1.12E+03	2.00E-04	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
43	FL000TB3	Steam flooding event in turbine building		6.32E-03	6.32E-03	1.28E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	LOSPFL	Flood State LOSPFL		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCMM00SRVS	Either Pressurizer Safety Valve Fails to Open		2.80E-04	2.80E-04	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	ST-LOSP	Steam Disables Buses 12A/12B		2.90E-01	2.90E-01	
	TBFL-TB2	Steam Flood Occurs in TB-2		5.00E-01	5.00E-01	
44	FL000SH1	Internal flood in screen house		1.29E-03	1.29E-03	1.16E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	IFHFDSLISOL	Failure to Isolate Large SH Flood		5.00E-01	5.00E-01	
	MSCCPSGMOV	Common cause failure of MOVs 3504A and 3505A to open		1.80E-04	1.80E-04	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	SHFL-1	Flood State SHFL-1		1.00E+00	1.00E+00	
	SHFL-LG	Large Flood in SH		1.00E-01	1.00E-01	
45	FL000AB7	Large internal flood in ABO that that damages equipment in ABO as well as ABB		2.21E-03	2.21E-03	1.12E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	ABFL-7	Flood State ABFL-7		1.00E+00	1.00E+00	
	ABFL-DIVB	Aux Bldg Flood--Bus 16 Disabled by Spray		1.00E-01	1.00E-01	
	ACMMMCC01C	480 VAC Motor Control Center MCCC Faults		5.07E-05	5.07E-05	
	ACTRAINB	Failure of Train B (tagging event)		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
46	FL00TB12	Small flood in turbine building (zone TB-1 / TB-2 or TB-3)		1.17E-02	1.17E-02	1.11E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	LOMFWFL	Flood State LOMFWFL		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFD01BAF	Operators Fail To Implement Feed And Bleed		5.30E-02	5.30E-02	
	RCHFDCD0SS	Operator Fails to Cooldown to RHR After SI Fails (INJECTION OR RECIRC) - SSLOC		3.70E-02	3.70E-02	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage		9.67E-01	9.67E-01	
	RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
47	FL00TB12	Small flood in turbine building (zone TB-1 / TB-2 or TB-3)		1.17E-02	1.17E-02	1.11E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	LOMFWFL	Flood State LOMFWFL		1.00E+00	1.00E+00	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCHFD01BAF	Operators Fail To Implement Feed And Bleed		5.30E-02	5.30E-02	
	RCHFDCD0SS	Operator Fails to Cooldown to RHR After SI Fails (INJECTION OR RECIRC) - SSLOC		3.70E-02	3.70E-02	
	RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Mi		1.00E-01	1.00E-01	
	RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage		9.67E-01	9.67E-01	
	RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	5.00E-03	1.00E+00	5.00E-03	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	
48	FL0BR1B1	Flood in Zone BR1B (Scenario 1-7)		2.20E-04	2.20E-04	1.10E-08
	AAAATRANSIN	Transient Initiating Event Which Donot Result in SI Conditions <Log Flag>		1.00E+00	1.00E+00	
	BRFL	Flood State BRFL		1.00E+00	1.00E+00	
	BRFL-LG	Large SW Leak in Battery Room		1.00E-01	1.00E-01	
	IFBRLSPRAX	No spray damage from large leak in Battery Room A or B		5.00E-01	5.00E-01	
	IFMPFBTPMP	Battery Room Sump Pump A fails to run (generic value x 24 hrs)		1.00E-03	1.00E-03	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
49	FL000AB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.10E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCLYD0431K	CONTROLLER PC-431K FAILS TO RESPOND	6.42E-07	6.59E+03	4.23E-03	
	RCRYT00434	Pressurizer Safety Valve PCV-434 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	

TABLE 9-7
Cutsets with Descriptions Report
UNTITLED = 3.38E-05

#	Inputs	Description	Rate	Exposure	Event Prob	Probability
50	FLOOOAB1	Large internal flood in zone ABB		7.73E-03	7.73E-03	1.10E-08
	ABFL-1	Flood State ABFL-1		1.00E+00	1.00E+00	
	CABFL-CHG	Charging not disabled during Aux Bldg Flood		9.00E-01	9.00E-01	
	NOSBO	NO STATION BLACKOUT TAGGING EVENT		1.00E+00	1.00E+00	
	RCLYD0431K	CONTROLLER PC-431K FAILS TO RESPOND	6.42E-07	6.59E+03	4.23E-03	
	RCRYT00435	Pressurizer Safety Valve PCV-435 Fails To Reclose Following Steam	7.45E-03	1.00E+00	7.45E-03	
	RXTRIPLL	PERCENTAGE OF RX TRIP DUE TO LOSS OF ELECTRIC LOAD		5.00E-02	5.00E-02	
	SLO	SMALL LOCA SEQUENCE TAGGING EVENT		1.00E+00	1.00E+00	
	TLSTRANS	TAGGING EVENT TO IDENTIFY TL_S_TRANS SEQUENCES		1.00E+00	1.00E+00	

Report Summary:
Filename: C:\CAFTA-W\QUANT\FLOOD\FLOOD.CUT
Print date: 2/22/1999 12:49 PM
Not sorted

TABLE 9-8
Initiating Events

NAME	DESCRIPTION	F-V	RAW
FL0BR1A1	Flood in Zone BR1A (Scenario 1-7)	3.86E-01	1.74E+0
FL0BR1B1	Flood in Zone BR1B (Scenario 1-7)	3.07E-01	1.39E+0
FL000SH1	Internal flood in screen house	9.34E-02	73.23
FL000TB1	Very large flood in turbine building (circulating water leak)	8.30E-02	23.91
FL000RR1	Flood in Zone RR (Scenario 1 and 2)	6.21E-02	141.77
FL000AB1	Large internal flood in zone ABB	3.46E-02	5.44
FL000AB3	Small internal flood in zone ABB / ABM or ABO	5.93E-03	1.52
FL000TB3	Steam flooding event in turbine building	5.76E-03	1.91
FL000AB5	Large internal flood in ABM that damages equipment in ABM as well as ABB	5.37E-03	4.64
FL000AB7	Large internal flood in ABO that damages equipment in ABO as well as ABB	3.61E-03	2.63
FL000IB1	Large internal flood in intermediate building	2.94E-03	2
FL000RC1	Internal flood in reactor containment	2.66E-03	1.06
FL000TB7	Large flood originating in turbine building mezzanine (zone TB-2)	2.61E-03	1.58
FL00CHG1	Internal flood in charging pump room	1.83E-03	1.62
FL00TB12	Small flood in turbine building (zone TB-1 / TB-2 or TB-3)	1.74E-03	1.15
FL000TB6	Large flood originating in TB-1	6.04E-04	1.13
FL000IB3	Small internal flood in intermediate building	4.00E-04	1.1
FL00SAF1	Internal flood in standby auxiliary feedwater pump room (zone SAF)	1.86E-04	1.06
FL000AB4	RWST rupture in Auxiliary Building	8.20E-05	10.32
FL000SB1	Flood in SB	4.66E-05	1.09
FL0DG1B1	Internal flood originating in diesel generator room 1B (zone EDG1B)	3.98E-05	1.06
FL00AHR1	Internal flood in zone AHR	3.52E-05	1.03
FL000TO1	Flood in Turbine Oil Storage Room	1.44E-05	1.03
FL0DG1A1	Internal flood originating in diesel generator room 1A (zone EDG1A)	9.69E-06	1.02
FL00AVT1	Internal flood in AVT	7.31E-06	1.06
FL000H21	Internal flood in zone H2	7.22E-06	1.03

TABLE 9-9
Human Errors

NAME	DESCRIPTION	F-V	RAW
IFHFDSAFWY	Failure to control MDAFW locally	2.91E-02	1.03
RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Min	1.74E-02	1.16
AFHFDALTTD	OPERATORS FAIL TO PROVIDE COOLING TO TDAFW LUBE OIL FROM DIESEL FIRE	1.33E-02	2.98
IFHFDAFWSW	Failure to locally align SW to TDAFW and SAFW suction following CR evacuation for floods	1.31E-02	2.29
IFHFDAFW1A	Failure to locally start and control AFW pump 1A (CR evacuation - flood)	7.03E-03	1.01
IFHFDEVACR	Operators fail to use ER-FIRE.1 following relay room flood that requires Ctrl Room	6.52E-03	2.3
IFHFDAFWXX	HCO fails to locally open MOV 3996 and MOV 3505A per Attach 3 of ER-FIRE	4.22E-03	1.84
RCHFD01BAF	Operators Fail To Implement Feed And Bleed	3.21E-03	1.06
ACAA0TDAFW	Offsite power recovered within 1 hour (1 - 0.355)	2.93E-03	1
RCHFDCD0SS	Operator Fails to Cooldown to RHR After SI Fails (INJECTION OR RECIRC) - SSLOCA	2.25E-03	1.06
ACAADLOSP1	Failure to Restore Offsite Power Within 1 Hour	1.68E-03	1
ACAALOSP10	Failure to Restore Offsite Power Within 10 Hours	1.66E-03	1.06
AFHFDSAFWX	OPERATORS FAIL TO CORRECTLY ALIGN SAFW	1.53E-03	1.29
MFHFDMF100	Operator Fails To Reestablish Main Feedwater Flow	1.36E-03	1.11
IFHFDDCPWR	Failure to align TSC DC supply to Battery B for TDAFW pump	8.29E-04	1.83
RCHFDRHRSB	Ops Fails to Rapidly Depressurize to RHR (or Use AFW Long-Term)	5.88E-04	1.12
AFHFDTDAFW	OPERATOR FAIL TO MANUALLY OPEN STEAM VALVES TO TDAFW PUMP (NO FIRE)	5.12E-04	1
IFHFDLOSP1	Failure to reconnect offsite power during CR evac if DG unavailable	4.78E-04	1
IFHFDDGAXZ	CO fails to strip Bus 14 loads and manually close breaker for DG A/SW A per Att. to ER-FIRE	4.00E-04	1.08
IFHFDACPWR	Failure to align TSC diesel to operate shroud fans	3.52E-04	1.03
AFHFDSUPPL	OPERATORS FAIL TO SUPPLY ALTERNATE SOURCES OF WATER TO AFW	2.08E-04	1.21
RRHFDTHROT	OPERATORS FAIL TO THROTTLE RHR FLOW WHEN REQUIRED	1.32E-04	1
AFHFLSAFWA	Failure to restore SAFW Pump Train 1C to service post test/maint	1.03E-04	1.03
RRHFDRECRC-S	Operator fails to correctly shift the RHR system to recirculation and ISOL CS	6.77E-05	1.06
CVHFD00371	OPERATORS FAIL TO MANUALLY ISOLATE AOV 371 (LETDOWN LINE)	6.17E-05	1
RRHFDSUCTN	OPS FAILS TO MANUALLY OPEN RHR SUCTION VALVES	5.94E-05	1
RCHFD00MRI	OPERATORS FAIL TO MANUALLY INSERT RODS	4.57E-05	1
AFHFDBLOWD	Operators fail to isolate SG blowdown manually	3.41E-05	
SRHFDRECRC	OPERATORS FAIL TO SHIFT SI SYSTEM TO RECIRCULATION	3.30E-05	1.03
IFHFDDGAXY	CRF fails to strip Bus 18 loads and manually close breaker for DG A per Att. 1 to ER-FIRE	2.99E-05	1.01
ACAABU1516	Bus-Ties for Bus 15 and 16 closed	2.86E-05	1
RRHFDRECRC-	Operator fails to correctly shift the RHR system to recirculation and ISOL CS	4.30E-06	1

TABLE 9-10
Test and Maintenance Events

NAME	DESCRIPTION	F-V	RAW
AFTM0TDAFW	TDAFW Pump Train out-of-service for maintenance	6.26E-02	3.95
AFTMTDAFWB	TDAFW Pump Train injection line to S/G B out-of-service for maintenance	1.80E-03	1.08
AFTMTDAFWA	TDAFW Pump Train injection line to S/G A out-of-service for maintenance	1.78E-03	1.08
DGTM00001A	DIESEL GENERATOR KDG01A unavailable due to testing or maintenance	1.66E-03	1.06
DGTM00001B	DIESEL GENERATOR KDG01B unavailable due to testing or maintenance	1.62E-03	1.06
AFTMSAFSGA	SAFW TRAIN C TO S/G A O.O.S. DUE TO T/M	1.21E-03	1.04
RHTM00000B	TRAIN B OOS FOR MAINTENANCE	7.16E-04	1.06
AFTMMAFSGA	MOTOR DRIVEN AFW TRAIN A TO A S/G O.O.S DUE TO T/M	3.62E-04	1.01
RHTM00000A	TRAIN A OOS FOR MAINTENANCE	3.34E-04	1.03
AFTMSAFSGB	SAFW TRAIN D TO S/G B O.O.S. DUE TO T/M	2.07E-04	1.01
HVTMSAFW_B	B SAFW ROOM HVAC STRING IN MAINTENANCE	8.43E-05	1
HVTMSAFW_A	A SAFW ROOM HVAC STRING IN MAINTENANCE	7.30E-05	1
HVTMACF05B	CONTROL ROD SHROUD FAN B IN TEST OR MAINTENANCE	4.51E-05	1.04
SWTM4616MT	SW Header Isolation MOV 4616 Is Unavailable Due To Maintenance	2.51E-05	1.03
CCTM_PUMPA	CCW PUMP A IS UNAVAILABLE DUE TO TESTING OR MAINTENANCE	7.76E-06	1
AFTMCONDPP	Condensate Transfer Pump out-of-service for test/maintenance	5.56E-06	1
AFHFLTDAFW	Failure to restore TDAFW pump train to service post test/maintenance	8.85E-03	3.94
AFHFL0AFWA	Failure to restore AFW Motor-Driven Pump Train 1A to service post test/maintenance	2.51E-05	1.01
AFHFLSAFWB	Failure to restore SAFW Pump Train 1D to service post test/maintenance	2.19E-05	1.01
AFHFLS5737	OPERATOR LEAVES SWITCH 1S1/5737 IN THE DEF. OR AUX. POSITION	1.71E-05	1.01
AFHFLS5738	OPERATOR LEAVES SWITCH 1S1/5738 IN THE DEF. OR AUX. POSITION	1.71E-05	1.01

TABLE 9-11
Modeling Assumptions

NAME	DESCRIPTION	F-V	RAW
BRFL-LG	Large SW Leak in Battery Room	6.92E-01	7.22
IFBRLSPRAX	No spray damage from large leak in Battery Room A or B	6.07E-01	1.61
IFHFDBRISLL	Failure to isolate large SW Leak in Battery Room (sump suceeds)	6.00E-01	1.05
SHFL-LG	Screenhouse Large Flood	9.34E-02	1
IFHFDSLISOL	Failure to Isolate Large SH Flood	9.17E-02	1.09
IFHFDCIRCW	Operators fail to trip circ water pumps upon indication of flood with no auto trip	8.24E-02	1.74
IFBRLSPRAY	Spray from large SW leak in battery room disables contents	8.50E-02	1.08
IFHFDBRISOL	Failure to Isolate Large SW Leak in Battery Room	8.15E-02	1.24
RRFL-LG	Relay Room Large Flood	6.06E-02	1.55
CABFL-CHG	Charging not disabled during Aux Bldg Flood	3.12E-02	1
IFHFDBRISLS	Failure to isolate large SW leak in Battery Room (sump fails)	6.69E-03	1
ABFL-DIVA	Aux Bldg Flood--Bus 14 Disabled by Spray	5.37E-03	1.05
TBFL-TB2	Steam Flood Occurs in TB-2	5.20E-03	1.01
ST-LOSP	Steam Disables Buses 12A/12B	4.94E-03	1.01
ABFL-SDIVA	Aux Bldg Flood--One electrical division disabled by small flood	3.49E-03	1.03
ABFL-CHG	Aux Bldg Flood is sufficiently large to fill ABB to critical height to disable charging	3.45E-03	1.03
CTB-IS-LG	Large Turbine Building Flood is Isolated	3.21E-03	1
ABFL-DIVB	Aux Bldg Flood--Bus 16 Disabled by Spray	3.08E-03	1.03
IFHFDIBISOL	Failure to Isolate Intermediate Bldg Flood Prior to Damage of all IB Equipment	2.69E-03	1.02
CABFL-SDIVA	Aux Bldg Flood--Reactor trip caused by small flood	2.45E-03	1
SP-LOSP	Spray disables buses 12A / 12B	2.08E-03	1.02
IFHFDSSISOL	Failure to Isolate Small SH Flood	1.63E-03	2.63
RRFL-SM	Relay Room Small Flood	1.53E-03	1
BRFL-SM	Small SW Leak in Battery Room	1.40E-03	1
IFBRSSPRAY	Spray from small SW leak in battery room disables contents	1.02E-03	1.01
IFHFDBRISOLS	Failure to isolate small SW leak in battery room prior to disabling both battery rooms	5.93E-04	1.59
TBFL-TB1	Steam Flood Occurs in TB-1	5.52E-04	1
SP-TB	Spray does not disable buses 12A / 12B	5.32E-04	1
ABFL-CCW	Aux Bldg Flood--CCW Disabled by Spray	5.29E-04	1.05
IFHFDBRISNS	Failure to isolate small SW leak prior to disabling both battery rooms	3.87E-04	1.13
ST-LOMFW	Steam Causes Loss of Main Feedwater	2.64E-04	1
CIBFL-ISOL	IB flood isolated prior to significant accumulation	2.52E-04	1
IFAABRISOX	Large SW Leak in Battery Rooms isol prior to propagation to second battery room	1.70E-04	1
IFHFDABISOL	Failure Isolate Aux Bldg Flood Prior to Submergence of Charging System	6.21E-05	1
EDGFL-TRIP	EDG Flood Causes Plant Trip	4.95E-05	1
IFHFDTBISOL	Failure to Isolate Large TB Flood	1.09E-05	1.11

TABLE 9-12
System Importances

NAME	DESCRIPTION	F-V	RAW
AC	AC Power	8.68E-02	1.30E+03
AF	Auxiliary Feedwater	4.37E-02	2.66E+01
CC	Component Cooling Water	8.80E-04	5.15E+00
CV	Charging	0	1.00E+00
DC	125 VDC DC Power	2.93E-03	2.43E+02
DG	Diesel Generator	1.78E-02	4.54E+01
ES	ESFAS	0	5.88E+00
HV	HVAC	2.93E-04	5.20E+00
IA	Instrument Air	8.80E-04	3.44E+00
IB	120 VAC Instrument Bus	5.86E-04	2.35E+00
IF	Control Bldg Sump Pumps	1.05E-02	2.89E+00
MS	Main Steam	3.81E-03	1.40E+01
RC	Reactor Coolant System	5.51E-02	2.11E+03
RH	Residual Heat Removal	8.80E-04	3.75E+00
SI	Safety Injection	0	1.04E+00
SW	Service Water	2.93E-03	5.25E+02
Offsite	Offsite Power System	1.06E-02	2.36E+00
RTS	Reactor Trip System	0.00E+00	1.69E+03

TABLE 9-13

Component Importances

NAME	DESCRIPTION	F-V	RAW
ACCBN52CWA	AC BREAKER 52/CWP1A FAILS TO OPEN	4.12E-02	11.65
ACCBN52CWB	AC BREAKER 52/CWP1B FAILS TO OPEN	4.12E-02	11.65
AFMM0TDAFW	Failure of TDAFW pump train components	3.78E-02	3.94
RCRYT00434	Pressurizer Safety Valve PCV-434 Fails To Reclose Following Steam Relief	1.47E-02	2.96
RCRYT00435	Pressurizer Safety Valve PCV-435 Fails To Reclose Following Steam Relief	1.47E-02	2.96
RCMVD00515N	Motor-Operated Valve 515 Is Not Closed Due to PORV Leakage	1.13E-02	1
RCRZT0431C	PORV PCV-431C Fails To Reseat After Steam Relief	1.13E-02	3.24
RCMVD00516N	Motor-Operated Valve 516 Is Not Closed Due To PORV Leakage	1.06E-02	1
RCRZT00430	PORV PCV-430 Fails To Reseat After Steam Relief	1.06E-02	3.1
IFMPABTPMP	Battery Room Sump Pump A fails to start	9.61E-03	1.95
RCMVD00516	Motor-Operated Valve 516 Is Closed Due To PORV Leakage	7.17E-03	1.21
RCMVD00515	Motor-Operated Valve 515 Is Closed Due to PORV Leakage	7.16E-03	1.21
HVAA>80DEG	OUTSIDE AIR TEMP IS GREATER THAN OR EQUAL TO 80 F	5.42E-03	1.03
ACLOPNOSI2	CORRECTION FACTOR FOR NO SI CONDITION	5.13E-03	1.04
RCMM00SRVS	Either Pressurizer Safety Valve Fails to Open	4.67E-03	17.67
ACLOPRTALL	Loss of All Off-Site Power Following Reactor Trip	4.44E-03	1.44
AFAA1TDAFW	TDAFW Pump operates successfully	2.93E-03	1
ACMMMCC01C	480 VAC Motor Control Center MCCC Faults	2.29E-03	46.14
SWMM0SWPAR	FAILURES OF SERVICE WATER PUMP A TO RUN	1.96E-03	27.19
MSCCCSGBLO	Common Cause Failure of Steam Generator Blowdown AOVs to Close	1.88E-03	4.38
CVAACHPMPA.	CHARGING PUMP A RUNNING	1.63E-03	1
DCMMMAIN1A	Failure of Circuit E14 (To Main DC Distribution Panel 1A)	1.52E-03	43.65
DGDGF0001A	DIESEL GENERATOR KDG01A FAILS TO RUN	1.29E-03	1.04
DGDGF0001B	DIESEL GENERATOR KDG01B FAILS TO RUN	1.23E-03	1.04
DGDGFTSCXX	TSC Diesel Generator fails to run	1.11E-03	1.04
ACMMMCC01D	480 VAC Motor Control Center MCCD Faults	1.03E-03	21.38
ACLOPNOSI1	CORRECTION FACTOR FOR NO SI CONDITION	1.00E-03	1
ACLOPRT751	Loss of Offsite Circuit 751 Following Reactor Trip	1.00E-03	1.08
IFMPFBTPMP	Battery Room Sump Pump A fails to run (generic value x 24 hrs)	9.61E-04	1.96
AFMMXXCSTS	Failure of Condensate Storage Tanks	9.48E-04	2.99
RCLYD0431K	CONTROLLER PC-431K FAILS TO RESPOND	9.01E-04	1.21
AFMMSAFWPC	Failure of SAFW Pump 1C train	8.81E-04	1.04
ACCBD2BTBB	4160 VAC Bus 11B Bus 12B Tie Breaker 52/BTB-B (BUS11B/21) Fails To Close	8.30E-04	1.21
ACCBD5211B	4160 VAC Bus 11B Feeder Circuit Breaker 52/11B (BUS11B/22) Fails to Open	8.30E-04	1.21
CVAACHPMPB	CHARGING PUMP B RUNNING	8.26E-04	1
CVAACHPMPC	CHARGING PUMP C RUNNING	8.26E-04	1
DGCC000RUN	DIESEL GENERATORS FAIL TO RUN (COMMON CAUSE)	7.93E-04	1.34
DCMMMAIN1B	Failure of Circuit E76 (To Main DC Distribution Panel B)	7.16E-04	21.12
DGCC0START	DIESEL GENERATORS FAIL TO START (COMMON CAUSE)	7.14E-04	2.98
TLCCFMATWS	Mechanical Scram Failure Probability	7.02E-04	389.07
ACLOPRT767	Loss of Offsite Circuit 767 Following Reactor Trip	6.91E-04	1.07
RCHFL0431K	CONTROLLER PC-431K MISCALIBRATED	6.33E-04	1.21
RCHFLC429B	BISTABLE PC-429B MISCALIBRATED	6.33E-04	1.21
RCHFLC430B	ALARM BISTABLE PC-430B MISCALIBRATED	6.33E-04	1.21
RCHFLC431B	ALARM PC-431B MISCALIBRATED	6.33E-04	1.21
RCHFLC431F	ALARM BISTABLE PC-431F MISCALIBRATED	6.33E-04	1.21
RCHFLPT429	PRESSURE TRANSMITTER PT-429 MISCALIBRATED	6.33E-04	1.21
RCHFLPT430	PRESSURE TRANSMITTER PT-430 MISCALIBRATED	6.33E-04	1.21
RCHFLPT431	PRESSURE TRANSMITTER PT-431 MISCALIBRATED	6.33E-04	1.21
RCHFLPT449	PRESSURE TRANSMITTER PT-449 MISCALIBRATED	6.33E-04	1.21
MSXVK3570E	Manual valve 3570E transfers closed	5.55E-04	3.78

TABLE 9-13
Component Importances

NAME	DESCRIPTION	F-V	RAW
SWMVP9629A	Motor operated valve 9629A fails to open	5.23E-04	1.04
AFCCAFWSTR	Common cause failure of all 3 AFW pumps (PAF01A, PAF01B, PAF03) to start	4.59E-04	4.23
DGMMASTART	FAILURES OF D/G A TO START	4.19E-04	1.08
RHCCPUMPAB	COMMON CAUSE FAILURE OF RHR PUMPS A AND B TO START	4.19E-04	2.02
DGMMBSTART	FAILURES OF D/G B TO START	4.16E-04	1.08
MSCCPSGMOV	Common cause failure of MOVs 3504A and 3505A to open	3.55E-04	2.97
CCCC738A/B	COMMON CAUSE FAILURE OF MOV'S 738A AND 738B TO OPEN	3.45E-04	2.02
DCMMCHG01B	Failure of Battery Charger B (BYCB)	3.09E-04	1.83
DGMMBRKR16	FAILURES OF DG B SUPPLY BREAKER TO BUS 16 TO CLOSE	3.09E-04	1.08
RRCC850A/B	MOVS 850A/B FAIL TO OPEN <COMMON CAUSE EVENT>	3.01E-04	1.98
DGMMBRKR14	FAILURES OF DG A SUPPLY BREAKER TO BUS 14 TO CLOSE	2.88E-04	1.07
TLCCFBRKRF	Electrical Scram Failure Probability (Breakers Only)	2.84E-04	22.83
DGMM0AAF04	FAILURES OF THE FUEL SUPPLY TO D/G A	2.82E-04	1.07
IAXVK7067F	MANUAL VALVE 7067F TRANSFERS CLOSED	2.56E-04	1.2
IAXVK7067L	MANUAL VALVE 7067L TRANSFERS CLOSED	2.56E-04	1.2
MSAVX05738	AOV 5738 Fails to Close	2.50E-04	1.09
CCMM00738B	MOV 738B FAILS TO OPEN	2.37E-04	1.05
AFXVK04015	Manual valve 4015 transfers closed	2.32E-04	2.95
SWCCPUMPSR	Common Cause Failure Of Service Water Pumps To Run	2.32E-04	306.44
MSAVX05737	AOV 5737 Fails to Close	2.18E-04	1.07
DGCCPMA2AB	FUEL OIL PUMPS PDG02A/02B FAIL TO START (COMMON CAUSE)	2.16E-04	2.83
RCXVK00510	Manual valve 510 to pressure transmitter PT-430 transfers closed	2.11E-04	1.19
RCXVK00512	Manual valve 512 transfers closed (common to PT-449 and PT-431)	2.11E-04	1.19
RCXVK00533	Manual valve 533 to pressure transmitter PT-429 transfers closed	2.11E-04	1.19
RCXVK12236	Manual valve 12236 to pressure transmitter PT-429 transfers closed	2.11E-04	1.19
RCXVK12237	Manual valve 12237 to pressure transmitter PT-430 transfers closed	2.11E-04	1.19
RCXVK12238	Manual valve 12238 to pressure transmitter PT-431 transfers closed	2.11E-04	1.19
RCXVK12239	Manual valve 12239 to pressure transmitter PT-449 transfers closed	2.11E-04	1.19
RCXVK12425	Manual valve 12425 to pressure transmitter PT-430 transfers closed	2.11E-04	1.19
RCRZP00430	PORV PCV-430 FAILS TO OPEN	2.09E-04	1.19
RCRZP0431C	PORV PCV-431C FAILS TO OPEN	2.09E-04	1.19
RRMVQ00700	MOV 700 FAILS TO OPEN	2.08E-04	1.09
RRMVQ00701	MOV 701 FAILS TO OPEN	2.08E-04	1.09
AFCVP04014	Check valve 4014 fails to open	2.06E-04	2.95
AFMMSAFWPD	Failure of SAFW Pump 1D Train	1.97E-04	1.01
DGMM0FUELA	FAILURES OF THE FUEL SUPPLY TO D/G A	1.88E-04	1.03
SWCCPSWMVB	Common cause failure of MOVs 9629A and 9629B to open	1.77E-04	1.2
DGDGATSCXX	TSC Diesel Generator fails to START	1.76E-04	1.04
DGMM0FUELB	FAILURES OF FUEL TO D/G B	1.72E-04	1.03
RCMVP00515	MOTOR-OPERATED VALVE 515 FAILS TO OPEN	1.70E-04	1.07
RCMVP00516	MOTOR-OPERATED VALVE 516 FAILS TO OPEN	1.70E-04	1.07
MSCCARVAIR	COMMON CAUSE FAILURE OF AIR OPERATED ARVS	1.66E-04	1.12
IASVX05738	Solenoid Valve 5738S for AOV 5738 Fails to Deenergize	1.36E-04	1.08
CCHFL0780B	CCW THROTTLING VALVE 780B MISPOSITIONED	1.35E-04	1.04
IBMMINV01A	Instrument Bus A (IBPDPCBAR) Inverter INVTA Circuit Faults	1.29E-04	1.19
IBMMINV01C	Instrument Bus C (IBPDPCBCB) Inverter INVTB Circuit Faults	1.29E-04	1.19
IASVX05737	Solenoid Valve 5737S for AOV 5737 Fails to Deenergize	1.20E-04	1.07
CCMM00738A	MOV 738A FAILS TO OPEN	1.19E-04	1.03
AFMMSGTURA	Failure of TDAFW injection line to S/G A	1.16E-04	1.07
AFMMSGTURB	Failure of TDAFW injection line to S/G B	1.16E-04	1.07
RHMMAC01BA	RHR PUMP B (PAC01B) FAILS TO START	1.15E-04	1.04

TABLE 9-13
Component Importances

NAME	DESCRIPTION	F-V	RAW
HVCCDGSTRT	FAN UNIT FOR DG FAILS TO START (COMMON CAUSE)	1.11E-04	2.61
SWMVP9629B	Motor operated valve 9629B fails to open	1.09E-04	1.01
DCMMAUX00A	Failure of Circuit E53 (To Auxiliary Building DC Distribution Panel A)	1.08E-04	4.04
RCMM000515	ELECTRICAL FAILURES PREVENT MOVING MOV-515	1.02E-04	1.07
RCMM000516	ELECTRICAL FAILURES PREVENT MOVING MOV-516	1.02E-04	1.07
RRMM00850B	MOV 850A FAILS TO OPEN (RECIRCULATION)	1.02E-04	1.03
RCSWK1P430	HAND SWITCH 1/430 TRANSFERS TO CLOSED POSITION	9.90E-05	1.19
RCSWK1P431	HAND SWITCH 1/431C TRANSFERS TO CLOSED POSITION	9.90E-05	1.19
FSPXDAFWLP	AFW local indicating panel fails	9.89E-05	1.01
FSPXDIBELP	IBELIP Panel fails	9.89E-05	1.01
AFCCAFWRUN	Common cause failure of all 3 AFW pumps (PAF01A, PAF01B, PAF03) to run	9.10E-05	3.88
RRMM00850A	MOV 850A FAILS TO OPEN (RECIRCULATION)	9.08E-05	1.03
UVLCD0X116	Relay 27X1/16 driver (Heat Sink Assembly #1) fails to energize	7.85E-05	1.05
UVLCD16LB1	Bus 16 undervoltage control logic board #1 fails to generate a signal	7.85E-05	1.05
UVLCD16LB2	Bus 16 undervoltage control logic board #2 fails to generate a signal	7.85E-05	1.05
UVLCD16S#1	Bus 16 undervoltage solid state switch #1 fails to generate a signal	7.85E-05	1.05
UVLCD16S#2	Bus 16 undervoltage solid state switch #2 fails to generate a signal	7.85E-05	1.05
UVLCDBX116	Relay 27BX1/16 driver (Heat Sink Assembly #2) fails to energize	7.85E-05	1.05
UVLCD0X114	Relay 27X1/14 driver (Heat Sink Assembly #1) fails to energize	7.53E-05	1.05
UVLCD14LB1	Bus 14 undervoltage control logic board #1 fails to generate a signal	7.53E-05	1.05
UVLCD14LB2	Bus 14 undervoltage control logic board # 2 fails to generate a signal	7.53E-05	1.05
UVLCD14S#1	Bus 14 undervoltage solid state switch # 1 fails to generate a signal	7.53E-05	1.05
UVLCD14S#2	Bus 14 undervoltage solid state switch #2 fails to generate a signal	7.53E-05	1.05
UVLCDBX114	Relay 27BX1/14 driver (Heat Sink Assembly #2) fails to energize	7.53E-05	1.05
RCCC431A/B	COMMON CAUSE FAILURE OF PCV-431A AND PCV-431B	7.40E-05	1.19
MSMMN2BOTA	NITROGEN BOTTLES FAIL TO SUPPLY ARV 3411	6.61E-05	1
MSMMN2BOTB	NITROGEN BOTTLES FAIL TO SUPPLY ARV 3410	6.61E-05	1
CVAVX00371	AOV 371 FAILS TO CLOSE	6.17E-05	1
CCHFL0780A	CCW THROTTLING VALVE 780A MISPOSITIONED	5.63E-05	1.02
AFMMSGAINJ	Failure of AFW injection line to S/G A	5.28E-05	1.01
ACB2FBUS14	Local Fault On 480 VAC Bus 14	5.16E-05	3.74
DGCCCV5920	Common cause failure of fuel oil foot valves 5919 and 5920 to close	4.96E-05	2.38
DGCCCV5956	Common cause failure of fuel oil check valves 5955 and 5956 to close	4.96E-05	2.38
DCCC0BATTD	Batteries A/B No Output on Demand <Common Cause>	4.82E-05	41.5
RHMMAC01AA	RHR PUMP A (PAC01A) FAILS TO START	4.80E-05	1.02
ACMMMCC01K	480 VAC Motor Control Center MCCK Faults	4.69E-05	1.93
AFMMSGASAF	Failure of SAFW injection line to S/G A	3.92E-05	1.03
MFLID0460A	LI-460A (IBELIP) fails to respond	3.91E-05	1.76
MFLTD0460A	LT-460A fails to respond on demand	3.91E-05	1.76
DGCCPMF2AB	FUEL OIL PUMPS PDG02A/02B FAIL TO RUN (COMMON CAUSE)	3.85E-05	1.22
AFMMMDFP1A	Failure of AFW Motor-Driven AFW Pump Train A	3.57E-05	1.01
DCMMAB01AD	Failure of Circuit E63 (To Bus 14 - Normal)	3.57E-05	1.22
AFCCDMOVNB	Common cause failure of MOVs 9701A and 9701B to throttle flow	3.55E-05	1.14
IBMMDIST0AJ	120 VAC Distribution Panel A (IBPDPCBA) Faults	3.49E-05	1.17
IBMMDIST0BJ	120 VAC Distribution Panel B (IBPDPCBB) Faults	3.49E-05	1.17
IBMMDIST0CJ	120 VAC Distribution Panel C (IBPDPCBC) Faults	3.49E-05	1.17
IBMMDIST0D	120 VAC Distribution Panel D (IBPDPCBD) Faults	3.49E-05	1.17

TABLE 9-13
Component Importances

NAME	DESCRIPTION	F-V	RAW
AFMMSGBSTM	Failure of S/G B Main Steam components to TDAFW pump	3.42E-05	1.01
AFMMSGASTM	Failure of S/G A Main Steam components to TDAFW pump	3.33E-05	1.01
MSRVP03410	ARV 3410 FAILS TO OPEN (STANDBY)	3.33E-05	1
AFFID2015A	TDAFW flow indicator FI-2015A (IBELIP) fails to respond	3.30E-05	1.76
AFFTD2015A	FT-2015A fails to respond	3.30E-05	1.76
MSRVP03411	AIR-OPERATED VALVE 3411 FAILS TO OPEN (ARV A)	3.28E-05	1
RRPTHPT420	PRESSURE TRANSMITTER PT-420 FAILS HIGH	2.87E-05	1.01
DCMMTBDIST	Failure of Circuit E74 (To Turbine Building DC Distribution Panel)	2.70E-05	1.76
HVCCDGOPEN	FAN UNIT DAMPER FOR DG FAILS TO OPEN (COMMON CAUSE)	2.58E-05	2.3
AFPPJFAILX	Failure of AFW pump suction line (pipe rupture)	2.54E-05	2.91
DCBDFFUSEA	Battery A Main DC Fuse Cabinet (DCPDPCB02A) Local Fault	2.32E-05	41.02
DCBDFMAINA	Main DC Distribution Panel A (DCPDPCB03A) Local Fault	2.32E-05	41.02
RCMM0430IA	SOLENOID VALVE 8620A FAILS TO OPEN ON DEMAND	2.18E-05	1.15
RCMM431CIA	SOLENOID VALVE 8620B FAILS TO OPEN ON DEMAND	2.18E-05	1.15
HVCCDG0RUN	FAN UNIT FOR DG FAILS TO RUN (COMMON CAUSE)	2.16E-05	2.15
RRMVP0857A	MOV 857A FAILS TO OPEN	2.00E-05	1.01
RRMVP0857C	MOV 857C FAILS TO OPEN	2.00E-05	1.01
SIHFL857AC	LATENT HUMAN FAILURE OF MOV 857A OR 857C	1.95E-05	1.01
ACB2FBUS16	Local Faults On 480 VAC Bus 16	1.94E-05	2.03
RRCCPUMPAB	PUMPS A/B FAIL TO START (RECIRC)<COMMON CAUSE EVENT>	1.88E-05	1.05
ACB2FFLOOD	Failure of flooding panel ACPDPCB07	1.74E-05	1.93
ACMMSST014	480 VAC Bus 14 Transformer PXABSS014 Faults	1.67E-05	1.2
RCCC00430P	Common cause failure of PCV-430 and PCV-431c to open on demand	1.64E-05	1.15
AFCCPDISCA	Common cause failure of check valves 4009, 4010, and 3998 to open	1.63E-05	3.56
AFCCPSGINA	Common cause failure of check valves 4000C, 4000D, 4003, and 4004 to open	1.63E-05	3.56
MSCCPSGCVS	Common cause failure of check valves 3504B and 3505B to open	1.63E-05	2.91
ACCBD0PHCG	480 VAC circuit breaker 52/PHCG to PRZR heater control cabinet fails to close	1.61E-05	1
DGCCCV5919	FOOT VALVES 5919/5920 FAIL TO OPEN (COMMON CAUSE)	1.56E-05	2.15
DGCCCV5955	CHECK VALVES 5955/5956 FAIL TO OPEN (COMMON CAUSE)	1.56E-05	2.15
DGCCCV5961	CHECK VALVES 5961/5962 FAIL TO OPEN (COMMON CAUSE)	1.56E-05	2.15
UVPXF12V14	12 VDC power supply to bus 14 UV control logic output fails	1.55E-05	1.03
UVPXF12V16	12 VDC power supply to bus 16 UV control logic output fails	1.55E-05	1.03
UVPXF12V17	12 VDC power supply to bus 17 UV control logic output fails	1.55E-05	1.03
UVPXF12V18	12 VDC power supply to bus 18 UV control logic output fails	1.55E-05	1.03
RRBIF850AX	BISTABLE 850A-X SPURIOUSLY OPERATES	1.54E-05	1
RRBIF850BX	BISTABLE 850B-X SPURIOUSLY OPERATES	1.54E-05	1
ACREE86X1G	Turbine / Generator Auxiliary Lockout Relay 86X/1G Fails To Energize On Demand	1.52E-05	1.2
SWCCEXPANJ	Common Cause Failure Of Service Water Pump Discharge Expansion Joints	1.37E-05	201.14
ACT6FFLOOD	Flooding transformer PXCB006 fails	1.34E-05	1.93
ACMMSST015	4160 VAC / 480 VAC Transformer PXTBSS015 Faults	1.29E-05	1.15
IBMMBUS01B	120 VAC Instrument Bus B (IBPDPCBBW) Bus Faults	1.23E-05	1.15
IBMMBUS01D	120 VAC Instrument Bus D (IBPDPCBDY) Bus Faults	1.23E-05	1.15
AFCCPCSTCV	Common cause failure of check valves 4014, 4016, and 4017 to open	1.22E-05	2.91
CCPPJ_COMM	PIPE RUPTURE IN THE COMMON CCW PIPING	1.21E-05	1.91
CCTKJSURGE	CCW SURGE TANK RUPTURE	1.21E-05	1.91

TABLE 9-13
Component Importances

NAME	DESCRIPTION	F-V	RAW
RCMM0429BX	RELAY PC-429B-X FAILS TO OPERATE	1.18E-05	1.15
RCMM0430BX	RELAY PC-430B-X FAILS TO OPERATE	1.18E-05	1.15
RCMM0431BX	RELAY PC-431B-X FAILS TO OPERATE	1.18E-05	1.15
RCMM0449BX	RELAY PC-449B-X FAILS TO OPERATE	1.18E-05	1.15
ACREE1T12B	Synchro Verifier Relay 25B/11T-12B Fails To Energize On Demand	1.17E-05	1.15
ACREEXT12B	Synchro Verifier Auxiliary Relay 25BX/11T-12B Fails To Energize On Demand	1.17E-05	1.15
SICCMPSI1Y	PSI01A, PSI01B & PSI01C fail to run during injection due to common cause	1.04E-05	1.01
SRCCMPSI1Y	PSI01A, PSI01B & PSI01C fail to run for recirc. Due to common cause	1.04E-05	1.01
DGCWINTAKE	CW INTAKE HEATERS ENERGIZED (OCT 1 TO MAY 1)	9.69E-06	1
AFAAFAILXX	Failure of all MDAFW and SAFW pumps (independent of AF300)	9.42E-06	1
DGCCFDP048	DG FUEL OIL STRAINERS NDG04/08 PLUG (COMMON CAUSE)	9.21E-06	1.14
DGCCFDP090	FOOT VALVE 5919/5920 STRAINERS PLUG (COMMON CAUSE)	9.21E-06	1.14
ACCBD0PHBG	480 VAC circuit breaker 52/PHBG TO PRZR backup heaters fails to close	9.16E-06	1
CRCCM0896X	Common cause failure of MOVS 896A and 896B to close (RECIRC)	8.57E-06	1.01
AFMMSGBSAF	Failure of SAFW injection line to S/G B	8.19E-06	1
CCMMPUMP_A	CCW PUMP A TRAIN FAILS TO RUN	7.82E-06	1.02
ACMMMCC01B	480 VAC Motor Control Center MCCB Faults	7.79E-06	1.15
CCCCPUMP/R	COMMON CAUSE FAILURE OF CCW PUMPS TO RUN	7.61E-06	1.91
AFMMHOTWEL	Failure of components needed to transfer condensate	7.53E-06	1
DCMM0BATTA	Failure of Battery A (BTRYA) To Battery A Main DC Fuse Cabinet	7.29E-06	1.15
DCMM0BATTB	Failure of Battery B To Battery B Main DC Fuse Cabinet	7.29E-06	1.15
RHMVR0850A	MOTOR-OP VALVE 850A TRANSFERS OPEN [INJECTION]	7.18E-06	1.34
RHMVR0850B	MOTOR-OP VALVE 850B TRANSFERS OPEN [INJECTION]	7.18E-06	1.34
RCHFLLT427	PRESSURIZER LEVEL TRANSMITTER LT-427 MISCALIBRATED	7.14E-06	1
RCHFLLT428	PRESSURIZER LEVEL TRANSMITTER LT-428 MISCALIBRATED	7.14E-06	1
UVREK0X317	BUS 17 UNDERVOLTAGE RELAY 27X3/17 TRANSFERS TO ENERGIZED	6.84E-06	1.05
UVREK0X318	BUS 18 UNDERVOLTAGE RELAY 27X3/18 TRANSFERS TO ENERGIZED	6.84E-06	1.05
UVREKBX317	BUS 17 Undervoltage relay 27bx3/17 transfers to energized	6.84E-06	1.05
UVREKBX318	BUS 18 undervoltage relay 27bx3/18 transfers to energized	6.84E-06	1.05
DCBDFFUSEB	Battery B Main DC Fuse Cabinet (DCPDPCB02B) Local Fault	6.79E-06	12.73
DCBDFMAINB	Main DC Distribution Panel B (DCPDPCB03B) Local Fault	6.79E-06	12.73
RCPTLPT429	PRESSURE TRANSMITTER PT-429 FAILS LOW	6.77E-06	1.15
RCPTLPT430	PRESSURE TRANSMITTER PT-430 FAILS LOW	6.77E-06	1.15
RCPTLPT431	PRESSURE TRANSMITTER PT-431 FAILS LOW	6.77E-06	1.15
RCPTLPT449	PRESSURE TRANSMITTER PT-449 FAILS LOW	6.77E-06	1.15
SICCMPSI1X	PSI01A, PSI01B & PSI01C fail to start for injection due to common cause	6.77E-06	1.01
HVMFFACF5B	CONTROL ROD SHROUD FAN B FAILS TO RUN	6.61E-06	1.04
RCPXFPQ429	POWER SUPPLY PQ-429 NO OUTPUT	6.45E-06	1.15
RCPXFPQ430	POWER SUPPLY PQ-430 NO OUTPUT	6.45E-06	1.15
RCPXFPQ431	POWER SUPPLY PQ-431 NO OUTPUT	6.45E-06	1.15
RCPXFPQ449	POWER SUPPLY PQ-449 NO OUTPUT	6.45E-06	1.15
ACCBR012BX	4160 VAC Circuit Breaker 52/12BX (Normal Supply To Bus 12B) Transfers Open	6.10E-06	1.19
RCMVK00515	MOTOR-OPERATED VALVE 515 TRANSFERS CLOSED	6.03E-06	1.15
RCMVK00516	MOTOR-OPERATED VALVE 516 TRANSFERS CLOSED	6.03E-06	1.15

TABLE 9-13
Component Importances

NAME	DESCRIPTION	F-V	RAW
EXCCCMTPTH	Common cause high failure of containment pressure transmitters	5.14E-06	2.23
EXCC0SGPTL	Common cause low failure of sg pressure transmitters	5.08E-06	2.23
EXCCPZRPTL	Common cause low failure of pressurizer pressure transmitters	5.08E-06	2.23
DCMMCHG01A	Failure of Battery Charger A (BYCA)	4.64E-06	1.01
DCMMCHG1A1	Failure of Battery Charger A1 (BYCA1)	4.64E-06	1.01
RRXVK0851A	DE-POWERED MOV 851A TRANSFERS CLOSED [RECIRC]	4.43E-06	1.01
SWMVP04013	Motor operated valve 4013 fails to open	4.39E-06	1
UVLCD17S1A	Bus 17 undervoltage solid state switch #1 generates a spurious signal	4.22E-06	1.05
UVLCD17S2A	Bus 17 undervoltage solid state switch #2 generates a spurious signal	4.22E-06	1.05
UVLCD18S1A	Bus 18 undervoltage solid state switch #1 generates a spurious signal	4.22E-06	1.05
UVLCD18S2A	Bus 18 undervoltage solid state switch #2 generates a spurious signal	4.22E-06	1.05
UVLCD7LB1A	Bus 17 undervoltage control logic board #1 generates a spurious signal	4.22E-06	1.05
UVLCD7LB2A	Bus 17 undervoltage control logic board #2 generates a spurious signal	4.22E-06	1.05
UVLCD8LB1A	Bus 18 undervoltage control logic board #1 generates a spurious signal	4.22E-06	1.05
UVLCD8LB2A	Bus 18 undervoltage control logic board #2 generates a spurious signal	4.22E-06	1.05
UVLCDBX37A	Relay 27bx3/17 driver (heat sink assembly #2) generates a spurious signal	4.22E-06	1.05
UVLCDBX38A	Relay 27bx3/18 driver (heat sink assembly #2) generates a spurious signal	4.22E-06	1.05
UVLCDX317A	Relay 27x3/17 driver (heat sink assembly #1) generates a spurious signal	4.22E-06	1.05
UVLCDX318A	Relay 27x3/18 driver (heat sink assembly #1) generates a spurious signal	4.22E-06	1.05
ACMMSST016	Transformer PXABSS016 Faults	3.80E-06	1.05
AFCCSSAFWA	Common cause failure of SAFW Pumps 1C and 1D to start	3.71E-06	1.1
ACLCD83TSC	Failure of Automatic Transfer Switch to load TSC DG (no power requirements for switch)	3.29E-06	1.04
EXCC000BIF	Common cause spurious operation of ESFAS sensing instrumentation alarms	3.04E-06	2.23
IBAABUSCMT	IB C on maintenance supply	-1.54E-07	1

Figure 9-7
Truncation Evaluation

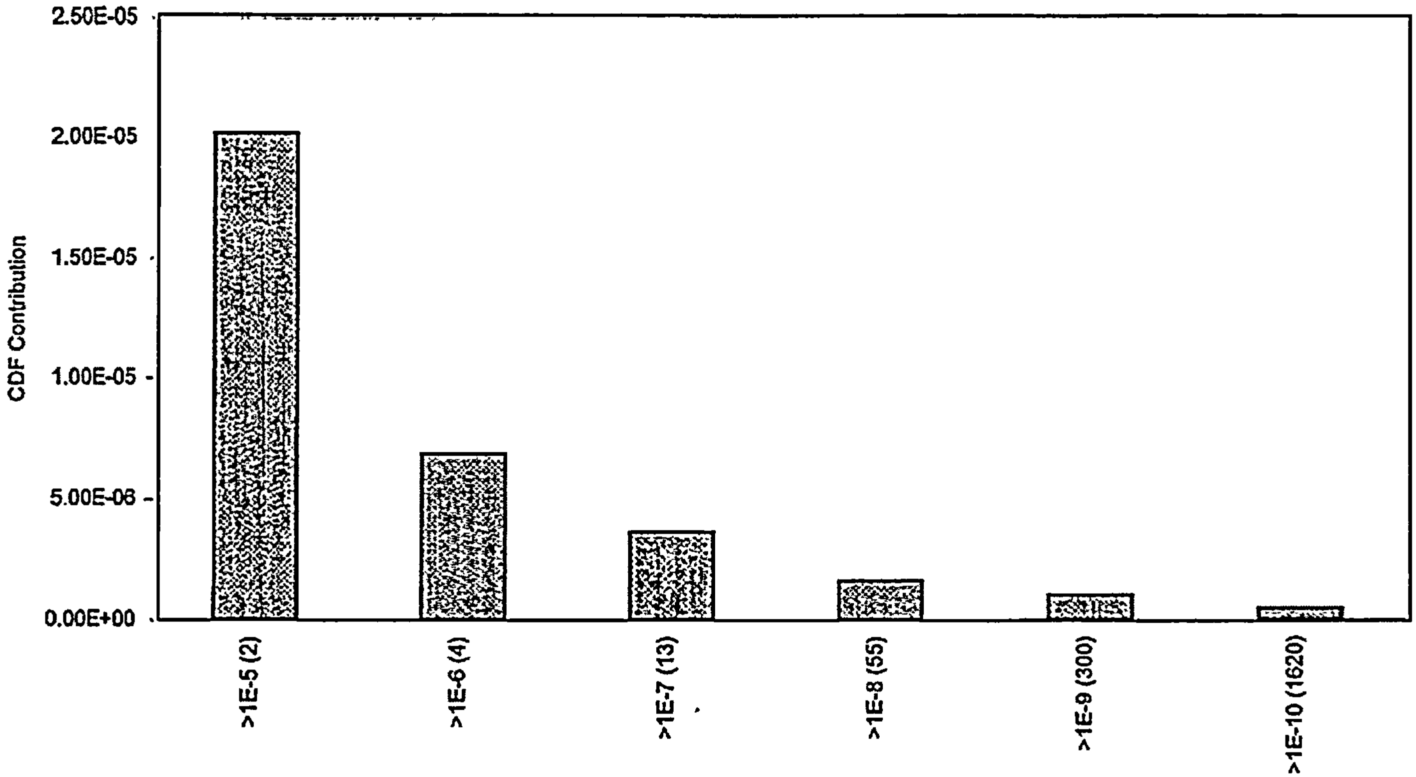
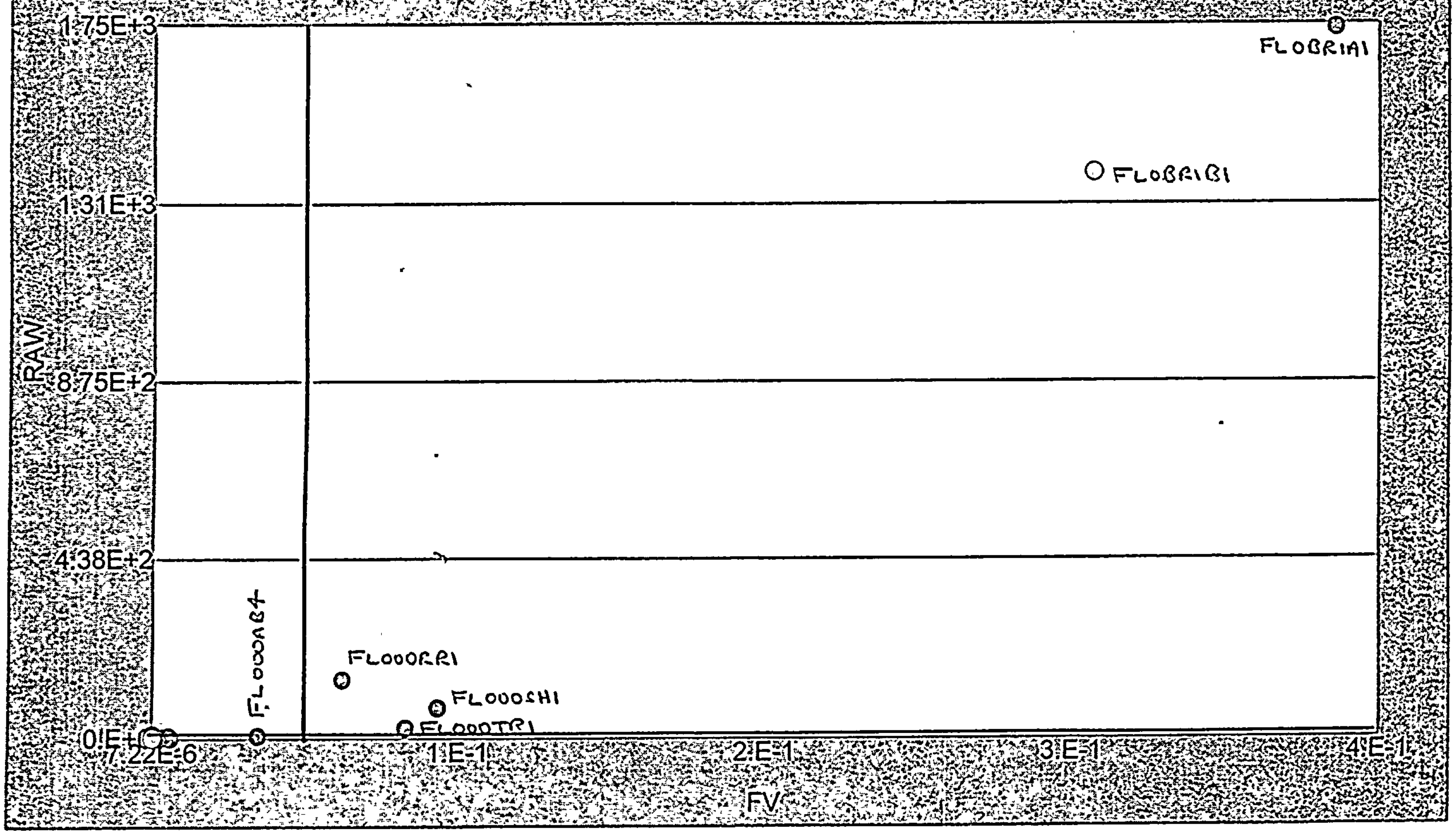


Figure 9-8, Initiating Events



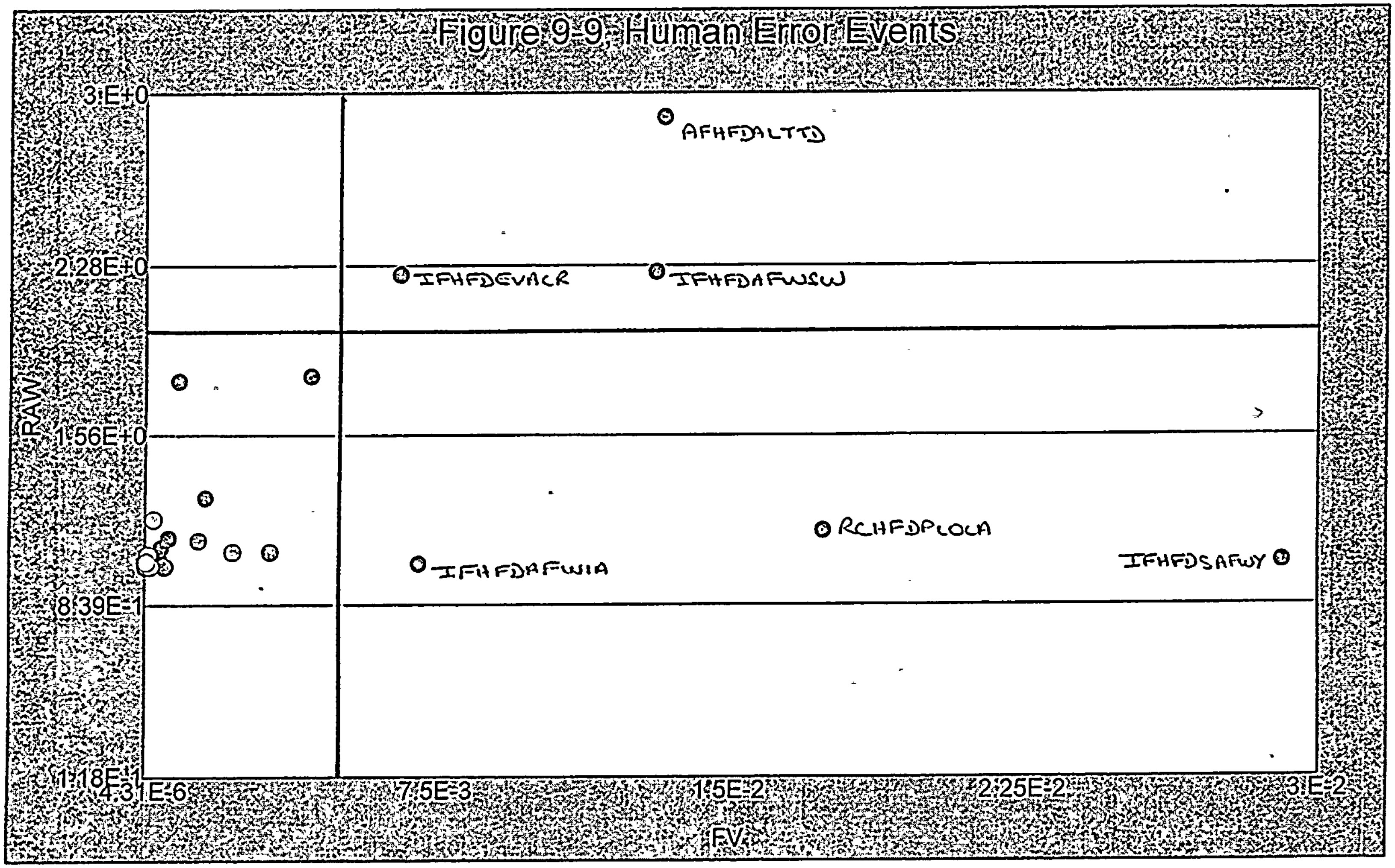


Figure 9-9 Human Error Events

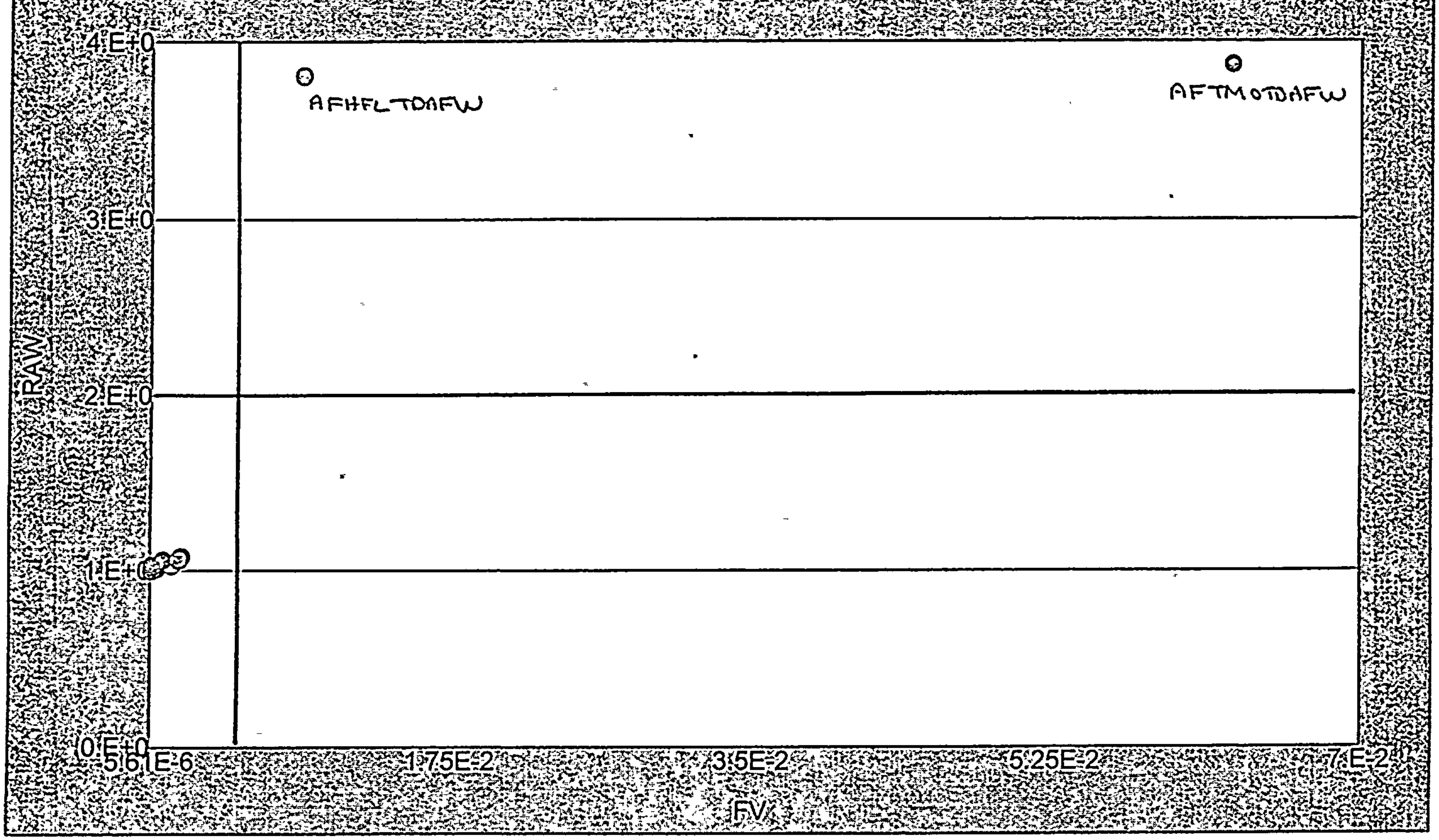


Figure 9-10: Test & Maintenance Events

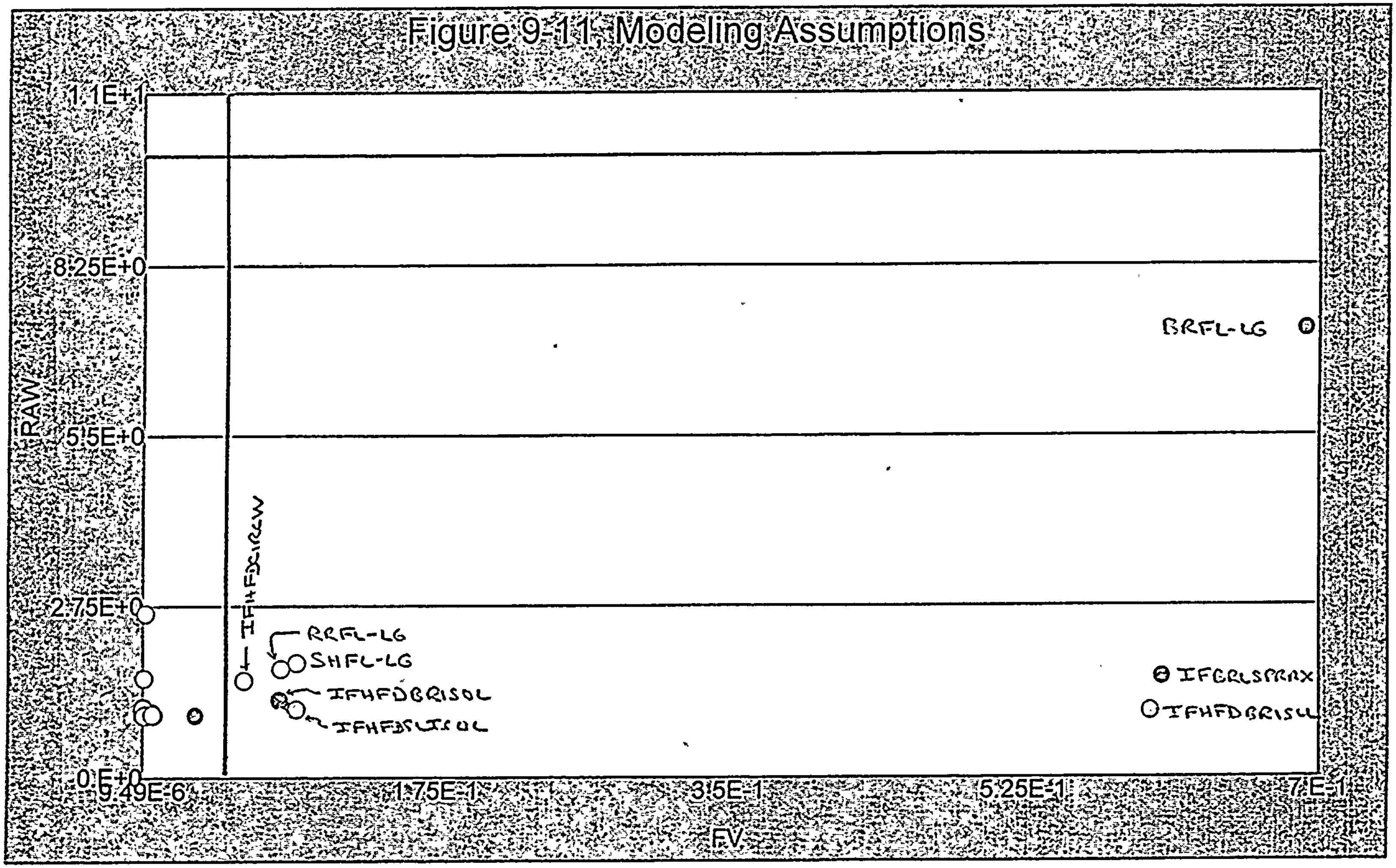


Figure 9-11: Modeling Assumptions

Figure 9-12, System Importances

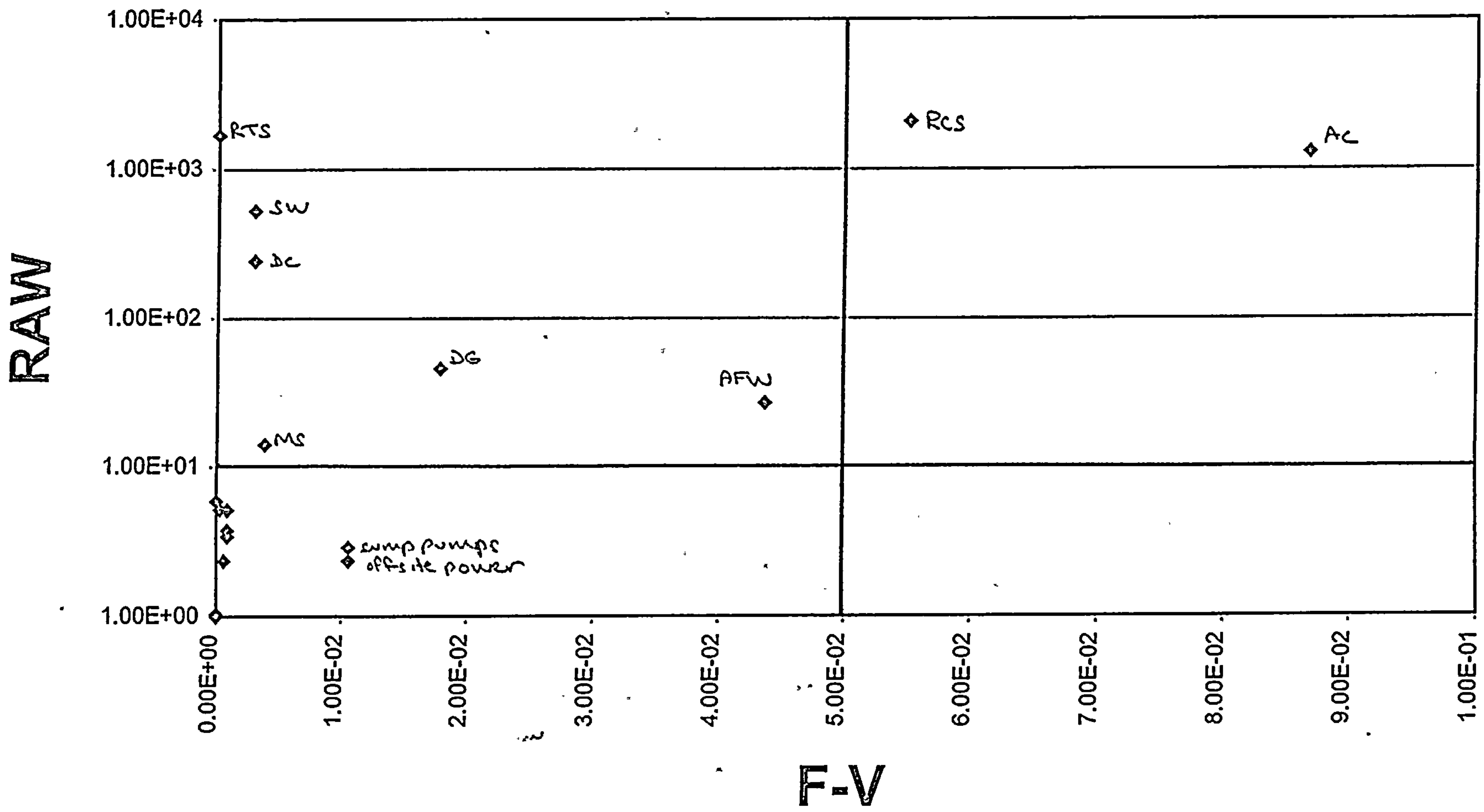
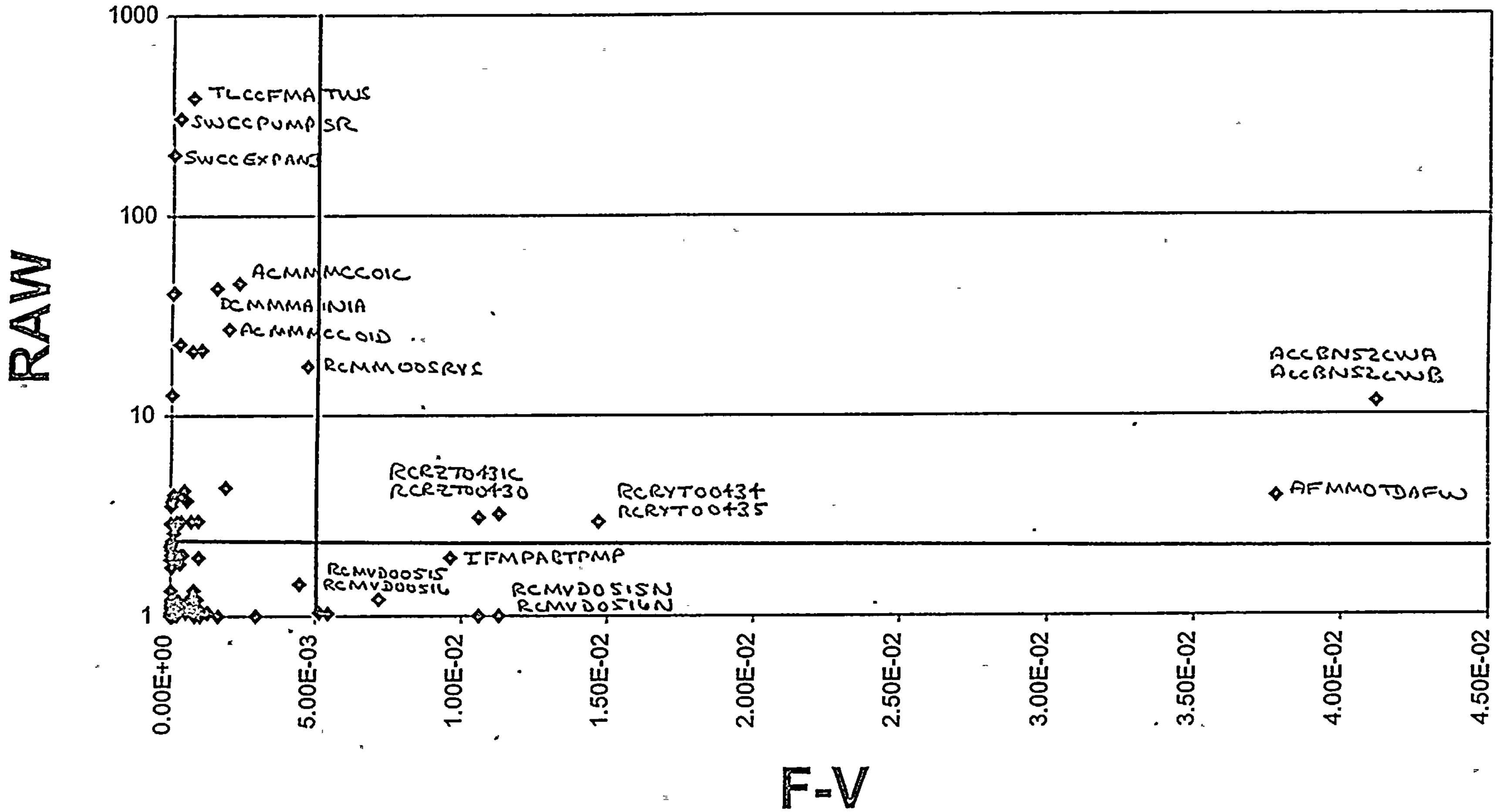


Figure 9-13, Component Importances



10.0 LEVEL 2 ANALYSIS

10.9 Internal Flooding Qualitative Assessment

To complete the analysis of internal flooding, a qualitative assessment of the potential effect upon the Level 2 Analysis is presented here. To focus this analysis, it is first necessary to determine which of the source term characteristics (STCs) identified in the existing Level 2 PSA (Reference 120) (Section 10.7.2.1, Tables 10-17 and 10-19 through 10-21, and Figure 10-21) correspond to a large early release.

10.9.1 Large Early Release (LER)

The 25 STCs are categorized in a relative, qualitative manner by the timing of the release (early vs. late) and magnitudes of the released fission products (high, medium, low and very low), as discussed in Section 10.7.2.2 and presented in Table 10-19. They are subsequently grouped into six release categories (I through VI), as discussed in Section 10.7.3 and presented in Table 10-20. The items in Categories III and above are characterized by high noble gas releases and at least medium volatile releases (the non-volatile releases range from very low to medium). Of these, the following seven STCs are early releases, where the noble gas release is high and the volatile and non-volatile releases are at least medium: 4, 6, 9, 18, 20, 22 and 25 (STC 25 indicates a very low non-volatile release, but is grouped with the others since its volatile release is high). The combined contribution to the internal event CDF from these seven STCs is ~4.0%. This is a reasonable estimate of the large early release fraction (LERF).

Two STCs (9 and 20) result from station blackout. Three (4, 6, and 18) result from a small-break LOCA where injection and recirculation fail but AFW and the CRFCs operate successfully. STC 18 also includes a failure to isolate containment. STC 22 is similar to the three small-break-LOCA items, except it results from an ISLOCA, thereby bypassing containment such that operability of the CRFCs will not provide any mitigation function. AFW and the accumulators are assumed to operate successfully. STC 25 results from an SGTR where injection subsequently fails and the affected ARV sticks open; the CRFCs again operate successfully. The majority of the LERF (3.3%) arises from just two of the seven STCs -- 18 and 22. Both are characterized by LOCAs with subsequent failure of injection and recirculation. Given the similarities among the seven STCs comprising the LERF, we will assume for simplicity that STCs 18 and 22 are representative of the entire group.

10.9.2 Effect of Internal Flooding on LERF from Small-Break LOCA (STC 18)

STC 18 results from plant damage state (PDS) 1, characterized in Figure 10-4 (see also Section 10.3.5 for a discussion of PDSs). Although not strictly resulting from a containment bypass scenario, failure of containment isolation provides a ready pathway out of containment, although CRFCs will provide some fission product removal. However, neither injection nor recirculation is available, and the ultimate result is an LER. PDS 1 is initiated by a small-break LOCA, either directly or induced by a transient. If transient-induced, it would require a stuck-open PORV. A direct small-break LOCA will, by definition, occur inside containment, where the effects of flooding will be confined. The Level 2 Analysis has already addressed the effects of a small-break LOCA, including possible flood degradation of the only active mitigating systems assumed available -- AFW and CRFC. Neither contains components inside containment at an elevation susceptible to flooding effects. Therefore, no effect from flooding on a direct small-break LOCA is foreseen.

There is the potential for a flood outside of containment (considered a transient initiator) to induce a small-break LOCA by lifting the PORVs. This would require immersion of a PORV control cable with a resulting hot-shorting to power. Since the PORV control cables are elevated well above any anticipated flood heights, this is not credible. Thus, no effect from flooding on a transient-induced small-break LOCA is foreseen. We conclude that there is no credible effect from internal flooding on LERF from a small-break LOCA.

10.9.3 Effect of Internal Flooding on LERF from ISLOCA (STC 22)

STC 22 results from PDS 55, specifically assigned to ISLOCAs. It is similar to STC 18 in that it provides a ready pathway out of containment. However, since the LOCA occurs outside containment, CRFCs will not provide fission product removal. As discussed in Sections 8.2.2 through 8.2.5, and presented in Table 8-6, the only ISLOCAs leading to core damage result from breaks either in SI or RHR piping outside containment. Since these systems are assumed lost by definition of PDS 55, any flooding effects from the ISLOCA on these systems are irrelevant. The Level 2 Analysis has already addressed the effects of an ISLOCA, including possible flood degradation of the only active mitigating systems assumed available -- AFW and the accumulators. The AFW components, including control and power cables, are located above any elevation considered susceptible to flooding effects. The accumulators are automatic, passive components located inside containment and remain unaffected by flooding from an ISLOCA. Therefore, we conclude that there is no credible effect from internal flooding on LERF from an ISLOCA.

10.9.4 Containment Isolation Analysis

The potential impacts of flooding events on containment isolation are as follows:

a. Air-operated valves (AOVs) - Containment isolation AOVs are postulated to fail in the closed position as a result of flooding damage (flood damage to control cables or solenoid control valves cause the air-operated valves to fail in the closed position; flood damage of the air-operated valve mechanism is postulated to result in the valves failing closed).

b. Motor-operated valves (MOVs) - MOVs can potentially fail in the open position due to damage to control or power cables. However, such valves can be manually closed since all are fitted with hand wheels. Significant time is available for flood accumulation to be cleared to allow access.

c. Check valves - Check valves are postulated to not be impacted by floods.

d. Containment Isolation actuation system - A flood could potentially damage the actuation system or signals. Because of the fail-safe design elements of the system, and the long time available for the operators to manually perform containment isolation, flood damage would most likely not significantly impact successful containment isolation.

Plant walkdowns also did not identify any flood related containment isolation issues. Based on the above considerations, the potential for containment isolation failure was found to not be uniquely impacted by flood events.

10.9.5 Summary

We have shown the LERF from the Level 2 Analysis to be ~4.0%, arising mainly from two STCs involving small-break LOCA and ISLOCA. Internal flooding does not introduce any credible effects into the release scenarios leading to this LERF that have not already been addressed in the Level 2 Analysis. Therefore, we conclude that there is no credible effect from internal flooding on the LERF.

11.0 SUMMARY AND CONCLUSION

11.5 Internal Flooding Summary

The final calculated CDF for Ginna Station is 3.375E-05/yr. Figure 11-3 illustrates how each flooding scenario contributes to this value. As can be seen, there are only five flooding scenarios which contribute significantly to the flooding risk at Ginna Station:

1. BRFL (69%) - Flooding in Battery Rooms A and B caused by failure of SW piping for room coolers located in the relay room.
2. SHFL (9%) - Flooding in screenhouse caused by failure of piping associated with SW pumps.
3. TBFL-1 (8%) - Flooding in turbine building basement (caused by circulating water piping) floods both Battery Rooms A and B.
4. RRFL (6%) - Flooding in relay room caused by failure of SW piping for room coolers located within room.
5. ABFL (3%) - Flooding in auxiliary building basement fails safety injection, residual heat removal, and charging pumps when equipment required post trip (e.g., stuck open PORV).

The most significant operator errors relate to: (1) failing to provide cooling to the TDAFW lube oil pump from the diesel fire pump, (2) failure to use ER-FIRE.1 for floods in the relay room (including all local operation), and (3) failure to close a PORV block valve for a stuck open PORV prior to needing inventory makeup capability.

The most important systems for responding to a flood were AC power and the RCS (with respect to isolating a stuck open PORV or responding to an open safety valve). Other important systems were the reactor trip system, service water, DC electrical power, diesel generators, auxiliary feedwater, and main steam (suction for TDAFW and blowdown isolation).

A qualitative assessment of Level 2 issues (i.e., containment vulnerabilities) was also performed. It was concluded that there were no new issues related to large early releases related to flooding scenarios.

11.5.1 Unique and Important Safety Features

The internal events PSA identified three attributes that helped to reduce the calculated CDF at Ginna Station:

a. Standby Auxiliary Feedwater (SAFW) System;
b. Limited requirements for ventilation; and
c. Service Water (SW) design.

However, with respect to floods, the last two items would be expected to create more vulnerabilities than assisting in mitigating floods. Specifically, the lack of need for ventilation is based on the limited use of compartments or rooms to protect and separate various equipment trains. This in turn created flood issues since multiple trains could be affected by the same flood source. Similarly, the SW design utilizes four pumps which feed a common header that can supply cooling water to any system load. However, the four SW pumps are located in a common area of the screenhouse and susceptible to common floods. Nonetheless, the open design of the Ginna Station layout did not significantly contribute to risk with respect to internal floods due to the ability of using different systems and/or components to perform the same function. That is, with respect to the top five scenarios described in Section 11.5, only the last item (ABFL) is directly related to this issue.

The SAFW is comprised on two 100% motor-driven pumps that are completely redundant to the preferred AFW system. This system can be used to mitigate any flood scenario that fails the three preferred AFW pumps.

11.5.2 Vulnerabilities

One of the major objectives of Generic Letter 88-20 was to identify potential plant vulnerabilities. Using the definition of vulnerability provided in the internal events PSA (Section 11.0), the following items were identified by the Ginna Station PSA:

- *Flood Detection Capability Within Battery Rooms* - The calculated CDF from loss of both battery rooms due to a failure of non-safety related SW lines is driven by the frequency of the line break and the probability that the leak is not isolated prior to flooding the rooms and failing DC equipment. A request for an engineering evaluation (TSR 99-024) of the material condition of the sump pump located in Battery Room A has been issued along with consideration of installing water alarms that would indicate in the main control room (e.g., computer alarms).

- *Lack of Procedural Guidance for Relay Room Internal Floods* - At the time of the evaluation, the only procedure that existed for loss of the relay room was concerned with fire initiators. This same procedure (ER-FIRE.1) was revised to allow it to be used for relay room floods such that this vulnerability no longer exists.

11.5.3 Changes Made to the Facility

As a result of the insights obtained from the internal flooding evaluation, the following changes have been (or are in the process of being) implemented:

a. *Change ER-FIRE.1 to Allow it to be Used for Relay Room Floods* - This procedural change is addressed by basic event IFHFDEVACR which has a Risk Achivement Worth (RAW) of 2.3 (i.e., if operators never used ER-FIRE.1 to mitigate a flood in the relay room, the CDF would increase by a factor of 2.3).

b. *Provide Early Flood Detection Capability Within Battery Rooms* - As described in Section 11.5.2, this issues is currently under engineering evaluation and nothing to date has been implemented. However, the Risk Reduction Worth (RRW) for the operators failing to isolate the SW breaks is 3.18 (i.e., the CDF would decrease by a factor of 3.18 if it were assumed that they always isolated the break).

11.5.4 RG&E Internal Flooding PSA Team

The internal flooding PSA evaluation was primarily performed by an outside consultant (EQE - Seattle) based on information provided by RG&E personnel. However, the evaluation of all flooding insights and conclusions was performed by RG&E personnel. The breakdown of assignments follows:

EQE (Seattle) Lead:

a. Development of flooding frequencies.
b. Identification of flooding scenarios.
c. Development of changes to internal events PSA models to address flooding considerations.

RG&E Lead:

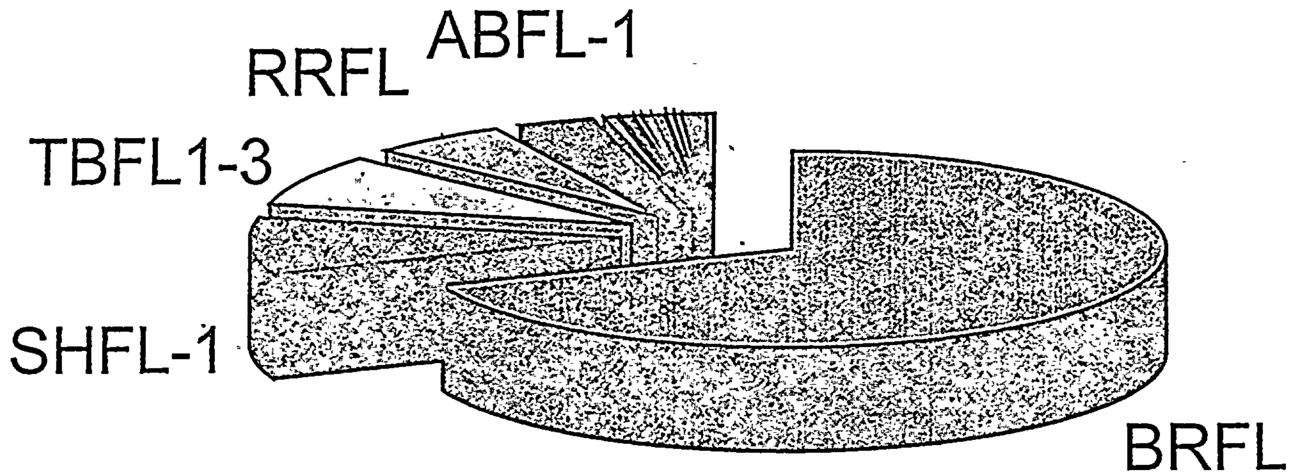
a. Development of databases identifying equipment and cabling located in each flood zone.
b. Final quantification of model.
c. Development of flooding insights.

Combined EQE (Seattle) and RG&E Lead:

a. Plant walkdowns to identify equipment vulnerable to floods.
b. Development of human actions credited within models.

The EQE (Seattle) team was lead by personnel who had previously performed the fire analysis for Ginna Station. The RG&E team was lead by three individuals, two of whom have at least 13 years of PSA experience and one of which has an SRO certification. The remaining team member was involved in the fire analysis and is a previous auxiliary operator.

Figure 11-3, Flooding Results



12.0 REFERENCES

119 Ginna Station Cable Routing and Equipment Locations Database, Microsoft Access Database, CABLETRK.MDB, June, 1998.

120 Ginna Station PSA Final Report, Revision 1

APPENDIX I

INTERNAL FLOOD MODELING SUPPORT DOCUMENTATION

This appendix is organized into three sections. Section I.1 provides supporting material for the development of internal flooding initiating event frequencies. Section I.2 documents the internal flooding human reliability analysis modeling. Section I.3 discusses the development of the internal flooding accident sequence scenarios.

I.1 FLOOD OCCURRENCE FREQUENCIES

The estimation of internal flooding event frequencies was based on both generic industry data and the Ginna plant-specific experience. In order to develop consistent flood frequencies, the industry event data are combined with actual plant-specific experience through a two-stage Bayesian analysis that provides a mathematically rigorous and structured method.

I.1.1 Generic Data and Screening

The generic data for the internal flood frequency assessment were collected from a variety of sources. For example, a PLG proprietary database for flood events (Ref. I.1-1) provides the generic input for the assessment of flood event frequencies. This database contains summaries of 174 flood events that occurred at U.S. nuclear power plants through the end of 1993. These event summaries are derived from U.S. Nuclear Regulatory Commission (NRC) Licensee Event Report (LER) data, American Nuclear Insurer data, and plant-specific data that have been collected by PLG during its previous probabilistic safety assessment (PSA) studies.

For the Ginna analysis, the generic flood event data were used in the following manner:

- The generic events were qualitatively screened to select those events that are appropriate for the design and operation of the Ginna plant
- Flood frequencies for each of the major plant areas and buildings were developed (termed "base" frequencies)
- Apportionment factors (e.g., flood size and type, plant trip occurrence) which are used to subdivide the base frequencies for the different flood scenarios were developed

The first step of the flood frequency assessment involved a thorough review of the industry experience data to develop a "specialized generic database" for Ginna. This database accounts for design features of the plant that is being evaluated, the scope of the PSA models, and characteristics of the specific hazard scenarios that have been defined for the analysis. The screening process was performed conservatively so that the maximum data was retained. Examples of events that were screened out are:

- Events that occurred before the plant had an operating license. It is judged that conditions during initial plant construction and pre-commercial startup testing are not similar to those during plant operation.

- Events that are unique to plant features that do not exist at Ginna. For example, flooding events unique to cooling towers were screened from the Ginna analysis since the Ginna plant does not use cooling towers.

- Events that could occur only during plant shutdown. For example, flooding events that were associated with the reactor cavity seal were screened since this could not cause a flood during operation.

The remaining 115 events were then categorized according to the following plant areas and buildings as if they were to have occurred at Ginna, and were further categorized as to whether they could only occur during power operations, or could occur anytime during plant operations. This latter step is necessary in order to account for the average time in "at power" operations, as discussed below.

Designator	Description
AB / IB / SAF	Auxiliary Building, Intermediate Building and Standby AFW Building
CB	Control Building
DG	Diesel Generator Building
OT	Other (all other plant areas)
RC	Reactor Containment
SB	Service Building
SH	Screen House
TB	Turbine Building

These events are judged to be relevant to the Ginna plant design and operation, the locations and types of equipment, and the scope of the analysis.

I.1.2 Ginna Plant Flood Data

Plant-specific flood event data for the Ginna study were compiled by the Ginna staff using a variety of plant reports. All events from 1979 through September 1998 were examined. The events were screened to determine which events apply to the flood event categories and plant locations being considered for the flood analysis. Table I.1-1 contains a summary of the eight flooding events used in this assessment.

I.1.3 Calculation of Base Flood Frequencies

A two-stage Bayesian analysis (Ref. I.1-2) was performed to combine the industry data with actual experience from the Ginna plant. The first stage of this analysis develops a generic frequency distribution for each building/location that consistently accounts for the observed site-to-site variability in the industry experience data.

The calculation of the base generic flood frequencies used the flooding events that occurred between January 1, 1980, and December 31, 1992. The starting date for this database period accounts for increased NRC and utility awareness and reporting requirements that may affect the applicability of pre-1980 data. The end date accounts for the fact that the PLG database contains a number of flood events that were reported in 1993, but it may not be complete for that year. Since this flooding analysis is calculated assuming that the plant will be at full power for the entire year, the frequencies of the industry events that could only occur during power operations were divided by 0.7, which is the average "at power" factor for US plants during this time period. The adjusted "power only" event frequencies were then combined with the flooding event frequencies that could occur at any time during operation to give the generic (prior) frequencies for each location.

The second stage updates this generic frequency to account specifically for the actual historical experience at Ginna. Table I.1-2 lists the plant-specific evidence, the generic (prior) mean frequency, and the final updated base frequency for each flood building category.

I.1.4 Calculation of Apportionment Factors

The base flood frequency bins were then further apportioned to apply the data to the actual internal flooding initiating events identified for Ginna Station as discussed in Section 7.3.2 of Ginna Station PSA final report. To develop the apportionment factors, all of the generic screened data (115 events) and Ginna events (8 events) were used to maintain the largest possible sample size. The historical events were classified into the following bins:

1. Flood type
   - Submergence (flood causes buildup of water on floor)
   - Spray (flood can cause spraying of equipment as well as submergence)
   - Steam (flood is initially steam, with potential for propagation)
2. Flood size
   - Very large (generally associated with circulating water)
   - Large (can propagate to several systems quickly)
   - Small (damages only nearby equipment, with limited potential to propagate)
3. Reactor trip after flood event
   - Yes
   - No

The Ginna Station PSA final report provides the results of the binning in Table 3-8, and the final apportionment factors in Table 7-16.

I.1.5 References

I.1-1 PLG, Inc., "Database for Probabilistic Risk Assessment of Light Water Reactor Power Plants," PLG-500, Vol. 9, May 1994.

I.1-2 Kaplan, S., "On a 'Two-Stage' Bayesian Procedure for Determining Failure Rates from Experiential Data," *Institute of Electrical and Electronics*

Engineers Transactions on Power Apparatus and Systems, Vol. PAS-102, No. 1, January 1983.

Table I.1-1
Ginna-specific Flood Events

I-1: August 15, 1975 - Power operation. Reportable. No Trip. No safety systems adversely affected.

During a safeguard valve operation test, 12,000 gallons of refueling water were inadvertently transferred to containment, resulting in the accumulation of one inch of water on the containment floor. The direct cause of the event was failure of a control room operator to perform a step in the testing procedure to close MOV-851B. The operator had checked off the step prior to performing it, and failed to perform the action due to distraction caused by simultaneously giving an order to another operator.

I-2: July 1, 1985 - Power operation. Reportable. No Trip.

Following completion of PT-2.7 "Service Water System Test", the containment vessel A sump pump actuation interval decreased significantly from normal. Operators entered containment to find the source of the leak and discovered a leak in containment recirculation fan A. A 1/8" diameter threaded motor cooler drain plug had become displaced during PT-2.7, allowing SW to flow out. The leak was isolated. A total of 1100 gallons had spilled into containment, at a rate of about 4-5 gpm.

I-3: April 11, 1986 - Power operation. Not Reportable. No trip.

The 1G fan filter deluge fire system was accidentally actuated from the control room. Water spilled into the auxiliary building basement and the auxiliary building basement sump pump auto start alarm was sounded in the control room. The primary auxiliary operator noted the absence of smoke and flames and isolated the deluge. The fire brigade was secured at that time.

Table I.1-1 (continued)
Ginna-specific Flood Events

I-4: July 29, 1986 - Hot shutdown. Reportable.

A containment sump pump actuated and an alarm in the control room alerted operators. Operators entered containment to find the source of the leak and discovered a leak in containment recirculation fan B. A 1/8" diameter threaded motor cooler drain plug had become displaced during PT-2.7, allowing SW to flow out. The leak was isolated. A total of 4500 gallons had spilled into containment.

I-5: March 2, 1987 - Cold Shutdown. Not reportable.

During flushing of boric acid system piping, water accumulated to a depth of ten inches in the auxiliary building sub-basement due to clogging of the sub-basement drain due to the presence of debris. The drain was cleared and the spill drained away.

I-6 May 24, 1988 - Power operation. Not reportable. No trip.

While performing procedure M-37.85.4, the operator maintained a vent valve open (per procedure), while he opened the supply valve to pressurize the standby auxiliary feedwater (SAF) Pump D. Water sprayed out the open vent valve, into miscellaneous electrical devices. The procedure was subsequently modified to preclude this event.

Table I.1-1 (continued)
Ginna-specific Flood Events

I-7 April 2, 1991 - Refueling Mode. Reportable.

Maintenance personnel were in the process of repacking MOV 738B (CCW inlet MOV to RHR heat exchanger B), which they believed to be isolated, but was not. Workers notified control room operators of the leak and subsequently it was discovered that it was non-isolable. An attempt was made to electrically open MOV 738B to place the valve on the backseat and stop the packing leak. This caused the leakage rate to increase to 25 gpm. The RHR and CCW systems were subsequently removed from service to manually place MOV 738B on the back seat to stop the packing leak. CCW Pump A and RHR Pump A were then started in order to re-establish shutdown cooling.

I-8: August 11, 1998 - Full Power operation. Reportable. No trip.

Fire water suppression system S-25 actuated on the generator seal oil system, due to an internal fault (hot short) in a control card that sent an electrical signal to the system dump solenoid valve. The solenoid valve is usually actuated by the "second" fire signal, or manual switch in the control room. This system is designed to provide 145 gallons of water per minute, and operated less than 5 minutes. The Aux Operator had to travel from the screen house to the turbine building. After visually verifying that there was no fire (the automatic fire doors close on heat, and were therefore open), he isolated the system at the pull station area. Approximately 725 gallons of water was discharged into the room enclosure. The room is diked and water was collected and transported to the lube oil storage tank (LOST) diked area. The seal oil area was cleaned up and the waste water was collected from the LOST area and treated for disposal. The fire suppression system has open spray heads so all of the room spray heads sprayed water. Although the seal oil pumps were sprayed, they did not trip. If they had tripped, the plant would have tripped. No safety equipment was affected.

Table I.1-2

Base Flood Frequencies

	Ginna Plant Data		Prior	Posterior Distribution			
Location	No. Events	Time (yr)	Mean	Mean	5th %	Median	95th %
AB	4	22.6	2.21E-02	9.42E-02	2.88E-02	8.06E-02	1.94E-01
CB	0	22.6	4.08E-03	3.52E-03	4.26E-04	2.22E-03	1.09E-02
DG	0	22.6	1.34E-03	1.27E-03	1.12E-04	7.49E-04	4.14E-03
OT	0	22.6	3.25E-03	2.67E-03	1.81E-04	1.38E-03	9.24E-03
RC	3	22.6	1.70E-02	5.83E-02	1.47E-02	4.85E-02	1.34E-01
SB	0	22.6	5.48E-04	5.20E-04	2.41E-05	2.04E-04	1.98E-03
SH	0	22.6	4.25E-03	3.87E-03	7.03E-04	2.78E-03	1.06E-02
TB	1	22.6	2.88E-02	3.07E-02	8.32E-03	2.55E-02	7.04E-02

I.2 HUMAN RELIABILITY ANALYSIS

The internal flooding events human reliability analysis consisted of the following tasks:

1. the evaluation of the internal events human error probabilities for their applicability to internal flooding accident sequences,

2. the development of human error probabilities for operator actions associated specifically with internal flooding accident sequences, and

3. evaluation of potential dependencies between multiple operator actions.

The following subsections document these tasks.

I.2.1 Evaluation of Internal Events Human Error Probabilities for Internal Flooding Applicability

The internal events PSA human error probabilities were examined for their applicability to internal flooding scenarios. This evaluation considered the potential for degradation of control room indication due to flood damage, the inability to perform local actions due to flooding effects, and the potential for increased stress due to flood-related impacts to plant systems.

I.2.1.1 Flood-Related Losses of Indication

The potential impacts to human error probabilities due to flood-related losses of indication were addressed using the following guidelines:

1. Submergence or steam flooding of instrumentation cables, instrumentation sensors, or instrumentation transmitters was assumed to make the associated indication unavailable.

2. Spraying of instrumentation sensors, or instrumentation transmitters was assumed to make the associated indication unavailable.

3. Spraying of instrumentation cables was postulated to not impact associated indication on the basis that a previous flooding event

occurring at Ginna Station in which the fire deluge system actuated in the cable tunnel led to no impacts on plant indication.

Using the above guidelines and the inventory of instrumentation impacts provided in Table I.2-1, the internal events human error probabilities (HEPs) were examined for adjustment as discussed in Table I.2-2 for all flood scenarios except the scenario that results in significant damage to relay room equipment. Treatment of the relay room flood scenario is discussed separately below.

Relay room floods that result in significant damage to equipment are postulated to result in significant losses of control room indications and control. For these floods, operators must shut down the plant from outside the control room using the control room evacuation procedure ER-FIRE.1. The human error probabilities associated with these actions were developed as discussed in Section I.2.2 and Table I.2-3. In general the HEPs developed for the internal events PSA do not apply with the exception of the following:

1. The HEP associated with the starting of a component cooling water (CCW) pump, RCHFDOORCP, has a value of 1.61E-2 for the internal events PSA. This value was judged to be applicable to control room evacuation scenarios as the tripping of the pumps is a specific procedural step performed as part of ER-FIRE.1 (the cognitive failure to initiate procedure ER-FIRE.1 is modeled separately as discussed in Table I.2-3).

2. The HEP associated with the starting of a component cooling water pump, CCHFDSTART, has a value of 7E-3 for the internal events PSA. This value was judged to be applicable to control room evacuation scenarios as the starting of the pump is a specific procedural step performed as part of ER-FIRE.1.

3. The HEPs associated with the alignment and starting of a charging pump, CVHFDSUCTN and CVHFDPMPST, have values of 2.4E-2 and 7E-3 for the internal events PSA. These values are judged to be applicable to control room evacuation scenarios as the actions are guided by specific procedural steps performed as part of ER-FIRE.1.

I.2.1.2 Impairment of Access for Local Actions

Human error probabilities were adjusted to a value of 1.0 if local actions are required in areas of the plant where significant accumulations occur. These considerations are discussed in Table I.2-2 for internal events HEPs, and in Table I.2-3 for HEPs defined specifically for internal flooding scenarios.

I.2.1.3 Impacts to Lighting and Communications

No flood-related impacts to operator performance shaping factors were identified with respect to lighting and communications. Sufficient lighting is provided by eight-hour battery-backed lights in the event that normal plant lighting is impacted by flood, and redundant and diverse radio systems are in place to support plant communications.

I.2.1.4 Impacts Arising from Increased Stress

Elevated levels of stress levels were judged to be induced by the following flood scenarios:

1. Flood events that result in significant damage to equipment located in the relay room are postulated to result in a significant loss of instrumentation and control and require operators to shut down the plant from outside of the control room. The human error probabilities developed for these actions are discussed in Section I.2.2.

2. Flood events that result in a complete loss of DC power are postulated to result in a loss of all instrumentation and control. These scenarios were assumed to result in core damage, and no human error probabilities apply.

For other flood scenarios, operators are well trained to perform actions associated with plant shutdown and are not expected to perform differently with the exception of influences on performance shaping factors resulting from indications degradation as discussed in Section I.2.1.1 and impaired access as discussed in Section I.2.1.2.

I.2.2 Development of Human Error Probabilities Specific to Internal Flooding Events

The development of internal flooding-related human error probabilities is documented in Table I.2-3.

I.2.3 Potential Human Error Probability Dependencies

Potential dependencies between multiple human error probabilities that appear in the flood PSA cutsets were quantified by raising the HEPs for successive actions. Such considerations are as follows:

1. Consideration of the potential dependencies between internal events HEPs has been addressed as part of the internal events PSA and is thus not duplicated here.

2. Potential dependencies between multiple HEPs specific to internal flooding events were examined and the following modeling considerations were made:

    - Successful performance of actions pertaining to plant shutdown from outside of the control room are all contingent upon successfully diagnosing the need to enter the pertinent control room evacuation procedure ER-FIRE.1. A single diagnosis error was modeled for failure to enter ER-FIRE.1. A failure of this diagnosis for the applicable flood scenario is assumed to result in core damage.

    - As part of shutting down the plant from outside of the control room, potential dependencies between the actions necessary to align auxiliary feedwater (AFW) or standby auxiliary feedwater (SAF) are reflected in the HEPs defined for these actions. A failure to align the Turbine-driven Auxiliary Feedwater (TDAFW) Pump (5E-3) was assumed to cause an increased likelihood for failure to subsequently align AFW Pump A (0.5) or SAF Pump C (0.5).

- As part of shutting down the plant from outside of the control room, the alignment of Diesel Generator (DG) A to safeguards Buses 14 and 18 is modeled with three HEPs. These three HEPs are performed by different persons and therefore judged to not be significantly influenced by dependencies (beyond the common diagnosis error for entering the control room evacuation procedure discussed above).

- HEPs pertaining specifically to screen house flood scenarios consist of the failure to isolate the leak prior to disabling the service water system and the failure to align the Technical Support Center (TSC) diesel generator for operating a charging pump and the reactor shroud fans (to support adequate reactor coolant system circulation following station blackout). Alignment of the TSC diesel generator is performed locally. No significant dependencies are judged to exist between the operator performing this action and the operators that remain within the control room to perform plant shutdown.

- No other combinations of HEPs specific to internal flooding scenarios exist in the flooding PSA.

3. Potential dependencies between internal events HEPs and internal flooding HEPs were examined and the following modeling considerations were made:

   - Dependencies between actions taken to perform plant shutdown and actions taken to isolate leaks: The human error probabilities for the location and isolation of flooding leaks were conservatively assigned to reflect the fact that actions may be concurrently taken to perform plant shutdown.

   - Dependencies between actions taken to perform plant shutdown and actions taken to align the TSC diesel generator as part of screen house flood scenarios: Alignment of the TSC diesel generator is performed locally, and therefore, no significant dependencies are judged to exist between the

operator performing this action and the operators that remain within the control room to perform plant shutdown.

- No other combinations of internal events HEPs and HEPs specific to internal flooding scenarios exist in the flooding PSA.

I.2.4 References

I.2-1 *Ginna Station Cable Routing and Equipment Locations Database,* Microsoft Access Database, CABLETRK.MDB, June 1998.

I.2-2 NUREG/CR-1278, *Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Application*, October 1980.

I.2-3 *Individual Plant Examination of External Events for San Onofre Nuclear Generating Station*, Submittal Document, Southern California Edison, December 1995.

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
ABB	LT-428A	PRZR LVL WIDE RANGE-XMTR
ABB	LT-433	PRZR LVL XMTR-WIDE RANGE
ABB	LT-920	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 920
ABB	LT-921	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 921
ABB	PT-420B	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420B
ABB	PT-922	SI P "1A" DISCH PRESS XMTR
ABB	PT-923	SI P "1B" DISCH PRESS XMTR
ABM	FT-4084	FLOW TRANSMITTER STANDBY AFW PUMP PSF01A DISCH INST LOOP 4084
ABM	FT-4085	FLOW TRANSMITTER STANDBY AFW PUMP PSF01B DISCH INST LOOP 4085
ABM	FT-416	RC FLOW LOOP "B" XMTR
ABM	FT-464	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 464
ABM	FT-465	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 465
ABM	FT-474	FLOW TRANSMITTER STEAM GENERATOR EMS01B
ABM	FT-475	FLOW TRANSMITTER STEAM GENERATOR EMS01B STEAM FLOW
ABM	LT-112	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04
ABM	LT-139	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04 INST LOOP 139
ABM	LT-426	PRZR LVL XMTR
ABM	LT-427	LEVEL TRANSMITTER PRESSURIZER INSTRUMENT LOOP 427
ABM	LT-428A	PRZR LVL WIDE RANGE-XMTR
ABM	LT-433	PRZR LVL XMTR-WIDE RANGE
ABM	LT-461	LEVEL TRANSMITTER STEAM GENERATOR EMS01A NARROW RANGE
ABM	LT-463	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 463
ABM	LT-471	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 471
ABM	LT-472	LEVEL TRANSMITTER SG B NARROW RANGE INSTRUMENT LOOP 472
ABM	LT-505	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
ABM	LT-507	STEAM GENERATOR EMS01B WIDE RANGE LEVEL TRANSMITTER
ABM	LT-920	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 920
ABM	LT-921	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 921
ABM	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
ABM	PT-420	PRESSURE TRANSMITTER RC HOT LEG INST LOOP 420
ABM	PT-420B	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420B
ABM	PT-429	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 429
ABM	PT-430	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 430
ABM	PT-449	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 449
ABM	PT-922	SI P "1A" DISCH PRESS XMTR
ABM	PT-923	SI P "1B" DISCH PRESS XMTR
ABM	PT-945	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 945
ABM	PT-946	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 946
ABM	TE-404A&B	TEMPERATURE ELEMENT RCS LOOP B HOT LEG INSTRUMENT LOOP 404
ABM	TE-408A&B	LOOP "B" HOT LEG TEMP ELEMENT
ABM	TE-410A1	LOOP "B" HOT LEG TEMP ELEM
ABM	TE-410B1	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
ABO	FT-4084	FLOW TRANSMITTER STANDBY AFW PUMP PSF01A DISCH INST LOOP 4084
ABO	LT-921	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 921
AHR	FT-2001	MTR DRIVEN AUXFW P "1A" DISCH FLO XMTR
AHR	FT-2002	MTR DRIVEN AUXFW P "1B" DISCH FLO XMTR
AHR	FT-2006	TURB DRIVEN AUX FW FLO TO S/G"1A" FLO XMTR
AHR	FT-2007	TURB DRIVEN AUX FW FLO TO S/G"1B" FLO XMTR
AHR	FT-2014	MTR DRIVEN AUXFW P "1B" DISCH FLOW XMTR
AHR	FT-2015	TURB DRIVEN AUX FW P DISCH FLO XMTR

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
AHR	FT-4084	FLOW TRANSMITTER STANDBY AFW PUMP PSF01A DISCH INST LOOP 4084
AHR	FT-4085	FLOW TRANSMITTER STANDBY AFW PUMP PSF01B DISCH INST LOOP 4085
AHR	FT-411	RC FLOW LOOP "A" XMTR
AHR	FT-412	RC FLOW LOOP "A" XMTR
AHR	FT-414	RC FLOW LOOP "B" XMTR
AHR	FT-464	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 464
AHR	FT-474	FLOW TRANSMITTER STEAM GENERATOR EMS01B
AHR	FT-924	SI LOOP "B" HOT LEG FLOW XMTR
AHR	FT-925	SI LOOP "A" HOT LEG FLOW XMTR
AHR	LT-112	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04
AHR	LT-139	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04 INST LOOP 139
AHR	LT-2022A	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02A INST LOOP 2022
AHR	LT-2022B	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02B INST LOOP 2022
AHR	LT-426	PRZR LVL XMTR
AHR	LT-427	LEVEL TRANSMITTER PRESSURIZER INSTRUMENT LOOP 427
AHR	LT-433	PRZR LVL XMTR-WIDE RANGE
AHR	LT-461	LEVEL TRANSMITTER STEAM GENERATOR EMS01A NARROW RANGE
AHR	LT-472	LEVEL TRANSMITTER SG B NARROW RANGE INSTRUMENT LOOP 472
AHR	LT-473	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 473
AHR	LT-504	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
AHR	LT-505	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
AHR	LT-507	STEAM GENERATOR EMS01B WIDE RANGE LEVEL TRANSMITTER
AHR	LT-920	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 920
AHR	LT-921	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 921
AHR	LT-934	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 934
AHR	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
AHR	LT-938	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 938
AHR	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
AHR	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
AHR	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
AHR	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
AHR	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
AHR	NE-41B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-41
AHR	NE-42B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-42
AHR	NE-43B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-43
AHR	NE-44B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-44
AHR	PT-420	PRESSURE TRANSMITTER RC HOT LEG INST LOOP 420
AHR	PT-420A	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420A
AHR	PT-429	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 429
AHR	PT-430	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 430
AHR	PT-449	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 449
AHR	PT-450	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
AHR	PT-451	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
AHR	PT-452	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 452
AHR	PT-468	PRESSURE TRANSMITTER SG EMS01A INST LOOP 468
AHR	PT-469	PRESSURE TRANSMITTER SG EMS01A
AHR	PT-478	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 478
AHR	PT-483	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 483
AHR	PT-922	SI P "1A" DISCH PRESS XMTR
AHR	PT-923	SI P "1B" DISCH PRESS XMTR
AHR	PT-936	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 936

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
AHR	PT-937	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 937
AHR	PT-940	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 940
AHR	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
AHR	PT-945	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 945
AHR	PT-946	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 946
AHR	PT-949	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 949
AHR	TE-401A&B	TEMPERATURE ELEMENT RCS LOOP A HOT LEG INSTRUMENT LOOP 401
AHR	TE-402A&B	TEMPERATURE ELEMENT LOOP A HOT LEG INSTRUMENT LOOP 402
AHR	TE-405A&B	LOOP "A" HOT LEG TEMP ELEMENT
AHR	TE-406A&B	LOOP "A" HOT LEG TEMP ELEMENT
AHR	TE-409A1	LOOP "A" HOT LEG TEMP ELEMENT
AHR	TE-409B1	LOOP "B" HOT LEG TEMP ELEMENT
AHR	TE-410A1	LOOP "B" HOT LEG TEMP ELEM
AHR	TE-410B1	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
AHR	TE-410B2	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
BR1A	LLSG-A-A	AUTO START RELAY SG A LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1A	LLSG-A-B	AUTO START RELAY SG A LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1A	LT-112	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04
BR1A	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
BR1A	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
BR1A	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
BR1A	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
BR1A	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
BR1A	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
BR1A	NE-41B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-41
BR1A	NE-42B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-42
BR1A	NE-43B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-43
BR1A	NE-44B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-44
BR1A	PT-923	SI P "1B" DISCH PRESS XMTR
BR1A	PT-937	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 937
BR1A	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
BR1B	LLSG-A-A	AUTO START RELAY SG A LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1B	LLSG-A-B	AUTO START RELAY SG A LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1B	LLSG-B-A	AUTO START RELAY SG B LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1B	LLSG-B-B	AUTO START RELAY SG B LO LEVEL AFW PUMPS PAF01A & PAF01B
BR1B	LT-112	LEVEL TRANSMITTER VOLUME CONTROL TANK TCH04
BR1B	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
BR1B	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
BR1B	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
BR1B	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
BR1B	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
BR1B	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
BR1B	NE-41B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-41
BR1B	NE-42B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-42
BR1B	NE-43B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-43
BR1B	NE-44B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-44
BR1B	PT-937	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 937
BR1B	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
CHG	LT-428A	PRZR LVL WIDE RANGE-XMTR
CHG	PT-420B	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420B
EDG1A	LIT-2051A	LEVEL INDICATING TRANSMITTER KDG01A DAY TANK

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
EDG1B	LIT-2051B	LEVEL INDICATING TRANSMITTER KDG01B DAY TANK
IBN-1	FT-2001	MTR DRIVEN AUXFW P "1A" DISCH FLO XMTR
IBN-1	FT-2002	MTR DRIVEN AUXFW P "1B" DISCH FLO XMTR
IBN-1	FT-2006	TURB DRIVEN AUX FW FLO TO S/G"1A" FLO XMTR
IBN-1	FT-2007	TURB DRIVEN AUX FW FLO TO S/G"1B" FLO XMTR
IBN-1	FT-2014	MTR DRIVEN AUXFW P "1B" DISCH FLOW XMTR
IBN-1	FT-2015	TURB DRIVEN AUX FW P DISCH FLO XMTR
IBN-1	FT-2015A	TURB DRIVEN AUX FW P DISCH FLO XMTR
IBN-1	FT-411	RC FLOW LOOP "A" XMTR
IBN-1	FT-412	RC FLOW LOOP "A" XMTR
IBN-1	FT-413	RC FLOW LOOP "A" XMTR
IBN-1	FT-414	RC FLOW LOOP "B" XMTR
IBN-1	FT-415	RC FLOW LOOP "B" XMTR
IBN-1	FT-924	SI LOOP "B" HOT LEG FLOW XMTR
IBN-1	FT-925	SI LOOP "A" HOT LEG FLOW XMTR
IBN-1	LT-2022A	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02A INST LOOP 2022
IBN-1	LT-2022B	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02B INST LOOP 2022
IBN-1	LT-428	LEVEL TRANSMITTER PRESSURIZER CHANNEL 3 INSTRUMENT LOOP 428
IBN-1	LT-433	PRZR LVL XMTR-WIDE RANGE
IBN-1	LT-460A	STEAM GENERATOR EMS01A LEVEL WIDE RANGE APPENDIX R TRANSMITTER
IBN-1	LT-462	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 462
IBN-1	LT-473	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 473
IBN-1	LT-504	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
IBN-1	LT-921	LEVEL TRANSMITTER RWST TSI01 INSTRUMENT LOOP 921
IBN-1	LT-934	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 934
IBN-1	LT-938	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 938
IBN-1	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
IBN-1	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
IBN-1	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
IBN-1	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
IBN-1	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
IBN-1	NE-41B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-41
IBN-1	NE-42B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-42
IBN-1	NE-43B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-43
IBN-1	NE-44B	NIS POWER RANGE LOWER DETECTOR CHANNEL N-44
IBN-1	PT-420A	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420A
IBN-1	PT-431	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 431
IBN-1	PT-449	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 449
IBN-1	PT-450	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
IBN-1	PT-451	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
IBN-1	PT-452	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 452
IBN-1	PT-468	PRESSURE TRANSMITTER SG EMS01A INST LOOP 468
IBN-1	PT-469	PRESSURE TRANSMITTER SG EMS01A INST LOOP 469
IBN-1	PT-469A	PRESSURE TRANSMITTER STEAM GENERATOR EMS01A
IBN-1	PT-478	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 478
IBN-1	PT-479	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 479
IBN-1	PT-482	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 479
IBN-1	PT-483	PRESSURE TRANSMITTER SG EMS01B INSTRUMENT LOOP 483
IBN-1	PT-936	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 936
IBN-1	PT-937	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 937
IBN-1	PT-940	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 940

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
IBN-1	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
IBN-1	PT-945	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 945
IBN-1	PT-946	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 946
IBN-1	PT-947	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 947
IBN-1	PT-948	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 948
IBN-1	PT-949	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 949
IBN-1	PT-950	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 950
IBN-1	TE-401A&B	TEMPERATURE ELEMENT RCS LOOP A HOT LEG INSTRUMENT LOOP 401
IBN-1	TE-402A&B	TEMPERATURE ELEMENT LOOP A HOT LEG INSTRUMENT LOOP 402
IBN-1	TE-403A&B	TEMPERATURE ELEMENT RCS LOOP B HOT LEG INSTRUMENT LOOP 403
IBN-1	TE-405A&B	LOOP "A" HOT LEG TEMP ELEMENT
IBN-1	TE-406A&B	LOOP "A" HOT LEG TEMP ELEMENT
IBN-1	TE-407A&B	LOOP "B" HOT LEG TEMP ELEM
IBN-1	TE-409A1	LOOP "A" HOT LEG TEMP ELEMENT
IBN-1	TE-409A2	LOOP "A" HOT LEG TEMP ELEMENT
IBN-1	TE-409B1	LOOP "B" HOT LEG TEMP ELEMENT
IBN-1	TE-409B2	LOOP "B" HOT LEG TEMP ELEMENT
IBN-1	TE-410A1	LOOP "B" HOT LEG TEMP ELEM
IBN-1	TE-410B2	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
IBN-2	PT-468	PRESSURE TRANSMITTER SG EMS01A INST LOOP 468
IBS-1	LT-2022A	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02A INST LOOP 2022
IBS-1	LT-2022B	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02B INST LOOP 2022
IBS-1	PT-947	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 947
IBS-1	PT-948	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 948
IBS-2	PT-947	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 947
IBS-2	PT-948	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 948
IBS-2	PT-949	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 949
IBS-2	PT-950	PRESSURE TRANSMITTER CONTAINMENT PRESSURE INSTRUMENT LOOP 950
RC-1	FT-411	RC FLOW LOOP "A" XMTR
RC-1	FT-412	RC FLOW LOOP "A" XMTR
RC-1	FT-413	RC FLOW LOOP "A" XMTR
RC-1	FT-414	RC FLOW LOOP "B" XMTR
RC-1	FT-415	RC FLOW LOOP "B" XMTR
RC-1	FT-416	RC FLOW LOOP "B" XMTR
RC-1	FT-924	SI LOOP "B" HOT LEG FLOW XMTR
RC-1	FT-925	SI LOOP "A" HOT LEG FLOW XMTR
RC-1	LT-426	PRZR LVL XMTR
RC-1	LT-427	LEVEL TRANSMITTER PRESSURIZER INSTRUMENT LOOP 427
RC-1	LT-428A	PRZR LVL WIDE RANGE-XMTR
RC-1	LT-433	PRZR LVL XMTR-WIDE RANGE
RC-1	LT-460A	STEAM GENERATOR EMS01A LEVEL WIDE RANGE APPENDIX R TRANSMITTER
RC-1	LT-504	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
RC-1	LT-507	STEAM GENERATOR EMS01B WIDE RANGE LEVEL TRANSMITTER
RC-1	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
RC-1	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
RC-1	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
RC-1	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
RC-1	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
RC-1	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
RC-1	NE-41A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-41
RC-1	NE-42A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-42

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
RC-1	NE-43A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-43
RC-1	NE-44A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-44
RC-1	PT-420A	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420A
RC-1	PT-420B	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420B
RC-1	PT-430	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 430
RC-1	PT-431	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 431
RC-1	PT-449	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 449
RC-1	PT-450	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
RC-1	PT-451	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
RC-1	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
RC-1	TE-403A&B	TEMPERATURE ELEMENT RCS LOOP B HOT LEG INSTRUMENT LOOP 403
RC-1	TE-407A&B	LOOP "B" HOT LEG TEMP ELEM
RC-1	TE-409B1	LOOP "B" HOT LEG TEMP ELEMENT
RC-1	TE-410A1	LOOP "B" HOT LEG TEMP ELEM
RC-1	TE-410B1	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
RC-1	TE-410B2	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
RC-2	FT-411	RC FLOW LOOP "A" XMTR
RC-2	FT-412	RC FLOW LOOP "A" XMTR
RC-2	FT-413	RC FLOW LOOP "A" XMTR
RC-2	FT-414	RC FLOW LOOP "B" XMTR
RC-2	FT-415	RC FLOW LOOP "B" XMTR
RC-2	FT-416	RC FLOW LOOP "B" XMTR
RC-2	FT-464	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 464
RC-2	FT-465	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 465
RC-2	FT-474	FLOW TRANSMITTER STEAM GENERATOR EMS01B
RC-2	FT-475	FLOW TRANSMITTER STEAM GENERATOR EMS01B STEAM FLOW
RC-2	FT-924	SI LOOP "B" HOT LEG FLOW XMTR
RC-2	FT-925	SI LOOP "A" HOT LEG FLOW XMTR
RC-2	LT-426	PRZR LVL XMTR
RC-2	LT-427	LEVEL TRANSMITTER PRESSURIZER INSTRUMENT LOOP 427
RC-2	LT-428A	PRZR LVL WIDE RANGE-XMTR
RC-2	LT-433	PRZR LVL XMTR-WIDE RANGE
RC-2	LT-460A	STEAM GENERATOR EMS01A LEVEL WIDE RANGE APPENDIX R TRANSMITTER
RC-2	LT-461	LEVEL TRANSMITTER STEAM GENERATOR EMS01A NARROW RANGE
RC-2	LT-462	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 462
RC-2	LT-463	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 463
RC-2	LT-471	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 471
RC-2	LT-472	LEVEL TRANSMITTER SG B NARROW RANGE INSTRUMENT LOOP 472
RC-2	LT-473	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 473
RC-2	LT-504	STEAM GENERATOR EMS01A WIDE RANGE LEVEL TRANSMITTER
RC-2	LT-507	STEAM GENERATOR EMS01B WIDE RANGE LEVEL TRANSMITTER
RC-2	LT-934	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 934
RC-2	LT-935	LEVEL TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 935
RC-2	LT-938	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 938
RC-2	LT-939	LEVEL TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 939
RC-2	NE-31	NIS SOURCE RANGE DETECTOR CHANNEL N-31
RC-2	NE-32	NIS SOURCE RANGE DETECTOR CHANNEL N-32
RC-2	NE-35	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-35
RC-2	NE-36	NIS INTERMEDIATE RANGE DETECTOR CHANNEL N-36
RC-2	NE-41A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-41
RC-2	NE-42A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-42

Table I.2-1
Instrumentation Cable Inventory[1]

Flood Zone	Equipment Associated With Cable	Function
RC-2	NE-43A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-43
RC-2	NE-44A	NIS POWER RANGE UPPER DETECTOR CHANNEL N-44
RC-2	PT-420	PRESSURE TRANSMITTER RC HOT LEG INST LOOP 420
RC-2	PT-420A	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420A
RC-2	PT-420B	PRESSURE TRANSMITTER REACTOR COOLANT SYSTEM INST LOOP 420B
RC-2	PT-429	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 429
RC-2	PT-430	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 430
RC-2	PT-431	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 431
RC-2	PT-449	PRESSURE TRANSMITTER PRESSURIZER PRESSURE INSTRUMENT LOOP 449
RC-2	PT-450	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
RC-2	PT-451	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 450
RC-2	PT-452	PRESSURE TRANSMITTER RC OVERPRESSURE PROTECTION INST LOOP 452
RC-2	PT-936	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 936
RC-2	PT-937	PRESSURE TRANSMITTER ACCUMULATOR B INSTRUMENT LOOP 937
RC-2	PT-940	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 940
RC-2	PT-941	PRESSURE TRANSMITTER ACCUMULATOR A INSTRUMENT LOOP 941
RC-2	TE-401A&B	TEMPERATURE ELEMENT RCS LOOP A HOT LEG INSTRUMENT LOOP 401
RC-2	TE-402A&B	TEMPERATURE ELEMENT LOOP A HOT LEG INSTRUMENT LOOP 402
RC-2	TE-403A&B	TEMPERATURE ELEMENT RCS LOOP B HOT LEG INSTRUMENT LOOP 403
RC-2	TE-404A&B	TEMPERATURE ELEMENT RCS LOOP B HOT LEG INSTRUMENT LOOP 404
RC-2	TE-405A&B	LOOP "A" HOT LEG TEMP ELEMENT
RC-2	TE-406A&B	LOOP "A" HOT LEG TEMP ELEMENT
RC-2	TE-407A&B	LOOP "B" HOT LEG TEMP ELEM
RC-2	TE-408A&B	LOOP "B" HOT LEG TEMP ELEMENT
RC-2	TE-409A2	LOOP "A" HOT LEG TEMP ELEMENT
RC-2	TE-409B1	LOOP "B" HOT LEG TEMP ELEMENT
RC-2	TE-409B2	LOOP "B" HOT LEG TEMP ELEMENT
RC-2	TE-410A1	LOOP "B" HOT LEG TEMP ELEM
RC-2	TE-410B1	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
RC-2	TE-410B2	TEMPERATURE ELEMENT FOR LOOP B COLD LEG
RC-3	FT-464	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 464
RC-3	FT-465	FLOW TRANSMITTER SG EMS01A STEAM FLOW INST LOOP 465
RC-3	LT-461	LEVEL TRANSMITTER STEAM GENERATOR EMS01A NARROW RANGE
RC-3	LT-462	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 462
RC-3	LT-463	LEVEL TRANSMITTER SG EMS01A NARROW RANGE INST LOOP 463
RC-3	LT-471	LEVEL TRANSMITTER SG EMS01B NARROW RANGE INSTRUMENT LOOP 471
SAF	FT-4084	FLOW TRANSMITTER STANDBY AFW PUMP PSF01A DISCH INST LOOP 4084
SAF	FT-4085	FLOW TRANSMITTER STANDBY AFW PUMP PSF01B DISCH INST LOOP 4085
SB-1WT	LT-2022A	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02A INST LOOP 2022
SB-1WT	LT-2022B	LEVEL TRANSMITTER CONDENSATE STORAGE TANK TCD02B INST LOOP 2022
TB-2	PT-485	PRESSURE TRANSMITTER TURBINE 1ST STAGE
TB-2	PT-486	PRESSURE TRANSMITTER TURBINE 1ST STAGE

Note

1 Inventory obtained from the Ginna Station Cable Routing and Equipment Locations Database (Ref I.2-1).

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
AFHFDALTTD	Operators Fail to Provide Cooling to TDAFW Lube Oil Using Fire Water	0.0067	Local action; at least four hours are available to complete this action (the pump has run without impairment for four hours without lube oil cooling). Relevant indications are assumed to be disabled by intermediate building floods and an 1.0 HEP was therefore assigned for these scenarios. (For large intermediate building floods that are not isolated prior to significant accumulation, access necessary to perform this action is also postulated to be impeded as well.) For all other floods scenarios, the internal events PSA HEP was used.
AFHFDSAFWX	Operators Fail to Correctly Align SAF System	0.00519	Control room action; forty five minutes are available. No flood scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications: SG level, AFW flow. The internal events PSA HEP was therefore used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
AFHFDSUPPL	Operators Fail to Supply Alternate Sources of Water to AFW	0.001	Local action performed within 4.25 hours after initiator as directed by procedure ER-AFW.1. Relevant indication (CST level) is lost for floods occurring in the service building that result in significant accumulations. However, given the significant time available, it is judged that the lack of direct CST level indication would not impact the performance shaping factors associated with this action since the emergency operating procedures instruct operators to continually verify CST level which can be inferred based on AFW flow rate (AFW flow indication is not impacted by service building floods). Access necessary to perform this action is postulated to be impeded for large intermediate building floods that are not isolated prior to significant accumulation. The probability for supplying alternate water sources to the AFW pumps is therefore assigned to be 1.0 for this scenario. For all other flood scenarios, the internal events PSA value was used.
AFHFDTDAFW	Operator Fail to Manually Open Steam Valves to TDAFW Pump	0.1	Local action performed in the intermediate building; 45 minutes available. For large intermediate building floods that are not isolated prior to significant accumulation, the assumed HEP is 1.0 due to the assumption that operator access is impeded. No other flood scenario, to which this action would apply, was identified which could disable all SG level and AFW flow indication nor impede access. The internal events PSA human error probability was therefore used for other flood scenarios.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
CCHFDCCWAB	Operators Fail to Start Standby CCW Pump if Auto Start Signal Fails	0.007	Control room action. Diverse indications are available (CCW system status, CCW heat loads temperature alarms). No flooding scenario was identified in which all relevant indications would be unavailable. The internal events PSA human error probability was therefore used.
CCHFDSTART	Operator Fails to Start a CCW Pump Following an Event with Both a Loop and SI	0.007	Control room action. Diverse indications are available (CCW system status, CCW heat loads temperature alarms). No flooding scenario was identified in which all relevant indications would be unavailable. The internal events PSA human error probability was therefore used.
CTHFDCSMOV	Operators Fail to Close MOVs 860A/B/C/D After Isolating Containment Spray	0.1	The internal events PSA value used; action is a procedural step that would occur several hours after a flood.
CVHFD00313	Operators Fail to Manually Isolate MOV 313 (Seal Return)	0.013	Large LOCA accident sequences are not credible for flood-induced initiating events.
CVHFD00313-M	Operators Fail to Manually Isolate MOV 313 (Seal Return)	0.0053	Procedural step performed following a medium LOCA to prevent a potential interfacing systems LOCA (ISLOCA). Valve 313 position status indication cables were not traced, however this action is a procedural step and such indication is only confirmatory.
CVHFD00313-S	Operators Fail to Manually Isolate MOV 313 (Seal Return)	0.0012	Procedural step performed following a small LOCA to prevent a potential ISLOCA. Valve 313 position status indication cables were not traced, however this action is a procedural step and such indication is only confirmatory.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
CVHFD00313-SS	Operators Fail to Manually Isolate MOV 313 (Seal Return)	0.0012	Procedural step performed following a small-small LOCA to prevent a potential ISLOCA. Valve 313 position status indication cables were not traced, however this action is a procedural step and such indication is only confirmatory.
CVHFD00371	Operators Fail to Manually Isolate AOV 371 (Letdown Line)	0.013	Large LOCA accident sequences are not credible for flood-induced initiating events.
CVHFD00371-M	Operators Fail to Manually Isolate AOV 371 (Letdown Line)	0.0053	Procedural step performed following a medium LOCA; control room action; seventy minutes are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. Although operators can utilize local level measurements, an HEP of 1.0 was used due to the relatively short time available. For all other flooding scenarios, the internal events PSA HEP was used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
CVHFD00371-S	Operators Fail to Manually Isolate AOV 371 (Letdown Line)	0.0012	Procedural step performed following a small LOCA; control room action; three hours are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. However, operators can utilize local level measurements and the internal events HEP was therefore applied, given the significant time available prior to performing the action. For all other flooding scenarios, the internal events PSA HEP was used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
CVHFD00371-SS	Operators Fail to Manually Isolate AOV 371 (Letdown Line)	0.0012	Control room action performed following a small-small LOCA; six hours are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. However, operators can utilize local level measurements and the internal events HEP was therefore applied, given the significant time available prior to performing the action. For all other flooding scenarios, the internal events PSA HEP was used.
CVHFDBORAT	Operators Fail To Implement Emergency Boration	0.01	Procedural step performed from the control room. Diverse indications are available. Flooding scenarios involving the submergence of both battery rooms could result in loss of relevant indications (instrumentation cables installed near the ceiling could be submerged). An HEP of 1.0 was therefore assumed for these scenarios. For all other scenarios, the internal events HEP was used since the action is performed from the control room and relevant indications are not impacted by floods.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
CVHFDPMPST	Operators Fail to Manually Load Charging Pump	0.007	Control room action which occurs one hour after initiator; this is a procedural step following an SI or undervoltage signal. No flood scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications: SI signal, undervoltage signals. The internal events PSA HEP was therefore used.
CVHFDSUCTN	Operators Fail to Manually Open Charging Pump Suction Line Upon Loss of instrument air or DC power	0.024	Local action; one hour available. A failure probability of 1.0 was applied for all turbine building flood scenarios. No other flood scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications--SG level, AFW flow--nor impede access. The internal events PSA HEP was therefore used.
HVHFD_CTMT	Operator Fails to Re-Start Containment Cooling	0.1	The internal events PSA HEP was judged to be sufficiently conservative, given the significant time available.
IAHFDCSA03	Operators Fail to Place Containment Breathing Air Compressor In Service	0.1	Procedural step performed from the control room in the event of loss of instrument air. Diverse indications are available. No flooding scenario was identified that would disable necessary indications. The internal events PSA HEP was therefore used.
IAHFDCSA04	Operators Fail to Place the Diesel Air Compressor in Service	0.1	Procedural step performed locally in the event of loss of instrument air. Diverse indications are available. No flooding scenario was identified that would disable necessary indications, nor impede access (the compressor is installed in the yard). The internal events PSA HEP was therefore used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
MFHFDMF100	Operator Fails To Reestablish Main Feedwater Flow	0.012	Local action performed in the turbine building; 45 minutes are available. A failure probability of 1.0 was applied for all turbine building flood scenarios. No other flood scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications: SG level, AFW flow, nor impede access. The internal events PSA HEP was therefore used.
MSHFDISOLA	Operators Fail to Isolate Ruptured S/G	0.1	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
MSHFDISOLR	Operators Fail to Isolate Ruptured S/G	0.00724	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
MSHFDISOLRN	Operators Successfully Isolates Ruptured S/G	0.99276	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
MSHFDMSIVX	Operators Fails to Close MSIV	0.1	Not applicable. This event applies to steam line break accident sequences which are not credible for flood-induced initiating events.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
RCHFDOOMRI	Operators Fail to Manually Insert Rods	0.01	Procedural step performed from the control room. Diverse indications are available. Flooding scenarios involving the submergence of both battery rooms could result in loss of relevant indications (instrumentation cables installed near the ceiling could be submerged). An HEP of 1.0 was therefore assumed for these scenarios. For all other scenarios, the internal events HEP was used since the action is performed from the control room and relevant indications are not impacted by floods.
RCHFDOORCP	Operators Fail to Trip RCPs After Loss of Support Systems	0.0161	Control room action; RCP seal support system failure modes (charging and CCW) typically occur over an extended time frame; circuits associated with relevant indications have not been routed but diverse indications available. A 0.1 HEP was used to account for potential losses of indication.
RCHFD01BAF	Operators Fail To Implement Feed And Bleed	0.053	Control room action performed as soon as one hour after the initiator. No flood scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications: SI pump discharge, SG level, AFW flow, pressurizer pressure and pressurizer level. The internal events PSA HEP was therefore used.
RCHFD01RCP	Operators Fail to Restore RCP Seal Cooling Within One Hour	1.0	The internal events PSA HEP equals 1.0 since this is a tagging event; no change was made to the value for the flooding PSA.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
RCHFDCD0SS	Operator Fails to Cooldown to RHR After SI Fails (Injection or Recirc) - SSLOCA	0.037	Core cooling recovery performed from control room. No flooding scenario, to which this action would apply, was identified which could cause a significant loss of relevant indications: SI pump discharge and pressurizer level. The internal events PSA HEP was therefore used.
RCHFDCDDPR	Operators Fail To Cooldown and Depressurize RCS During SGTR Prior to Overfill	0.00961	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
RCHFDCDOVR	Operators Fail to Cooldown to RHR Conditions After Overfill Occurs	0.0307	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
RCHFDCDTR2	Operator Fails to Cooldown to RHR After SI Fails - SGTR	0.0307	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
RCHFDCOOLD	Operators Fail to Rapidly Cooldown to RHR Conditions After ARV Sticks Open	0.0307	Not applicable. This event applies to SGTR accident sequences which are not credible for flood-induced initiating events.
RCHFDHEATR	Operators Fail to Load Pressurizer Heaters Following a Loop or SI Signal	0.00031	Procedural step performed several hours after an initiator from the control room; the internal events PSA HEP was therefore used.
RCHFDPLOCA	Operators Fail To Close PORV Block Valve (515/516) To Terminate LOCA W/In 3 Min	0.1	Procedural step performed from the control room in the event a PORV sticks open; circuits associated with PORV position indication were not traced, therefore, they cannot be assured to be available. Due to potential unavailability of adequate indication (PORV position, pressurizer level), a 0.5 HEP was used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
RCHFDRHRSB	Operator Fails to Rapidly Depressurize to RHR (or Use AFW Long-Term)	0.005	Procedural step required to align RHR closed-cycle cooling for core cooling recovery (after station blackout or failure of steam generator cooling). Diverse indications are available. No flooding scenario was identified that would disable necessary indications. The internal events PSA HEP was therefore used.
RCHFDSCRAM	Operators Fail to Trip Rod Drive MG Sets During ATWS	0.01	Procedural step performed from the control room. Diverse indications are available. Flooding scenarios involving the submergence of both battery rooms could result in loss of relevant indications (instrumentation cables, installed near the ceiling could be submerged). An HEP of 1.0 was therefore assumed for these scenarios. For all other scenarios, the internal events HEP was used since the action is performed from the control room and relevant indications are not impacted by floods.
RRHFDRECRC	Operator Fails to Correctly Shift the RHR System to Recirculation and Isolate CS	0.013	Not applicable. This event applies to large LOCA accident sequences which are not credible for flood-induced initiating events.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
RRHFDRECRC-M	Operator Fails to Correctly Shift the RHR System to Recirculation and ISOL CS	0.0053	Control room action performed following a medium LOCA; seventy minutes are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. Although operators can utilize local level measurements an HEP of 1.0 was used due to the relatively short time available. For all other flooding scenarios, the internal events PSA HEP was used.
RRHFDRECRC-S	Operator Fails to Correctly Shift the RHR System to Recirculation and ISOL CS	0.0012	Control room action performed following a small LOCA; three hours are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. However, operators can utilize local level measurements and the internal events HEP was therefore applied, given the significant time available prior to performing the action. For all other flooding scenarios, the internal events PSA HEP was used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
RRHFDRECRC-SS	Operator Fails to Correctly Shift the RHR System to Recirculation and ISOL CS	0.0012	Control room action performed following a small-small LOCA; six hours are available. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. However, operators can utilize local level measurements and the internal events HEP was therefore applied, given the significant time available prior to performing the action. For all other flooding scenarios, the internal events PSA HEP was used.
RRHFDSUCTN	Operators Fail to Manually Open RHR Suction Valves	0.1	Procedural step performed from the control room to align RHR closed-cycle cooling (after station blackout or failure of steam generator cooling). Diverse indications are available. No flooding scenario was identified that would disable necessary indications. The internal events PSA HEP was therefore used.
RRHFDTHROT	Operators Fail to Throttle RHR Flow When Required	0.1	Procedural step performed from the control room to control RHR closed-cycle cooling (after station blackout or failure of steam generator cooling). Diverse indications are available. No flooding scenario was identified that would disable necessary indications. The internal events PSA HEP was therefore used.

Table I.2-2

Re-evaluation of Internal Events PSA Human Error Probabilities for Internal Flooding Accident Sequences

Human Error Event Label	Description	HEP Used in the Ginna Internal Events PSA	Applicability of Internal Events HEP to Internal Flooding Accident Sequences[1]
SRHFDRECRC	Operators Fail to Shift SI System to Recirculation	0.0013	Action is performed at least three hours following a LOCA from the control room. RWST level indication provides the cue for performing this action. Such indication is not impacted by flooding events with the exception of auxiliary building flooding scenarios. For large auxiliary building floods, the assumed HEP is 1.0 due to the assumption that relevant indication is unavailable and operator access is assumed to be unavailable. For small auxiliary building floods, RWST level indication may be disabled. However, operators can utilize local level measurements and the internal events HEP was therefore applied, given the significant time available prior to performing the action.
SWHFDSTART	Operators Fail to Start SW Pump	0.005	Control room action. Diverse indications are available (SW system status, SW heat loads temperature indications). No flooding scenario was identified in which all relevant indications would be unavailable. The internal events PSA human error probability was therefore used.

Note

1 These actions apply to scenarios in which the control room is not evacuated. Control room evacuation HEPs are addressed in Table I.2-3.

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDABISOL	Failure isolate auxiliary building flood prior to submergence of charging system. The applicable flooding sources are fire water and service water. For SW leaks, the applicable procedure is AP-SW.1; isolation may require local actions; flooding effects were determined to not impact the areas operators would pass or enter to perform the actions. For fire water leaks, the specific response procedure corresponding to the alarm received in the control room is utilized; actions are performed from the control room.	This operator action is applied to flooding scenarios for which spray disables one or both CCW pumps or safeguards Buses 14 or 16. The applicable cues for performing this action are the main control board (MCB) alarms that arise from spray damage.	1.0E-01[1]
IFHFDACPWR	Following a flood in the screen house that damages all four SW pumps, failure to align the TSC diesel generator to operate reactor shroud fans within ten hours in the event of station blackout per procedure ER-ELEC.5. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action performed as a procedural step during station blackout. Relevant indications are the undervoltage signals associated with safeguards Buses 14, 16, 17, and 18.	1.0E-02[1]
IFHFDAFW1A	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally align AFW Pump A by starting the pump and opening MOV 4007 when the TDAFW Pump fails to function using plant emergency operating procedures. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of plant operating procedures, implemented in conjunction with ER-FIRE.1. The human error probability accounts for potential dependencies between this action and IFHFDAFWXX.	5.0E-01[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDAFWSW	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally align service water to the TDAFW Pump suction per step 4.4.7 of ER-FIRE.1, or to AFW Pump A or SAF Pump C using plant emergency operating procedures. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	1.0E-02[1]
IFHFDAFWXX	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, HCO fails to align the TDAFW Pump by locally opening motor-operated valve 3996 and 3505A, and controlling AOV 4297 per Attachment 3 of ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	5.0E-03[2]
IFHFDCHG1A	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CO fails to line up alternate DC to Charging Pump A and start the pump per ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	1.0E-01[1]
IFHFDCVCSX	Following a flood in the screen house that damages all four SW pumps, operators fail to align TSC diesel generator to supply either Charging Pump B or C to maintain RCP seal integrity per ER-ELEC.4. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is performed as a procedural step in the event of a station blackout. Applicable cues are the undervoltage signals on safeguards Buses 14, 16, 17 and 18.	1.0E-01[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDDCPWR	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to align TSC DC supply to Battery B for TDAFW Pump per Attachment 8 of ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	1.0E-03[1]
IFHFDDGAXX	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, STA fails to start DG A per Attachment 2 of ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	5.0E-03[2]
IFHFDDGAXY	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CRF fails to strip Bus 18 loads and manually close breaker for DG A per Attachment 1 of ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	5.0E-03[2]
IFHFDDGAXZ	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, CO fails to strip Bus 14 loads and manually close breaker for DG A/SW A per Attachment 4 to ER-FIRE.1. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed below in this table.	5.0E-03[2]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDIBISOL	Failure to isolate intermediate building flood prior to damage of all intermediate building equipment. The applicable flooding sources are fire water and service water. For SW leaks, the applicable procedure is AP-SW.1; isolation may require entering the intermediate building, however access is judged to not be impeded due to lack of flood accumulation on the floor where isolation would be performed (flood accumulation would instead occur in a large empty sub-basement). For fire water leaks, the specific response procedure corresponding to the alarm received in the control room is utilized; actions are performed from the control room.	One hour is available to perform this action due to a large empty sub-basement present in the intermediate building into which intermediate building floods would accumulate. The entire volume of the sub-basement would need to fill prior to accumulation in areas of the intermediate building that contain plant equipment. The flood sources associated with this operator action are service water and fire water. Leaks in the firewater system would be evident due to fire system alarms and subsequent investigation of the cause. Service water leaks would be noticed by security personnel during hourly tours.	1.0E-01[1]
IFHFDLOSP1	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to reconnect offsite power following control room evacuation if DG A is unavailable, using plant emergency operating procedures. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of procedure ER-FIRE.1. The failure of operators to enter ER-FIRE.1 is modeled by human error event IFHFDEVACR, discussed above.	1.0E-01[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDBRISLL	Failure to isolate large SW leak in battery room prior to disabling DC Trains A and B; sump pump operation is successful; spray does not damage equipment installed in the room; isolation is performed from the control room.	Isolation must occur within 17 minutes from the onset of the leak prior to equipment damage. Currently, no flood detection equipment is installed in the rooms, and spray does not damage equipment for the flood scenarios to which this action applies. Therefore, discovery of a leak would occur only if security personnel note the leak in sufficient time during hourly tours. The failure probability assumed is 0.9 based on a postulated six minute time window available during which the leak would need to be detected. If detection is a success, the failure probability for operators to isolate the SW leak is 0.2 (0.2 diagnosis error probability plus a 2.0E-03 action error probability, Ref. I.2-2) based on a nine minute time window to perform the action (two minutes are assumed to be necessary to alert operators of the leak). Taking into account the complementary probability for successful detection (0.1), the HEP is equal to 0.9 + 0.1 * 0.2 = 9.2E-01.	9.2E-01
IFHFDSAFWY	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, failure to locally align SAF Pump C using plant emergency operating procedures. Action is performed locally; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of plant operating procedures, implemented in conjunction with ER-FIRE.1. The human error probability accounts for potential dependencies between this action and IFHFDAFWXX.	5.0E-01[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDSLISOL	Failure to isolate large screen house flood prior to loss of the service water system. Actions are performed locally per AP-SW.1; flooding effects were determined to not impact the areas operators would pass or enter to perform the actions (no actions are necessary within the screen house).	The time available to perform this action is postulated to range from 5 to 20 minutes. The applicable cue is the MCB alarm associated with the water treatment equipment installed at the lowest elevation of the building. An operator would be sent to the building in the event of the trouble alarm and the leak would be subsequently discovered.	5.0E-01[1]
IFHFDSSISOL	Failure to isolate small screen house flood prior to loss of the service water system. Actions are performed locally per AP-SW.1; flooding effects were determined to not impact the areas operators would pass or enter to perform the actions (no actions are necessary within the screen house).	The time available to perform this action is postulated to be one hour. The applicable cue is the MCB alarm associated with the water treatment equipment installed at the lowest elevation of the building. An operator would be sent to the building in the event of the trouble alarm and the leak would be subsequently discovered.	1.0E-03[1]
IFHFDTBISOL	Failure to isolate large turbine building flood prior to submergence and disabling of equipment in turbine building basement, turbine oil storage building, service building and diesel generator rooms. Isolation is performed from the control room. The applicable flooding sources are fire water and service water. For SW leaks, the applicable procedure is AP-SW.1; isolation may require local actions; flooding effects were determined to not impact the areas operators would pass or enter to perform the actions. For fire water leaks, the specific response procedure corresponding to the alarm received in the control room is utilized; actions are performed from the control room.	Several hours are available to perform this action due to the large area comprised by the turbine oil storage building, service building and diesel generator rooms. The flood sources associated with this operator action are service water and fire water. Leaks in the firewater system would be evident due to fire system alarms and subsequent investigation of the cause. Service water leaks would be noticed either by plant personnel (present in the service building throughout most shifts) or security personnel (during hourly tours). Operators can terminate such leaks from the control room.	1.0E-04[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDBRISLS	Failure to isolate large SW leak in battery room prior to disabling DC Trains A and B; sump pump fails to function; isolation is performed from the control room.	Isolation must occur within 13 minutes from the onset of the leak prior to equipment damage. Currently, no flood detection equipment is installed in the rooms. Therefore, discovery of a leak would occur only if security personnel note the leak in sufficient time. The failure probability assumed is 0.9 based on a postulated six minute time window available during which the leak would need to be detected. If detection is a success, the failure probability for operators to isolate the SW leak is 0.2 (0.2 diagnosis error probability plus a 2.0E-03 action error probability, Ref. I.2-2) based on a five minute time window to perform the action (two minutes are assumed to be necessary to alert operators of the leak). Taking into account the complementary probability for successful detection (0.1), the HEP is equal to 0.9 + 0.1 * 0.2 = 9.2E-01.	9.2E-01
IFHFDBRISNS	Failure to isolate a small SW leak in battery room prior to disabling DC Trains A and B; spray does not damage equipment installed in the room; isolation is performed from the control room.	Isolation must occur within one hour from the onset of the leak prior to equipment damage. Currently, no flood detection equipment is installed in the rooms, and spray does not damage equipment for the flood scenarios to which this action applies. However, the flood is postulated to be detected 30 minutes from the onset of the leak, on average, by security personnel who make hourly tours to all plant areas. The failure probability to isolate the leak is 3.0E-03 based on a time window of approximately 30 minutes (1.0E-03 diagnosis error probability and a 2.0E-03 action error probability, Ref. I.2-2).	3.0E-03

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Event Label	Description and Considerations of Operator Access to Perform Local Actions	Discussion	Failure Probability
IFHFDBRISOL	Failure to isolate large SW leak in battery room prior to disabling DC Trains A and B; spray damages equipment installed in the room for the flood scenarios to which this action applies; isolation is performed from the control room.	Isolation must occur within thirteen minutes from the onset of the leak prior to equipment damage. Spray damage to equipment installed in room provides the cue to operators to enter the room to investigate the cause of the damage. The failure probability to isolate the leak based on a time window of approximately 4 minutes is 2.5E-01 (2.5E-01 diagnosis error probability and a 2.0E-03 action error probability, Ref. I.2-2).	2.5E-01
IFHFDBRISOLS	Failure to isolate small SW leak in battery room prior to disabling DC Trains A and B; spray damage to equipment installed in room provides cue to operators to enter the room to investigate the cause of the damage; isolation is performed from the control room.	Isolation must occur within one hour from the onset of the leak prior to equipment damage. Spray damage to equipment installed in room provides the cue to operators to enter the room to investigate the cause of the damage. The failure probability to isolate the leak is 1.0E-03 based on a time window of approximately 45 minutes, once the leak is detected.	1.0E-03[1]
IFHFDCIRCW	In the event of a turbine building flood, operators fail to trip the circulating water pumps if automatic trip fails (flood detection equipment installed in the turbine building is designed to automatically trip the circulating water pumps). Action may require local action; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	The applicable cue is the indication of flood occurring in turbine building with no automatic tripping of the circulating water pumps. Twenty minutes are postulated to be available to perform the action.	1.0E-01[1]
IFHFDEVACR	Following a flood in the relay room that causes significant equipment damage and requires plant shutdown to be performed outside of the control room, operators fail to initiate the appropriate procedure, ER-FIRE.1, for shutting down the plant.	The applicable cue for entering procedure ER-FIRE.1 is the significant loss of control room instrumentation and control. Recent procedural change with operator training scheduled.	5.0E-03[2]
IFHFDRWSTX	Operators fail to locally verify RWST level long term for cases where MCB indication is lost; flooding effects were determined to not impact the areas operators would pass or enter to perform the action.	This action is a procedural step performed as part of plant operating procedures, implemented in conjunction with ER-FIRE.1.	1.0E-01[1]

Table I.2-3

Development of Human Error Probabilities Applicable Specifically to Internal Flooding Accident Sequences

Note

1 The human error probability was selected qualitatively for the purposes of the internal flooding submittal on a conservative basis depending on anticipated stress levels and time available.

2 The human error probability is comparable to that previously published in an IPEEE analysis (Ref. I.2-3) and was determined to be applicable to Ginna Station based on a similar set of performance shaping factors and time available to perform the actions.

I.3 FLOOD SCENARIO DEVELOPMENT

The internal flooding scenarios developed for Ginna Station are documented in Table I.3-1 based on the internal flooding initiating events identified for the study. These scenarios were developed using the following guidelines:

1. Multiple flood scenarios were postulated for many of the internal flooding initiating events if distinct consequences of such scenarios were identified. Flood scenarios were differentiated by flood size (large or small), flood type (for example, submergence effects only, spray effects only, or submergence and spray effects), or by consequence (spray damages equipment on mezzanine level versus the operating level).

2. The flooding scenarios defined for the PSA capture all potential outcomes of each internal flooding initiating event by the use of flooding event sequences—that is, failure events as well as the complementary success events were postulated. For example, scenarios were developed to model the consequences for failure to isolated a particular flood as well as for the successful isolation of the flood.

3. Probabilities were assigned for some flood scenario precursors based on engineering judgement. For example, probabilities for the spray damage of particular equipment were assigned. Probabilities for the failure of operators to isolate floods prior to the attainment of critical flood heights were developed as discussed in Table I.2-3.

4. For the purposes of performing the sequence quantification, the initiating events for each of the flood scenarios were defined as equivalent to either a reactor trip or to a loss of main feedwater, depending on whether main feedwater is disabled as part of the scenario.

5. A flood damage state corresponding to the set of equipment disabled by flooding effects was defined for each of the flood scenarios. The labels for these states are shown in Table I.3-1.

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
ABB, ABM or ABO	AUXILIARY BUILDING	ABFL01	Large flood	Submergence/dripping disables all ABB equipment except charging pumps.	AB-1	FL000AB1	Reactor Trip
ABB, ABM or ABO	AUXILIARY BUILDING	ABFL02	Large flood	Large flood disables all ABB equipment as well as charging pumps.	AB-2	FL000AB1	Reactor Trip
ABB, ABM or ABO	AUXILIARY BUILDING	ABFL03A	Small flood	Spray and/or submergence damage assumed to be equivalent to loss of one safeguards AC power train.	AB-3A	FL000AB3	Reactor Trip
ABB, ABM or ABO	AUXILIARY BUILDING	ABFL03B	Small flood	Spray and/or submergence assumed to necessitate reactor trip.	AB-3B	FL000AB3	Reactor Trip
ABB	AUXILIARY BUILDING BASEMENT LEVEL	ABFL04	RWST rupture	Rupture of RWST results in accumulation in ABB; all ABB cables and equipment as well as charging pumps are submerged and damaged	AB-4	FL000AB4	Reactor Trip
ABM	AUXILIARY BUILDING MEZZANINE LEVEL	ABFL05	Large flood	Spray damages Bus 14; dripping/submergence damages all ABB equipment except charging pumps.	AB-5	FL000AB5	Reactor Trip
ABM	AUXILIARY BUILDING MEZZANINE LEVEL	ABFL06	Large flood	Spray damages Bus 14; submergence damages all ABB equipment as well as charging pumps.	AB-6	FL000AB5	Reactor Trip
ABO	AUXILIARY BUILDING OPERATING LEVEL	ABFL07	Large flood	Spray damages Bus 16 or one CCW pump; dripping/submergence damages all ABB equipment except charging pumps.	AB-7	FL000AB7	Reactor Trip
ABO	AUXILIARY BUILDING OPERATING LEVEL	ABFL08	Large flood	Spray damages Bus 16 or one CCW pump; submergence damages all ABB equipment as well as charging pumps.	AB-8	FL000AB7	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
ABO	AUXILIARY BUILDING OPERATING LEVEL	ABFL09	Large flood	Spray damages both CCW pumps; submergence damages all ABB equipment except charging pumps.	AB-9	FL000AB7	Reactor Trip
ABO	AUXILIARY BUILDING OPERATING LEVEL	ABFL10	Large flood	Spray damages both CCW pumps; submergence damages all ABB equipment as well as charging pumps.	AB-10	FL000AB7	Reactor Trip
AHR	AIR HANDLING ROOM	AHRFL01	Flooding event	Flood damages all equipment located in the room, consisting of control room HVAC equipment; the plant is shut down as a result of the HVAC unavailability.	FRXTRIP	FL0OAHR1	Reactor Trip
AVT	CONDENSATE DEMINERALIZER BUILDING	AVTFL01	Flooding event	Flood propagates to Turbine Building and causes plant trip. Main feedwater is unavailable due to flood damage.	LOMFW	FL0OAVT1	Loss of Main Feedwater
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL01	Small leak in SW piping	Spray damages equipment located in the room; sump pump is unavailable due to the loss of division A DC power; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FL0BR1A1	Reactor Trip
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL02	Small leak in SW piping	Spray damages equipment located in the room; sump pump is unavailable due to the loss of DC Train A; flood is isolated prior to propagating to second battery room; DC Train A assumed unavailable.	FBR1A	FL0BR1A1	Reactor Trip
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL03	Small leak in SW piping	Spray doesn't damage equipment located in the room; sump pump fails to function due to random causes; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FL0BR1A1	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL04	Large leak in SW piping	Spray damages equipment located in the room; sump pump is unavailable due to the loss of division A DC power; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1A1	Reactor Trip
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL05	Large leak in SW piping	Spray damages equipment located in the room; sump pump is unavailable due to the loss of division A DC power; flood is isolated prior to propagating to second battery room; DC Train A assumed unavailable.	FBR1A	FLOBR1A1	Reactor Trip
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL06	Large leak in SW piping	Spray doesn't damage equipment located in the room; sump pump operation succeeds; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1A1	Reactor Trip
BR1A	BATTERY ROOM 1A,CONTROL BUILDING	BR1AFL07	Large leak in SW piping	Spray doesn't damage equipment located in the room; sump pump fails due to random causes; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1A1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL01	Small leak in SW piping	Spray damages equipment located in the room; sump pump fails due to random causes; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1B1	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL02	Small leak in SW piping	Spray damages equipment located in the room; sump pump fails due to random causes; flood is isolated prior to propagating to second battery room; DC Train B assumed unavailable.	FBR1B	FLOBR1B1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL03	Small leak in SW piping	Spray doesn't damage equipment located in the room; sump pump fails due to random causes; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1B1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL04	Large leak in SW piping	Spray damages equipment located in the room; sump pump fails due to random causes; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1B1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL05	Large leak in SW piping	Spray damages equipment located in the room; sump pump fails due to random causes; flood is isolated prior to propagating to second battery room; DC Train B assumed unavailable.	FBR1B	FLOBR1B1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL06	Large leak in SW piping	Spray doesn't damage equipment located in the room; sump pump succeeds; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1B1	Reactor Trip
BR1B	BATTERY ROOM 1B,CONTROL BUILDING	BR1BFL07	Large leak in SW piping	Spray doesn't damage equipment located in the room; sump pump fails; flood is not isolated prior to propagating to second battery room; all DC power assumed unavailable.	BR	FLOBR1B1	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
BRRM	COMPUTER (MUX) ROOM,CONTROL BUILDING	n/a	n/a	No internal flooding sources located within this zone; propagation potential from relay room assumed and modeled in scenario RR-1.	n/a	n/a	n/a
CHG	CHARGING PUMP ROOM,AUXILIARY BUILDING	CHGFL01	Flooding event	Spray and/or submergence damages all equipment located in room.	CHG	FL0OCHG1	Reactor Trip
CR	CONTROL ROOM,CONTROL BUILDING	n/a	n/a	Flooding caused by leak in domestic water line (one-inch) assumed to be isolable prior to damage of any equipment since zone is manned at all times.	n/a	n/a	n/a
CT	CABLE TUNNEL	n/a	n/a	The only credible flooding source for this zone is the inadvertent actuation of fire sprinklers. Previous inadvertent actuation events have caused no impacts to plant operation, therefore, no credible internal flooding scenarios exist.	n/a	n/a	n/a
DG-ST	DIESEL GENERATOR STORAGE TANK AREA	n/a	n/a	Flooding events would involve the leakage of groundwater into a tank; two independent storage tanks are installed; tank level monitored twice per shift and therefore leakage would be detected; either tank can supply both diesel generators; coincident leakage of both tanks is not credible.	n/a	n/a	n/a
EDG1A	DIESEL GENERATOR ROOM 1A	EDGAFL01	Flooding event	Flood damages one diesel generator; 0.1 plant trip probability assumed.	EDG1A	FL0DG1A1	Reactor Trip
EDG1B	DIESEL GENERATOR ROOM 1B	EDGBFL01	Flooding event	Flood damages one diesel generator; 0.1 plant trip probability assumed.	EDG1B	FL0DG1B1	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
EDG1A	DIESEL GENERATOR ROOM 1A	EDGAFL02	Flooding event	Flood originating in EDG1A propagates and damages both DGs; plant is assumed to be tripped.	EDG	FLODG1A1	Reactor Trip
EDG1B	DIESEL GENERATOR ROOM 1B	EDGBFL02	Flooding event	Flood originating in EDG1B propagates and damages both DGs; plant is assumed to be tripped.	EDG	FLODG1B1	Reactor Trip
H2	HYDROGEN STORAGE ROOM	H2FL01	Flooding event	Flood assumed to damage all equipment.	FRXTRIP	FLO00H21	Reactor Trip
IB	INTERMEDIATE BUILDING	IBFL01	Large flood	Spray and/or submergence damages all equipment.	IB-1	FLO00IB1	Reactor Trip
IB	INTERMEDIATE BUILDING	IBFL02	Large flood	Spray damages one TDAFW Pump; flood isolated prior to significant accumulation.	IB-2	FLO00IB1	Reactor Trip
IB	INTERMEDIATE BUILDING	IBFL03	Small flood	Spray and/or submergence damages TDAFW Pump.	IB-2	FLO00IB3	Reactor Trip
RC	REACTOR CONTAINMENT BASEMENT	RCFL01	Flooding event	Flood causes plant trip and spray is assumed to disable one containment fan cooling unit.	RCXF	FLO00RC1	Reactor Trip
RR	RELAY ROOM,CONTROL BUILDING	RRFL01	Flooding event	Flood damages significant quantity of equipment and requires control room evacuation.	RRXF	FLO00RR1	Reactor Trip
RR	RELAY ROOM,CONTROL BUILDING	RRFL02	Flooding event	Flood damages limited equipment; one electrical division assumed disabled.	FDIVA	FLO00RR1	Reactor Trip
RRA	RELAY ROOM EXTENSION,CONTROL BUILDING	n/a	n/a	No internal flooding sources located within this zone; propagation potential from relay room assumed and modeled in scenario RR-1.	n/a	n/a	n/a
SAF	STANDBY AUXILIARY FEEDWATER PUMP BUILDING	SAFFL01	Flooding event	Spray and/or submergence damages all equipment located in building.	SAF	FLO0SAF1	Reactor Trip

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
SB	SERVICE BUILDING	n/a	SBFL01	Flood propagates to Turbine Building and causes plant trip. Main feedwater unavailable due to flood damage.	FLOMFW	FL000SB1	Loss of Main Feedwater
SH	SCREEN HOUSE	SHFL01	Large SW flood	SW assumed to be disabled due to submergence if isolation fails	FSH-1	FL000SH1	Loss of Main Feedwater
SH	SCREEN HOUSE	SHFL02	Large SW flood	Isolation succeeds; 2/4 SW pumps assumed to be unavailable due to the breach in the system	FSH-2	FL000SH1	Loss of Main Feedwater
SH	SCREEN HOUSE	SHFL03	Small SW flood	SW assumed to be disabled due to submergence if isolation fails	FSH-1	FL000SH1	Loss of Main Feedwater
TB-1	TURBINE BUILDING BASEMENT LEVEL	TBFL01	Very large flood	CW leak fails to be isolated prior to significant accumulation, flood is assumed to damage all equipment in TB-1, TO, SB-1, SB-1HS, SB1-WT, BR1A, BR1B, IB and EDG1A and EDG1B	TB3	FL000TB1	Loss of Main Feedwater
TB-1	TURBINE BUILDING BASEMENT LEVEL	TBFL02	Very large flood	CW leak automatically isolates, spray assumed to damage all equipment in TB-1	TB1	FL000TB1	Loss of Main Feedwater
TB-1	TURBINE BUILDING BASEMENT LEVEL	TBFL03	Steam flood event	Steam flood assumed to damage all equipment in TB-1	TB1	FL000TB3	Loss of Main Feedwater
TB-2	TURBINE BUILDING MEZZANINE LEVEL	TBFL04	Steam flood event	Steam flood causes limited damage; loss of main feedwater assumed to occur	FLOMFW	FL000TB3	Loss of Main Feedwater
TB-2	TURBINE BUILDING MEZZANINE LEVEL	TBFL05	Steam flood event	Steam flood damages Buses 12A / 12B, assumed to cause a recoverable loss of offsite power	FLOSP	FL000TB3	Reactor Trip
TB-1	TURBINE BUILDING BASEMENT LEVEL	TBFL06	Large flood	Failure to isolate large flood causes flood accumulation in TB-1, TO, SB-1, SB-1HS, SB1-WT, and DG and damages contents	TB2	FL000TB6	Loss of Main Feedwater

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
TB-2 or TB-3	TURBINE BUILDING MEZZANINE OR OPERATING LEVELS	TBFL07	Large flood	Failure to isolate large flood causes flood accumulation in TB-1, TO, SB-1, SB-1HS, SB-1WT, and DG and damages contents, spray does not damage 12A/12B	TB2	FL000TB7	Loss of Main Feedwater
TB-2 or TB-3	TURBINE BUILDING MEZZANINE OR OPERATING LEVELS	TBFL08	Large flood	Failure to isolate large flood causes flood accumulation in TB-1, TO, SB-1, SB-1HS, SB-1WT, and DG and damages contents, spray damages 12A/12B	TB4	FL000TB7	Loss of Main Feedwater
TB-1	TURBINE BUILDING BASEMENT LEVEL	TBFL09	Large flood	Large flood is isolated prior to significant accumulation, spray causes a loss of main feedwater	FLOMFW	FL000TB6	Loss of Main Feedwater
TB-2 or TB-3	TURBINE BUILDING MEZZANINE OR OPERATING LEVELS	TBFL10	Large flood	Large flood is isolated prior to significant accumulation, spray damage to Buses 12A and 12B causes a non-recoverable loss of offsite power	FLOSP	FL000TB7	Reactor Trip
TB-2 or TB-3	TURBINE BUILDING MEZZANINE OR OPERATING LEVELS	TBFL11	Large flood	Large flood is isolated prior to significant accumulation; spray does not damage Buses 12A and 12B; loss of main feedwater assumed	FLOMFW	FL000TB7	Loss of Main Feedwater
TB	TURBINE BUILDING	TBFL12	Small flood	Small flood causes minor accumulation in turbine building; loss of main feedwater is assumed.	FLOMFW	FL00TB12	Loss of Main Feedwater
TO	TURBINE OIL STORAGE ROOM	TOFL01	Flooding event	Flood assumed to damage all equipment.	FRXTRIP	FL000TO1	Reactor Trip
TSC	TECH SUPPORT CENTER	n/a	n/a	Trip will not occur; flooding sources in this zone are postulated to propagate to the relay room; such propagation is accounted for in scenario RR-1.	n/a	n/a	n/a

Table I.3-1
Internal Flooding Scenarios

Flood Zone		Flood Scenario	Flood Type	Flood Damage		Initiating Event	
Label	Description			Impact	State	Label	Type
TY	TRANSFORMER YARD	n/a	n/a	Inadvertent actuation of fire sprinklers is the only credible flooding source applicable to the internal flooding study; no credible damage would occur since equipment is normally exposed to wet conditions, such as rain.	n/a	n/a	n/a