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Your ref: Docket No. 52-006
Our ref: DCP/NRC1600

July 1, 2003

SUBJECT: Transmittal of Westinghouse Responses to Open Items Identified in the AP1000 Draft Safety Evaluation Report

This letter transmits Westinghouse responses to open items identified in the AP1000 Draft Safety Evaluation Report (DSER) that was issued on June 16, 2003. A list of the DSER Open Item responses that are transmitted with this letter is provided in Attachment 1. Attachment 2 provides the DSER Open Item responses.

Please contact me if you have questions regarding this transmittal.

Very truly yours,

M. M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects

/Attachments

1. Table 1, "List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1600"
2. Westinghouse Non-Proprietary Responses to US Nuclear Regulatory Commission DSER Open Items dated July 1, 2003

DR63

DCP/NRC1600
Docket 52-006

July 1, 2003

Attachment 1

"List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1600"

Attachment 1

Table 1

"List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1600"

	18.3.3.1-1
3.3.2-3	18.11.3.4-1
3.3.2-2	18.11.3.5-1
3.6.3.4-1	18.11.3.5-2
	18.11.3.5-3
4.4-1	18.11.3.5-4
	18.11.3.6-1
13.6-1	
	19A.2-7
14.3.2-8	19A.2-2
14.3.3-11	19A.2-6
14.3.3-12	
14.3.3-13	19.1.10.1-5
14.3.3-14	19.1.10.1-3
14.3.3-15	19.1.10.1-4
14.3.3-16	19.1.10.2-4
14.3.4-1	19.1.10.2-3
	19.1.10.2-2
15.3-1	19.1.10.2-1
15.1.5-1	19.1.10.2-5
15.3.6-1	19.1.10.3-2
	19.1.3.2-2
17.3.2-1	19.1.3.2-1
	20.7-1
	21.1-1

DCP/NRC1600
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Attachment 2

Westinghouse Non-Proprietary Response to
AP1000 Draft Safety Evaluation Report (DSER) Open Items

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 3.3.2-2

Original RAI Number(s): None

Summary of Issue:

The applicant states in DCD Tier 2 Section 3.3.2.3 that the failure of structures not designed for tornado loadings does not affect the capability of seismic Category I structures or the performance of safety-related systems because the applicant has either:

- designed the adjacent non-safety-related structure to the design-basis tornado loading
- investigated the effect of failure of adjacent structures on seismic Category I SSCs to determine that no impairment of safety function results, or
- designing a structural barrier to protect seismic Category I SSCs from adjacent structural failure

The applicant has stated in DCD Tier 2 Section 3.3.3 that COL applicants referencing the AP1000 certified design will address site interface criteria for wind and tornado. The site interface criteria for wind and tornado do not make it clear that the COL applicant needs to follow the three acceptable criteria described in DCD Tier 2 Section 3.3.2.3 to ensure that structures outside the scope of the certified design do not compromise the function of safety-related structures or systems of the AP1000 plant. Although DCD Tier 2 Table 1.8-2 mentions DCD Tier 2 Section 3.3.3 for the wind and tornado site interface criteria, neither DCD Tier 2 Section 3.3, nor DCD Tier 2 Table 1.8-2 clearly specifies that the COL applicant ensure that a tornado initiated failure of structures and components within the COL scope will not compromise the safety of AP1000 safety related structures and components. Identification of wind and tornado site interface criteria remains an open issue. This is Open Item 3.3.2-2.

Westinghouse Response:

Due to the definition of the certification boundary for AP1000, its site plan and its required security provisions, there are no structures close enough to certified structures that their tornado or wind induced collapse could affect safety-related structures or systems. This leaves the potential for tornado or wind induced missiles generated by structures outside the certification boundary. Evaluation for these types of missiles is covered by Section 3.5.4 of the Tier 2 portion of the DCD. It is repeated here for information:

> The Combined License applicant will demonstrate that the site satisfies the interface requirements provided in Section 2.2. This requires an evaluation for those external events that produce missiles that are more energetic than the tornado missiles postulated for design of the AP1000, or additional analyses of the AP1000 capability to handle the specific hazard.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 3.3.2-3

Original RAI Number(s): None

Summary of Issue:

The staff's evaluation documented in this section concentrates on the differences between the AP1000 and the AP600 design with the understanding that the AP600 wind tunnel test reports were found to be acceptable for the AP600 design in accordance with the staff's evaluation documented in Chapter 21 of NUREG-1512, "Final Safety Evaluation Report Related to Certification of the AP600 Standard Design," September 1998. Prior to issuing the final safety evaluation report for the AP1000, the staff will amend this section with the basis for its conclusion that the AP600 wind tunnel test reports are acceptable for the AP1000. This is Open Item 3.3.2-3.

Westinghouse Response:

Westinghouse addressed the applicability of the AP600 tests to the AP1000 Design Certification during the AP1000 Pre-Application review that was held between December 2001 and March 2002. As part of that review, Westinghouse submitted WCAP-15613, "AP1000 PIRT and Scaling Assessment." This report documents the applicability of the tests that were conducted in support of AP600 Design Certification to the AP1000 plant. This issue of the applicability of the AP600 Wind Tunnel Tests to the AP1000 was discussed more extensively in our Revision 1 response to NRC RAI 220.001 that was submitted via Westinghouse letter DCP/NRC1553 dated March 13, 2003.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 3.6.3.4-1

Original RAI Number(s): 251.004

Summary of Issue:

In RAI 251.004, the staff requested that the applicant address the following: (1) clarify whether Alloy 600 material, which is susceptible to PWSCC as indicated by the V.C. Summer primary loop leakage, will be used in any of the AP1000 LBB candidate piping systems, (2) provide test and plant operational data demonstrating that the proposed weld material, Alloy 52/152, is not susceptible to PWSCC, and (3) provide an inspection plan licensees would perform to address additional inspection techniques for detecting tight flaws that might exist in LBB piping welds.

The applicant's response to RAI 251.004 states the following: (1) Alloy 600 will not be used for any of the AP1000 LBB candidate piping systems; (2) Alloy 52/152 weld material (for Alloy 690 base material) has been used in various applications such as steam generator welds and safe end-nozzle welds for 9 plants (7 years in one application) without any reported instances of environmental degradation, and although laboratory data for Alloy 52/152 in simulated primary water is limited, they indicated no environmentally-related crack propagation was observed for periods up to 4122 hours; and (3) since Alloy 52/152 weld material has better crack resistance than Alloy 82/182, augmented inservice inspection using eddy current testing (ET) to supplement ASME Code required ultrasonic testing (UT) should not be necessary for the AP1000 applications.

The staff considers the information provided for (1) to be complete and that no further information is required. Regarding (2), although the chrome content of Alloy 52/152 is approximately twice the chrome content of Alloy 82/182, making Alloy 52/152 more resistant to PWSCC, the test and plant operational data for Alloy 52/152 are for periods less than 7 years. This is not long enough for the NRC staff to consider the question of PWSCC for Alloy 52/152 material in the AP1000 LBB candidate piping to be resolved, considering the licensing period for AP1000 facilities.

To address this issue for currently operating plants, the industry has undertaken an initiative to (1) develop overall inspection and evaluation guidance, (2) assess the current inspection technology, and (3) assess the current repair and mitigation technology. An interim industry report, "PWR Materials Reliability Project Interim Alloy 600 Safety Assessment for U.S. PWR Plants (MRP-44), Part 1: Alloy 82/182 Pipe Butt Welds," was published in April 2001 to justify the continued operation of PWRs while the industry completes the development of the final report. The final industry report on this issue has not yet been published. Subsequent to staff review and evaluation of the final report and receipt of additional Inconel UT inspection data from the industry, the staff will determine if additional regulatory actions will need to be imposed to address the potential for PWSCC to occur in lines with currently approved LBB analyses in operating plants. To address this issue for the AP1000 application, the applicant needs to modify its DCD Tier 2 Section 3.6.4 on COL information to indicate that COL holders should implement inspection plans, evaluation criteria, and other types of measures imposed on or

adopted by operating PWRs with currently approved LBB applications as part of the resolution of concerns regarding the potential for PWSCC in those units. This is Open Item 3.6.3.4-1.

Westinghouse Response:

The Westinghouse revised response to NRC RAI 251.004 provided in Westinghouse letter DCP/NRC1553 dated 3/13/2003 addresses this issue. That response included the COL item that has subsequently been incorporated in the AP1000 DCD Revision 4. DCD section 3.6.4.4 is as follows:

3.6.4.4 Primary System Inspection Program for Leak-before-Break Piping

Combined License applicants referencing the AP1000 certified design will develop an inspection program for piping systems qualified for leak-before-break. The inspection program will consider the operating experience of the materials used in the AP1000 piping systems qualified for leak-before-break, and will consider the need for augmented inspections to those required by the applicable portions of the ASME code.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 4.4-1

Original RAI Number(s): 440.022

Summary of Issue:

In its response to RAI 440.022, the applicant stated that, based on experience, the instrumentation uncertainties are expected to be typical values that bound both the specified and delivered uncertainties for the plant instrumentation. In the unlikely event that the assumed uncertainty values are exceeded when the plant is built, the calculated COLR limits could be adjusted to accommodate any additional uncertainties for the installed instrumentation beyond the originally assumed uncertainty values. In addition, the safety analyses are performed with safety analysis limit DNBRs higher than the design limit DNBR values. The difference between the safety analysis limit DNBRs and the design limit DNBRs is the DNBR margin, which can be used to offset DNB penalties such as rod bow penalty and unanticipated DNBR penalties. Therefore, the staff believes that even with the revised design limit DNBR values, the conclusion that the minimum DNBR design limits are not violated during the AOOs will remain valid. However, upon installation of the actual instrumentation in the plant, the COL applicant should calculate the design limit DNBR values using the RTDP with the instrumentation uncertainties of the plant operating parameters based on the actual instrumentation of the plant. Based on this calculation, the COL applicant should confirm that either the design limit DNBR values as described in DCD Tier 2 Section 4.4, "Thermal and Hydraulic Design," and the response to RAI 440.022, Revision 1 remains valid, or the safety analysis minimum DNBR bounds the new design limit DNBR values plus DNBR penalties, such as rod bow penalty. DCD Tier 2 Section 4.4.7, "Combined License Information," does not address this issue. Therefore, this is Open Item 4.4-1 and COL Action Item 4.4-1.

Westinghouse Response:

The Combined License Information in Sections 1.8 and 4.4.7 of the DCD will be revised as shown below to include confirmation of the assumptions used in the safety analysis.

Design Control Document (DCD) Revision:

Table 1.8-2 of the DCD will be revised as follows:

Table 1.8-2 (Sheet 3 of 6)

SUMMARY OF AP1000 STANDARD PLANT COMBINED LICENSE INFORMATION ITEMS

Item No.	Subject	Subsection
4.3-1	Changes to Reference Reactor Design	4.3.4
4.4-1	Changes to Reference Reactor Design	4.4.7
4.4-2	**Confirm Assumptions for Safety Analyses DNBR Limits**	4.4.7
5.2-1	ASME Code and Addenda	5.2.6.1

Section 4.4.7 of the DCD will be revised as follows:

Combined License applicants referencing the AP1000 certified design will address changes to the reference design of the fuel, burnable absorber rods, rod cluster control assemblies, or initial core design from that presented in the DCD.

Following selection of the actual plant operating instrumentation and calculation of the instrumentation uncertainties of the operating plant parameters as discussed in Section 7.1.6, Combined License applicants will calculate the design limit DNBR values using the RTDP with these instrumentation uncertainties and confirm that either the design limit DNBR values as described in DCD 2 Section 4.4, "Thermal and Hydraulic Design," remain valid, or that the safety analysis minimum DNBR bounds the new design limit DNBR values plus DNBR penalties, such as rod bow penalty.

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 13.6-1

Original RAI Number(s): None

Summary of Issue:

The staff has not completed the review of the applicant's change to the security plan. At this time, the staff plans to issue a supplemental DSER that will address the AP1000 security plan, including the COL action items and any additional ITAAC. This is Open Item 13.6-1.

Westinghouse Response:

In Westinghouse letter NRC/DCP1596 dated June 6, 2003, Westinghouse submitted the AP1000 Security Assessment report that documents the compliance of the AP1000 plant to the applicable security-related requirements.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.2-8

Original RAI Number(s): None

Summary of Issue:

Sections 2.6.9 and 2.6.10. The staff cannot complete its review of these ITAAC because the staff's review of the security program for AP1000 is not complete (see Section 13.6 of this report). This is Open Item 14.3.2-8.

Westinghouse Response:

DCD Sections 2.6.9 and 2.6.10 is the Tier 1 information for the Plant Security Systems and the Closed Circuit TV System. The AP1000 Tier 1 information contains "No entry" for these systems. This is consistent with the approach taken for the other certified designs including the AP600. In Westinghouse letter NRC/DCP1596 dated June 6, 2003, Westinghouse submitted the AP1000 Security Assessment report that documents the compliance of the AP1000 plant to the applicable security-related requirements. Westinghouse does not believe that additional information is required in Tier 1 Sections 2.6.9 and 2.6.10.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-11

Original RAI Number(s): None

Summary of Issue:

Section 3.2, Table 3.2-1, "Acceptance Criteria for Design Commitment 3," should include the following as a last criterion: "Man-in-the loop engineering test reports." This is Open Item 14.3.3-11.

Westinghouse Response:

Westinghouse agrees to revise DCD Tier 1 Table 3.2-1, item 3, as shown below.

Design Control Document (DCD) Revision:

Table 3.2-1 (cont.)
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The HSI design is performed for the OCS in accordance with the HSI design implementation plan.	An evaluation of the implementation of the HSI design will be performed.	A report exists and concludes that the HSI design for the OCS was conducted in conformance with the implementation plan and includes the following documents: – Operation and Control Centers System Specification Document – Functional requirements and design basis documents for the alarm system, plant information system, wall panel information system, controls (soft and dedicated), and the qualified data processing subsystems – Design guideline documents (based on accepted HFE guidelines, standards, and principles) for the alarm system, displays, controls, and anthropometrics – Design specifications for the alarm system, plant information system, wall panel information system, controls (soft and dedicated), and the qualified data processing subsystems. – **Engineering test report document summarizing outcomes of each Man-in-the-loop Engineering test iteration performed to support HSI design.**

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-12

Original RAI Number(s): None

Summary of Issue:

Table 3.2-1, "Acceptance Criteria for Design Commitment 4," should be changed to indicate that the verification and validation implementation plan includes the following activities (terminology to be consistent with NUREG-0711, Revision 1):

- Operational Conditions Sampling
- Design Verification
  (HSI Task Support Verification)
  (HFE Design Verification)
- Integrated System Validation
- Human Engineering Discrepancy Resolution
- Plant HFE/HSI (as designed at the time of plant start-up) verification.

This is Open Item 14.3.3-12.

Westinghouse Response:

The present contents of Table 3.2-1 are similar to the above with three basic exceptions.

Operational Conditions Sampling – The process of Operational Conditions Sampling is an original recommendation of NUREG-0711 Rev.1. Westinghouse understands the goal of that process to be to establish a representative test set for integrated system validation. Westinghouse agrees on the importance of this goal. However, Westinghouse does not believe that the representative test set is established by sampling in general, or by the recommended process in particular. Instead, Westinghouse believes that:

> *The Representative Test Set (RTS) must be selected from the universe of conceivable scenarios based on an ad hoc technical understanding of the plant system and its credible failure modes. The bases for the selected events must justify that the RTS is reasonably conservative in its coverage of credible challenges to system safety. The basis for the RTS is a principle justification for the sufficiency of validation testing.*

Westinghouse proposes that these words be added to Section 4.6 of WCAP 15860 Rev.1. This is consistent with the fact that RTS selection is part of the preparation for Integrated System Validation as now given in Table 3.2-1 (and is not a separate V&V process). For these reasons, as well as to maintain consistency in the DCD, no change to Table 3.2-1 is required.

Design Verification – The two components of Design Verification given above are now explicit in Table 3.2-1. This itself was principally a name change to address similar activities established by earlier NUREGs. There is now little difference in either name or content between what exists

and what is proposed. For this reason, and to maintain consistency in the DCD, no change to Table 3.2-1 is required.

Human Engineering Discrepancy Resolution – The original commitment, for "issue resolution verification" includes outstanding HEDs, but is more comprehensive. This is discussed further for Open Items 14.3.3-15, 14.3.3-16, 18.11.3.4-1, and 18.11.3.6-1, and is captured by added text in Section 5 of WCAP-15860. For these reasons, and for consistency throughout the AP1000, no change to the DCD is required.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-13

Original RAI Number(s): None

Summary of Issue:

Table 3.2-1, "Design Commitment" statement No. 5, should be changed to indicate that the verification and validation implementation plan includes the following activities (terminology to be consistent with NUREG-0711, Revision 1):

- Operational Conditions Sampling
- Design Verification
  (HSI Task Support Verification)
  (HFE Design Verification)
- Integrated System Validation
- Human Engineering Discrepancy Resolution
- Plant HFE/HSI (as designed at the time of plant start-up) verification.

This is Open Item 14.3.3-13.

Westinghouse Response:

See response to DSER Open Item 14.3.3-12.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-14

Original RAI Number(s): None

Summary of Issue:

Table 3.2-1, "Acceptance Criteria," for "Design Commitment" statement No. 5, should be changed to include a new "a)" to indicate that, "a) Operational Conditions Sampling was conducted in accordance with the implementation plan." The remaining criteria should be re-lettered. This is Open Item 14.3.3-14.

Westinghouse Response:

The process of Operational Conditions Sampling is an original recommendation of NUREG-0711 Rev.1. Westinghouse understands the goal of that process to be to establish a representative test set for integrated system validation. Westinghouse agrees on the importance of this goal. However, Westinghouse does not believe that the representative test set is established by sampling in general, or by the recommended process in particular. Instead, Westinghouse believes that:

> *The Representative Test Set (RTS) must be selected from the universe of conceivable scenarios based on an ad hoc technical understanding of the plant system and its credible failure modes. The bases for the selected events must justify that the RTS is reasonably conservative in its coverage of credible challenges to system safety. The basis for the RTS is a principle justification for the sufficiency of validation testing.*

Westinghouse proposes that these words be added to Section 4.6 of WCAP 15860 Rev.1. This is consistent with the fact that RTS selection is part of the preparation for Integrated System Validation as now given in Table 3.2-1 (and is not a separate V&V process). For these reasons, as well as to maintain consistency in the DCD, no change to Table 3.2-1 is required.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-15

Original RAI Number(s): None

Summary of Issue:

Table 3.2-1, "Inspections, Tests, Analyses," item "d)", should be changed to replace "design issues resolution" with "human engineering discrepancy resolution." This is Open Item 14.3.3-15.

Westinghouse Response:

As explained for Open Items 14.3.3-16, 18.11.3.4-1 and 18.11.3.6-1, issue tracking and resolution for AP1000 is not limited to the treatment of HEDs. Other issues and concerns will be tracked that are not yet design discrepancies, or are not HFE-related, or both. That is, the issue tracking system will be project-wide, so that mechanisms of issue tracking and resolution will be similar across disciplines and project phases. This is explained in DCD Sections 18.2.3.1 (General Process and Procedures), 18.2.3.2 (Process Management Tools) and 18.2.4 (HFE Issues Tracking). In addition, Section 5 of WCAP-15860 (Rev.1) will add the following material to identify HEDs as a subset of the possible issues being tracked for resolution:

> *"Among the potential human factors issues to be tracked and resolved are Human Engineering Discrepancies (HEDs). HEDs occur when a human factors deficiency is formally identified in an otherwise completed design. A human factors deficiency is a failure of a complete design to meet design requirements or V&V criteria. The V&V processes defined in this document will cause human factors deficiencies to be identified and in turn formally documented as HEDs. HEDs will be thoroughly described, including their scope of occurrence and their expected impact. An assessment of safety- or risk-significance should be made such that risk-significant HEDs will receive high priority. As for other formally tracked HFE issues, all HEDs identified by Westinghouse are resolved prior to plant startup. After plant startup, human factors deficiencies and HEDs should be addressed similarly by the COL."*

For these reasons, and to maintain consistency throughout the existing documentation, no change to Table 3.2-1 is required.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.3-16

Original RAI Number(s): None

Summary of Issue:

Table 3.2-1, "Acceptance Criteria," item "d)", should be changed to "human engineering discrepancy resolution verification was conducted in accordance with the implementation plan and includes verification that human factors issues that were documented in the design issues tracking system and human engineering discrepancies that were identified in the design process have been addressed in the final design." This is Open Item 14.3.3-16.

Westinghouse Response:

As explained for Open Items 14.3.3-15, 18.11.3.4-1 and 18.11.3.6-1, issue tracking and resolution for AP1000 is not limited to the treatment of HEDs. Other issues and concerns will be tracked that are not yet design discrepancies, or are not HFE-related, or both. That is, the issue tracking system will be project-wide, so that mechanisms of issue tracking and resolution will be similar across disciplines and project phases. This is explained in DCD Sections 18.2.3.1 (General Process and Procedures), 18.2.3.2 (Process Management Tools) and 18.2.4 (HFE Issues Tracking). In addition, Section 5 of WCAP-15860 (Rev.1) will be revised as specified in DSER Open Item Response 14.3.3-15.

For these reasons, and to maintain consistency throughout the existing documentation, no change to Table 3.2-1 is required.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 14.3.4-1

Original RAI Number(s): None

Summary of Issue:

Control room χ/Q values are not provided in Table 5.0-1, "Site Parameters." In the staff's judgment these values should also be provided in the table as were the Exclusion Area Boundary and Low Population Zone χ/Q values. However, even when provided in Table 5.0-1, the control room χ/Q values remain an open item for the following reason. As part of its review of Table 15A-5, "Atmospheric Dispersion Factors (χ/Q) for Accident Analysis," in Tier 2, the staff initially asked the applicant if the methodology and all inputs and assumptions related to the control room χ/Q values would be evaluated as part of the COL review. The applicant provided a detailed response stating that the methodology, inputs and assumptions would be provided as part of the COL and noting additional information about the analysis. NRC staff issued a second RAI to inquire if the applicant was seeking certification of any of the AP1000 design values used as inputs to the χ/Q calculations. The applicant subsequently provided certain design-specific information that was used as input to the assessment and for which the applicant was seeking certification. The staff has not completed its evaluation of this response, but has identified unresolved issues related to adequate justification for assuming a diffuse release, estimation of initial sigma values, other release assumptions, building cross-sectional areas, and distances between release/receptor pairs. Pending completion of the review, this is open item 14.3.4-1.

Westinghouse Response:

The information that is documented in Tier 1 (which includes Table 5.0-1) was the subject of extensive discussion between NRC and representatives of the nuclear power industry. A graded approach was applied to determine the information that must be included in Tier 1 documentation, and the information to be included in Tier 2. The outcome of that process with respect to Tier 1 / Tier 2 split is reflected in the current AP1000 DCD.

The remainder of this open item is the same as DSER open item 2.3.4-1, and will be addressed under that open item.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 15.1.5-1

Original RAI Number(s): 440.002, 440.062

Summary of Issue:

Westinghouse has issued three Nuclear Service Advisory Letter (NSAL), NSAL-02-3 and revision 1, NSAL-02-4 and 02-5, that document the problems with the Westinghouse-designed SG water level setpoint uncertainties. NSAL-02-3 and its revision, issued on February 15 and April 8, 2002, respectively, deal with the uncertainties caused by the mid-deck plate located between the upper and lower taps used for SG level measurements. These uncertainties affect the low-low level trip setpoint (used in the analysis for events such as the feedwater line break (FLB), ATWS and steam line break). NSAL-02-4, issued on February 19, 2002, deals with the uncertainties created because the void contents of the two-phase mixture above the mid-deck plate are not reflected in the calculation and affect the high-high level trip setpoint. NSAL-02-5, issued on February 19, 2002, deals with the initial conditions assumed in the SG water level related safety analysis. The safety analysis may not be bounding because of velocity head effects or mid-deck plate pressure differential pressure that have resulted in significant increases in the control system uncertainties. In RAI 440.062 the staff requested the applicant to discuss: (1) how the AP1000 design accounts for all these uncertainties documented in these advisory letters in determining the SG water level setpoints, and (2) the effects of the water level uncertainties on the analyses of the LOCA and non-LOCA transients and the ATWS event.

The applicant response to RAI 440.062 stated that measurement uncertainties for the reactor protective system and engineered safety features actuation system instrument can be determined only when actual instrumentation is selected for the plant. The plant specific setpoint calculations will be completed and reviewed as part of the COL. The COL applicants referencing the AP1000 certified design will provide a calculation of setpoints for protective functions consistent with the methodology discussed in WCAP-14605, "Westinghouse Setpoint Methodology for Protective Systems, AP600." The methodology can be used for performing setpoint studies independent of the hardware used for the protection system, and therefore is applicable to the AP1000. The setpoint study will include applicable uncertainties discussed in the referenced NSAL. Using the methodology in WCAP-14605, plant nominal setpoints are calculated by adding the channel allowance from the setpoint study to the setpoint used in the safety analysis.

The COL applicant should evaluate and confirm the validity of the safety analysis documented in the DCD using plant specific setpoints and instrument uncertainties, including the SG mid-deck level measurement uncertainty. The COL applicants should submit in the plant specific applications the setpoint analysis and the associated safety analysis for the staff to review and approve. This is COL Action Item 15.1.5-1. The applicant should include this in the DCD. This is Open Item 15.1.5-1.

Westinghouse Response:

Item E of Revision 1 to RAI 440.022 addressed the COL Information in DCD Section 7.1.6 related to instrumentation uncertainty calculations by the COL applicant upon selection of the installed plant instrumentation.

As discussed below, RAI 440.103 may also be considered as an appropriate reference for this DSER Open Item.

The COL applicant does not need an action to re-perform safety analyses to make it plant-specific. The safety analyses will become plant-specific when the setpoint study is performed by the COL to develop plant-specific Technical Specification (TS) setpoints based on the safety analysis values, adding instrumentation uncertainty, as well as uncertainties related to the SG mid-deck plate affects on SG level measurement. These uncertainties will be appropriately combined with the actual safety analysis setpoint values as part of the COL plant-specific setpoint study discussed in DCD 7.1.6.

The safety analyses performed for AP1000 used the safety analysis setpoints specified in TS Tables 3.3.1 and/or 3.3.2. As discussed in the response to RAI 440.103, the Reviewer Note in each TS table identifies the TS setpoints in that table as the actual parameter input values used in the safety analyses.

These TS setpoints become plant-specific when the instrumentation uncertainties, including uncertainties addressed in the NSALs, are incorporated to develop the plant-specific parameter values to be inserted into the TS tables when preparing the final plant-specific TSs. The responses to RAI 440.103 and Item E of RAI 440.022R1 explain how the instrumentation uncertainties are used to determine the correct TS setpoints and allowable values. The response to RAI 440.062 confirms that other uncertainties, such as the uncertainties documented in NSALs are incorporated as needed when the plant-specific setpoint study is performed.

Therefore, the COL actions to establish appropriate plant-specific setpoints as discussed in DCD 7.1.6 add the appropriate uncertainty values to the TS setpoints used in safety analyses. In summary, the Technical Specification setpoints are changed to reflect instrumentation uncertainties. The plant safety analyses are not changed since the revised Technical Specification setpoints are based on the safety analyses documented in the DCD. No other COL action is required to re-perform any safety analyses.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 15.3-1

Original RAI Number(s): 470.009, 470.011

Summary of Issue:

The staff has not completed its evaluation of the applicability of the AP600 aerosol removal coefficients to the AP1000 design. The staff will evaluate the impact of the differences in the AP1000 design as compared to the AP600 on the modeling of aerosol removal and will perform independent analyses of the estimated aerosol removal rates. Upon resolution of issues with the determination of aerosol removal rates in containment, as discussed in RAIs 470.009 and 470.011, the staff will complete its evaluation of the bounding accident sequence and the aerosol behavior and removal rates corresponding to the selected bounding accident sequence in the containment following a DBA. This is Open Item 15.3-1.

Westinghouse Response:

The Westinghouse responses to RAI 470.009 transmitted by Westinghouse letter DCP/NRC1535, November 26, 2002 and RAI 470.011 Rev. 1 transmitted by Westinghouse letter DCP/NRC1571, April 11, 2003 address previous NRC comments related to this issue.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 15.3.6-1

Original RAI Number(s): 470.009, 470.011

Summary of Issue:

The staff has not completed its evaluation of the applicant's assumptions on aerosol removal in containment, as discussed in RAIs 470.009 and 470.011. To verify the applicant's assessment, the staff will perform independent radiological consequence calculations for a postulated design-basis LOCA coincident with the loss of spent fuel pool cooling capability once these issues are resolved. This is Open Item 15.3.6-1.

Westinghouse Response:

The Westinghouse responses to RAI 470.009 transmitted by Westinghouse letter DCP/NRC1535, November 26, 2002 and RAI 470.011 Rev. 1 transmitted by Westinghouse letter DCP/NRC1571, April 11, 2003 address previous NRC comments related to this issue.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 17.3.2-1

Original RAI Number(s): None

Summary of Issue:

QA Issues Associated with AP1000 Design Testing

The NRC staff plans to perform a QA test control implementation inspection to determine if additional testing activities performed at the test facility associated with the AP1000 design are accomplished, in accordance with the Westinghouse 10 CFR Part 50, Appendix B, QA program as described in Chapter 17 of the AP1000. The NRC will review QA provisions applicable to the identified test facility as described in the applicable AP1000 test project quality plan and test procedures. In particular, the team plans to examine the areas covered by the QA program to confirm that the test activities were accomplished under suitably controlled conditions by properly trained personnel and that pertinent test data, used to furnish documentary evidence of activities, affecting quality were properly recorded and maintained. For additional details, see Chapter 21 of this report. This is Open Item 17.3.2-1.

Westinghouse Response:

In Westinghouse letter DCP/NRC-1572, Westinghouse informed the NRC of our intent to use test data from the Oregon State University APEX-1000 test facility to answer questions related to thermal-hydraulic issues associated with the liquid entrainment issue. It is our understanding that the NRC has scheduled an audit of the OSU test facility for the week of August 11th, 2003.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.3.3.1-1

Original RAI Number(s): 620.044

Summary of Issue:

Criterion 5, "Risk-important human actions", states that the OER should identify risk-important human actions that have been identified as different or where errors have occurred. The human actions should be identified as requiring special attention during the design process to lessen their probability. The applicant does not address this item in discussing developing the OER. Therefore, this is Open Item 18.3.3.1-I.

Westinghouse Response:

This issue was addressed in response to RAI 620.044. In that response Westinghouse stated:

> *For AP1000, Risk Important Tasks (Human Actions) are identified using PRA-based techniques (Ref: DCD Sections 18.5.1 and 18.7). Tasks are identified as risk-important based on quantitative and qualitative criteria described in WCAP-14651. This method of identifying Risk Important Tasks matches the requirements of NUREG-0711, Rev. 1, Criterion 7.4(1). The Risk Important Tasks are used as input to HFE design activities to identify those activities requiring special attention during the design process, as required by NUREG-0711, Rev. 1.*
>
> *The AP1000 is significantly different from existing nuclear power plants. Passive systems, compact control room, and integrated I&C contribute to the differences between AP1000 and existing nuclear power plants. In addition, the AP1000 design has been thoroughly analyzed using the PRA. Because AP1000 is different and because of the extensive PRA modeling work, Westinghouse believes that the use of PRA techniques to identify Risk Important Tasks is more thorough and more accurate than the OER techniques described in NUREG-0711, Rev. 1, Criterion 3.4.1(5). PRA techniques are therefore sufficient and acceptable for identifying AP1000 Risk Important Tasks.*

AP1000 is a new plant and was designed to minimize reliance on operator actions to mitigate plant risk. Risk-important tasks (as explained in NUREG/CR-6637, Sec.9.3, and in NUREG-1764) are based on PRA. Interest in risk-important tasks under OER is thus logical in the context of any given plant modernization, where the impact of proposed changes to that single plant should be considered in terms of the effect on its PRA. However, analogous results from one plant's PRA are not applicable to another's, especially if the plants are dissimilar. It is therefore reasonable for AP1000 to address risk-important tasks entirely through DCD Chapter 18.7 and the associated plant-specific PRA.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.4-1

Original RAI Number(s): None

Summary of Issue:

Criterion 3, "HED Documentation", states that HEDs should be documented in terms of the HSI component involved and how the characteristics depart from a particular guideline.

Westinghouse described their general approach to human engineering discrepancy (HED) resolution in WCAP-15860. Section 5 of WCAP-15860 provides a commitment to develop a procedure to ensure that all issues documented in the HFE issue tracking system are verified to be completely addressed in the final HSI. However, the staff believes that further detail is needed related to the process the applicant will use to identify, analyze, prioritize, evaluate, document, and determine and evaluate design solutions, etc. for HEDs using the HED resolution review criteria in NUREG-0711 as a template. Therefore, this is Open Item 18.11.3.4-1.

Westinghouse Response:

The issue of HEDs and their resolution applies to discrepancies in an otherwise complete design. For Westinghouse, issue tracking and resolution is not limited to the treatment of HEDs. Other issues and concerns will be tracked that are not yet design discrepancies, or are not HFE-related, or both. That is, the issue tracking system will be project-wide, so that mechanisms of issue tracking and resolution will be similar across disciplines and project phases. This is explained in DCD Sections 18.2.3.1 (General Process and Procedures), 18.2.3.2 (Process Management Tools) and 18.2.4 (HFE Issues Tracking). In addition, to address the HED-related guidance cited above, Section 5 of WCAP-15860 (Rev.1) will be revised as specified in DSER Open Item Response 14.3.3-15.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.5-1

Original RAI Number(s): None

Summary of Issue:

Criterion 3, "Plant Personnel", states that participants in validation tests should represent an unbiased sample; be representative of actual plant personnel; reflect characteristics of the population of plant personnel; include shift supervisors, reactor operators, shift technical advisors, etc., and minimum and normal crew configurations. Westinghouse submitted WCAP-14396 (Revision 3), "Man-In-The-Loop Test Plan Description," Section 2.4.3, "Subjects," address the composition of the "target user population," the test subject population. While this WCAP addresses preliminary or "engineering" tests, rather than final or "validation" tests, with validation tests addressed by WCAP-15860, the test subject selection criteria should be applicable for both test types. The applicant should amplify/clarify or explain how validation tests address this NUREG-0711 item. Therefore, this is Open Item 18.11.3.5-1.

Westinghouse Response:

Section 2.4.3, "Subjects," in WCAP-14396 (Revision 3), "Man-in-the-loop Test Plan Description" applies only to preliminary or "engineering" tests, and is not applicable to final validation tests. To address the topic for validation tests, the following section will be added to WCAP-15860 (Rev. 1), "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan":

4.9 SUBJECTS

In actual operation, the AP1000 main control room and associated HSID features will be used only by highly trained, qualified commercial nuclear power plant (NPP) operating crews. The hypothetical group of all such qualified crew members is referred to here as the "target user population". To assure that test subjects will represent this population, validation crews will be comprised of currently qualified operating crews, as adjusted in number to man the AP1000 control room for conditions of minimum and maximum staffing. This excludes, by definition, members of the design organization.

The target users can be subdivided on the basis of qualification and experience. For AP1000, two subgroups of interest are referred to here as "operators" and "supervisors". Supervisors by definition have longer experience and higher qualifications. To ensure a conservative test, steps will be taken to identify and select test subjects from crews with less experience or unexceptional performance. This may be difficult to achieve for several reasons, include the sensitivity of being identified as average or below. However, test subjects will in no case be selected for their superior skills or experience.

A key question is the number of subjects to be used in each test (i.e., sample size = n). Several authors have examined the mathematical models that underlie descriptive usability evaluations. Plotting the proportion of usability problems detected as a function of number of test participants, the relation can be modeled as a simple Poisson process. In essence, each successive test subject tends to reveal fewer findings. Reference [n] continues in this vein to suggest that five test subjects are typically enough to detect 70% to 90% of major usability problems in a prototype. Thus, a minimum of n = 6 subjects (3 crews) is proposed as sufficient for validation tests.

Prior to testing, subjects will receive a week of training on the testbed. Training content will exclude actual scenarios used for validation testing. Training should be sufficient to prepare subjects for the demands of the planned tests. However, since the training is relatively brief, it is not expected to produce test subjects for the new design quite equal to the fully qualified and experienced crew of an existing plant. As a result, inexperience still tends to weigh against favorable validation results, but as a conservative error, this is acceptable.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.5-2

Original RAI Number(s): None

Summary of Issue:

Criterion 6, "Test Design", states that tests used for V&V should address such characteristics as ensuring that important characteristics of scenarios are balanced across crews; detailed, clear, and objective procedures are available to conduct the tests; testing administration personnel are appropriately trained; participant training should be "high-fidelity," and not focused on training to perform validation scenarios; level of training should result In performance that is at/near the level of performance expected of actual plant personnel: and pilot testing should be conducted to assess the adequacy of the test design before conducting integrated testing.

WCAP-15860, in combination with WCAP-14396 (Revision 3), "Man-In-The-Loop Test Plan Description," Section 2.4, "General Test Plan," address the aspects of this criterion. While WCAP-14396 (Revision 3) addresses preliminary or "engineering" tests, rather than final or "validation" tests, with validation tests addressed by WCAP-15860, elements of the general test plan should be applicable for both test types. The applicant should indicate the applicability of the general test plan to validation tests or provide further detail on this criterion in DCD Tier 2 Section 18.8.11 or in WCAP-15860. Therefore, this is Open Item 18.11.3.5-2.

Westinghouse Response:

Section 2.4, "General Test Plan," in WCAP-14396 (Revision 3), "Man-in-the-loop Test Plan Description" applies only to preliminary or "engineering" tests, and is not applicable to final validation tests. To address the topic for validation tests, the following section will be added to WCAP-15860 (Rev. 1), "Programmatic Level Description of the AP1000 Human Factors Verification and Validation Plan":

4.10 VALIDATION TEST DESIGN

The basic design of validation tests is to administer the representative test set to multiple subject crews, for a minimum of 3 runs on each scenario in the test set. Because the number of crews is likely to be much fewer than the number of scenarios, no formal balancing strategy is needed other than random assignment of scenario order. The representative test set will be defined later as described in Section 4.6.

It is not actually necessary for each crew to perform each scenario, as long as each scenario in the set is exercised three or more times. For one thing, there is no basic concern with controlling for subject variance in validation tests, other than by proper selection and training (see Section 4.9). The point of the test is to demonstrate that any passably trained crew can at least operate safely; hence, validation failure is possible with each individual test run, and differences between crews are of no interest. This is

advantageous because, particularly if the test set is long, it may be necessary to begin with one crew, and finish with another. It also allows for lost test runs to be made up by a different crew, if a restart of the scenario is unreasonable (e.g., because the scenario has progressed far enough to invalidate the test.) In fact, though added diversity among the crews is less efficient (due to added training overhead) it will tend to create a more demanding test, since every crew will be less experienced at the conclusion of testing, and each added crew stands to be the best (or worst) yet. If the added crew happens to be the worst, then validation failure becomes more likely.

Pilot testing of each scenario should be performed at least once to ensure that the test procedures are sufficient, that test personnel are sufficiently trained, that the scenario provide an effective test, that the scenario behaves as expected on the simulator, that the evaluation tools have been properly tailored, and so forth. Pilot testing is performed for the benefit of the test developers. Actual test subjects are not used.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.5-3

Original RAI Number(s): None

Summary of Issue:

Criterion 7, "Data Analysis and Interpretation", states that validation test data should be analyzed through a combination of quantitative and qualitative methods; for pass/fail performance measures, failed indicators must be resolved before the design can be validated; the degree of convergent validity should be evaluated; data analyses should be independently validated for correctness; inference from observed performance to estimated real-world performance should allow for margins of error (i.e., allow that actual performance may be more variable than observed test performance).

WCAP-15860, in combination with WCAP-14396 (Revision 3), "Man-In-The-Loop Test Plan Description," Section 2.4, "General Test Plan, address the aspects of this criterion. While WCAP-14396 (Revision 3) addresses preliminary or "engineering" tests, rather than final or 'validation" tests, with validation tests addressed by WCAP-15860, elements of the general test plan should be applicable for both test types. The applicant should indicate the applicability of the general test plan (e.g., Section 2.4.2, "Measures and Analysis,") to validation tests or provide further detail on this criterion in DCD Tier 2 Section 18.8.11 or in WCAP-15860. Therefore, this is Open Item 18.11.3.5-3.

Westinghouse Response:

Section 2.4, "General Test Plan," in WCAP-14396 (Revision 3), "Man-in-the-loop Test Plan Description" applies only to preliminary or "engineering" tests, and is not applicable to final validation tests. Performance Measures and Acceptance Criteria are addressed in Section 4.8 of WCAP-15860 (Rev.0). This is sufficient prior to the specification of detailed implementation plans. To address the topic of data analysis for validation tests, the following section will be added to WCAP-15860 (Rev. 1):

4.11 DATA ANALYSIS

The following performance measures will be collected and used as a basis for generating results from the test trials:

- *Questionnaires (self-assessment; issue assessments; HSI ratings; raw TLX/workload)*
- *Observer checklists (OPAS-style milestones; completeness)*
- *Debriefing (questions, comments & discussion)*
- *Time history (speed)*
- *Action history (actions, usage, errors, accuracy)*
- *Plant performance (applicable margins & behavior)*
- *Video tape*

Overall, the measures produce data that are either objective, (defined as observable and verifiable), or subjective (defined as inherently meaningful responses from knowledgeable participants). Whether quantitative or qualitative, data will primarily be treated as descriptive. That is, use of inferential hypothesis testing for validation tests will be limited to statistical comparisons deemed of interest, and will not be used to implement validation criteria. Data measures that do not fit these definitions, or that are otherwise not cost-effective to collect and process, will be avoided. Examples of typical measurement tools, data, and analysis techniques used by Westinghouse are identified in WCAP-14396.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.5-4

Original RAI Number(s): None

Summary of Issue:

Criterion 8, "Validation Conclusions", states that the statistical and logical bases for determining that performance of the integrated system is and will be acceptable should be clearly documented. Limitations of validation tests and their potential effects on validation conclusions should be clearly documented.

WCAP-15860, in combination with WCAP-14396 (Revision 3), "Man-In-The-Loop Test Plan Description," Section 2.4, "General Test Plan," address the aspects of this criterion. While WCAP-14396 (Revision 3) addresses preliminary or "engineering" tests, rather than final or "validation" tests, with validation tests addressed by WCAP-15860, elements of the general test plan (e.g., 2.4.6, "Use of Results," 2.4.8, "Documentation,") should be applicable for both test types. The applicant should indicate the applicability of the general test plan (e.g., DCD Tier 2 Section 2.4.2, "Measures and Analysis," to validation tests or provide further detail on this criterion in DCD Tier 2, Section 18.8.11 or in WCAP-15860. Therefore, this is Open Item 18.11.3.5-4.

Westinghouse Response:

Section 2.4, "General Test Plan," in WCAP-14396 (Revision 3), "Man-in-the-loop Test Plan Description" applies only to preliminary or "engineering" tests, and is not applicable to final validation tests. To address the remaining topics of results and documentation for validation tests, the following section will be added to WCAP-15860 (Rev. 1):

> *4.12 RESULTS AND DOCUMENTATION*
>
> *Results will document the test design, the representative test set and its basis, and a summary of the data collected. All HEDs identified from the testing will be identified along with their resolution. The basis for concluding that the HSID is valid, i.e., that the integrated system performed acceptably during testing and that the HSID is safe and acceptably operable, will be documented. The inherent limitations of the validation paradigm will be reviewed.*

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.6-1

Original RAI Number(s): None

Summary of Issue:

For Section 18.11.3.6, "Human Engineering Discrepancy Resolution", Westinghouse described their general approach to human engineering discrepancy (HED) resolution in WCAP-15860. Section 5 of WCAP-15860 provides a commitment to develop a procedure to ensure that all issues documented in the HFE issue tracking system are verified to be completely addressed in the final HSI. However, the staff believes that further detail is needed related to the process the applicant will use to identify, analyze, prioritize, evaluate, document, and determine and evaluate design solutions, etc. for HEDs using the HED resolution review criteria in NUREG-0711 as a template. Therefore, this is Open Item 18.11.3.6-1.

Westinghouse Response:

This issue is similar to Open Item 18.11.3.4-1. The issue of HEDs and their resolution applies to discrepancies in an otherwise complete design. For Westinghouse, issue tracking and resolution is not limited to the treatment of HEDs. Other issues and concerns will be tracked that are not yet design discrepancies, or are not HFE-related, or both. That is, the issue tracking system will be project-wide, so that mechanisms of issue tracking and resolution will be similar across disciplines and project phases. This is explained in DCD Sections 18.2.3.1 (General Process and Procedures), 18.2.3.2 (Process Management Tools) and 18.2.4 (HFE Issues Tracking). In addition, to address the HED-related guidance cited above, Section 5 of WCAP-15860 (Rev.1) will be revised as specified in DSER Open Item Response 14.3.3-15.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 18.11.3.6-1

Original RAI Number(s): None

Summary of Issue:

For Section 18.11.3.6, "Human Engineering Discrepancy Resolution", Westinghouse described their general approach to human engineering discrepancy (HED) resolution in WCAP-15860. Section 5 of WCAP-15860 provides a commitment to develop a procedure to ensure that all issues documented in the HFE issue tracking system are verified to be completely addressed in the final HSI. However, the staff believes that further detail is needed related to the process the applicant will use to identify, analyze, prioritize, evaluate, document, and determine and evaluate design solutions, etc. for HEDs using the HED resolution review criteria in NUREG-0711 as a template. Therefore, this is Open Item 18.11.3.6-1.

Westinghouse Response:

This issue is similar to Open Item 18.11.3.4-1. The issue of HEDs and their resolution applies to discrepancies in an otherwise complete design. For Westinghouse, issue tracking and resolution is not limited to the treatment of HEDs. Other issues and concerns will be tracked that are not yet design discrepancies, or are not HFE-related, or both. That is, the issue tracking system will be project-wide, so that mechanisms of issue tracking and resolution will be similar across disciplines and project phases. This is explained in DCD Sections 18.2.3.1 (General Process and Procedures), 18.2.3.2 (Process Management Tools) and 18.2.4 (HFE Issues Tracking). In addition, to address the HED-related guidance cited above, Section 5 of WCAP-15860 (Rev.1) will be revised as specified in DSER Open Item Response 14.3.3-15.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.3.2-1

Original RAI Number(s): None

Summary of Issue:

Containment Isolation Failure (CI)

CIs are events involving failure of the system of valves that close the penetrations between the containment and the environment. The containment isolation analysis in the AP1000 PRA consists of a screening of all penetrations to identify those penetrations whose failure would result in a failure of the containment isolation function, and a fault tree analysis on the remaining penetrations to determine the probability of failure to isolate. Penetrations retained in the analysis (i.e., not screened out) are limited to the following lines:

- instrument air in normal containment sump
- containment air filter supply and exhaust
- main steam lines and feedwater lines
- startup feedwater lines
- steam generator blowdown lines

Failure of steam generator isolation following a SGTR, and steamline isolation following a main steamline break event are considered in the Level 1 event tree analysis, but do not contribute to the containment isolation frequency reported in the Level 2 PRA. The frequency of containment isolation failure in the baseline PRA is 1.9E-09/yr, or about 7 percent of the containment failure frequency. The probability of a pre-existing opening in containment large enough to constitute an isolation failure (1.2E-04) is included in the Level 1 fault tree model for LOCA, but was omitted in the containment isolation fault trees. The inclusion of this contributor would not noticeably impact the CI frequency. Nevertheless, for completeness of the PRA model, the staff believes that Westinghouse should include this failure mechanism within the AP1000 PRA. This is Open Item 19.1.3.2-1.

Westinghouse Response:

Attachment 43D titled Effect of "Pre-existing Containment Opening" on LRF will be incorporated in Chapter 43 of the AP1000 PRA to account for the effect of this failure mechanism on plant LRF.

Design Control Document (DCD) Revision:

None

PRA Revision:

Attachment 43D is added in Chapter 43, Release Frequency Quantification.

ATTACHMENT 43D

EFFECT OF "PRE-EXISTING CONTAINMENT OPENING" ON LRF

This discussion is included in the AP1000 PRA documentation to include the effect of pre-existing containment opening on the plant LRF.

The contribution of containment isolation failure to AP1000 PRA base case LRF is captured under the accident class CI, as summarized in Table 43-8 of the AP1000 PRA. The frequency of the accident class CI is 1.33E-09/year.

Three fault trees, CIC, CID, and XCID are used in the modeling of containment failure. The system failure probabilities obtained from these fault trees are 1.77E-03, 1.77E-03, and 2.76E-03, respectively. These fault tree models do not account for the pre-existing containment opening with a failure probability of 1.2E-04. If these scenario were to be included in the model, the system failure probability would increase by at most 7.3 percent (1.0 - (1.77E-03+1.2E-04)/1.77E-03). This increase will be used to estimate the corresponding increase in LRF.

A 7.3 percent increase in the CI accident class LRF of 1.33E-09 would raise it to 1.43E-09/year. The plant LRF would change from 1.95E-08/year to 1.96E-08/year. This change is small.

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.3.2-2

Original RAI Number(s): None

Summary of Issue:

Important Insights from Level 2 PRA and Supporting Sensitivity Analyses

An additional PCS-related failure mode is plugging of the drains near the floor of the annulus around the containment shell. Drain plugging can lead to accumulation of PCS water in the annulus, eventually reaching the baffle plate in the annulus and interrupting the air circulation. The availability of the PCS annulus drains will be confirmed every two years in accordance with the TSs. In the AP600 PRA, PCS failure was dominated by blockage of the PCS annulus drain lines, which was estimated to have a probability of 1E-04. This failure mechanism is not modeled in the AP1000 PRA, but at that same failure probability would have a corresponding containment failure frequency of about 2E-11/yr. Inclusion of this failure mode would substantially increase the frequency of CFLs in the AP1000. However, the frequency of CFL would remain less than 0.1 percent of the total containment failure frequency. Although not a key failure mode, for completeness of the PRA model, the staff believes that Westinghouse should include this failure mechanism within the AP1000 PRA. This is Open Item 19.1.3.2-2.

Westinghouse Response:

Attachment 43E titled Effect of Containment Air-Cooling Failure on Plant Risk is included in the Chapter 43 of the AP1000 PRA to account for the effect of this failure mechanism on plant LRF.

Design Control Document (DCD) Revision:

None

PRA Revision:

Attachment 43E is added in Chapter 43, Release Frequency Quantification.

ATTACHMENT 43E

Effect of Containment Air-Cooling Failure on Plant Risk

This attachment discusses the effect of containment air-cooling failure on plant risk given the success criteria that air-cooling alone is sufficient to prevent containment failure for accidents studied in the base AP1000 PRA model.

When PCS is modeled by fault trees to be used in the at-power CDF event trees (under the event tree top event CHR), to identify and collect the late containment failure (LCF) end states for sequences, it includes only water cooling function. This function serves both as short –term and long term (24-72 hours) cooling. The objective of introducing LCF end state was to collect those success sequences where only air cooling by PCS is deemed to be sufficient to avoid core damage, and both the water cooling by PCS and normal RHR are unavailable. This collection is stored under the LCF end-state with a frequency of 6.92E-08/year, which is not a CDF end state, but represents the uncertainty in the sufficiency of containment cooling solely by PCS air-cooling.

Failure of air-cooling is deemed to be less likely than the mechanical and actuation failure modes already accounted for in the PCS water cooling fault tree models. Thus, this failure mode is not assigned a failure probability. Moreover, other supplies of water are expected to be available from the fire protection system, demineralized water system, ancillary water system and temporary sources (fire trucks or water buffaloes) that can be brought on line by the operators to avoid dependence on air only cooling.

In the context of AP1000 PRA Chapter 6, the following success criteria is in effect for containment cooling:

Containment cooling either by

1. "Water cooling mode" of PCS

   or

2. Decay heat removal mode of normal RHR

   or

3. "Air cooling mode" of PCS

is sufficient to prevent core damage during the mission time specified for CDF event trees. Moreover, the probability of failure of all three of these functions for an other wise "success" sequence is deemed to be very small. Thus, this containment cooling function is not queried in the CDF event trees for CDF purposes.

If these LCF sequences were to lead to core damage, then the same sequences would also lead to a late LRF consequence. The frequency of additional late LRF (it is also CDF) introduced by failure of air cooling on top of failure of water cooling and normal RHR cooling (for otherwise success end states) is estimated below for different values of air cooling reliability.

The table below shows the relation between assuming different values for air-cooling failure probability, and the resulting increase in plant CDF/LRF:

Air cooling Failure Probability	Current LCF with air cooling success	Increase in LRF (also CDF) if LCF and failure of air cooling occurs	comparative increase in base LRF	Risk Significance
0.0001	6.92E-08	6.92E-12	very small	Insignificant
0.001	6.92E-08	6.92E-11	very small	Insignificant
0.01	6.92E-08	6.92E-10	3.5%	Insignificant

From this table, one sees that with any reasonable value for the air-cooling failure probability, the increase in LRF is not risk significant, increase of CDF being even less significant.

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.1-3

Original RAI Number(s): 720.039, 720.027, 720.030

Summary of Issue: PRA Input to RTNSS Process

Furthermore, the staff review found that the issue of uncertainties (e.g., those associated with the assumed reliability values for passive system components) had not been addressed. Staff sensitivity studies have shown that the "focused" PRA results (e.g., CDF and LRF) are sensitive to the reliability values used in the PRA for certain passive system components which have significant uncertainties associated with them. The results of such sensitivity studies have shown that when more bounding data are used in the PRA in order to address uncertainties, both probabilistic criteria are met only when credit is taken for some additional non-safety-related "defense-in-depth" systems. Therefore, the need for regulatory oversight of certain SSCs has been determined and is discussed below and in Chapter 22 of this report.

The results of the uncertainty and importance analyses were used to select SSCs for sensitivity studies. These analyses indicated that the following SSCs have the largest impact on PRA results, such as CDF and LRF, used in the criteria for selecting non-safety-related SSCs for regulatory oversight according to the RTNSS process:

- reactor trip components, such as circuit breakers
- ESF actuation components, such as software
- passive system check valves and explosive (squib) valves

A series of sensitivity studies were performed by the staff to investigate the impact of uncertainties in the performance of these SSCs on PRA results, under the assumption of plant operation without credit for one or more non-safety-related "defense-in-depth" systems. These studies provided additional insights about the risk importance of the various "defense-in-depth" systems which were taken into account in selecting non-safety-related systems for "regulatory treatment" according to the RTNSS process (detailed results and insights related to CDF are reported in Section 19.1.3.1.5 of this report while insights related to LRF and CCFP are reported in Section 19.1.3.2 of this report). The most important insights from such sensitivity studies, as they relate to the RTNSS process, are summarized below.

- Availability control of the RT function of DAS provides an efficient means for minimizing the impact of uncertainties in reactor trip components, such as circuit breakers, on PRA results used in the criteria for selecting non-safety-related SSCs for regulatory oversight according to the RTNSS process. Such availability control should include the two M-G set CBs because the RT function of DAS requires the availability (to open) of both these CBs.
- Availability control of the ESF actuation function of DAS provides an efficient means for minimizing the impact of uncertainties associated with ESF actuation components, such as digital I&C system software, on PRA results used in the criteria for selecting non-safety-related SSCs for regulatory oversight according to the RTNSS process.

- Availability control of the RNS (including its support systems) provides an efficient means for minimizing the impact of uncertainties associated with passive system check valves and explosive (squib) valves on PRA results used in the criteria for selecting non-safety-related SSCs for regulatory oversight according to the RTNSS process.

For AP600, the staff also have determined the following:

- Criterion #1 (i.e., CDF less than 1E-04/y) is fully satisfied when an unavailability of 0.25 or less is assumed in the PRA for DAS (for both the reactor trip and ESF actuation functions) and for RNS. This requires an "average" yearly availability of at least 75 percent for such systems.

- Criterion #2 (i.e., LRF less than 1E-06/y) is fully satisfied when an unavailability of 0.1 or less is assumed in the PRA for each of the automatic and manual portions of DAS (for both the reactor trip and ESF actuation functions) and for RNS. This requires an "average" yearly availability of at least 90 percent for such systems or subsystems.

The staff cannot reach similar conclusions for AP1000 at this time. As explained in Section 19.1.10 of this report, additional information is needed which will provide the link between the PRA results and the level of regulatory oversight needed to meet the above mentioned criteria. This is Open Item 19.1.10.1-3.

Westinghouse Response:

Westinghouse revised its response to RAI 720.027 in order to address the NRC concerns about the initiating event frequency of large LOCAs. The response to RAI 720.030 was also revised in order to address the NRC concerns about the initiating event frequency of steam generator tube ruptures. These revised responses (rev. 1) were submitted to the NRC on March 25, 2003 in letter DCP/NRC1556. Westinghouse also revised the discussion on uncertainties in the AP1000 RTNSS evaluation (WCAP-15985, rev. 1) to reflect these RAI responses as well as other uncertainties. This revision was included in a revised response to RAI 720.039. This revised response (rev. 2) was submitted to the NRC on April 4, 2003 in letter DCP/NRC1565.

Westinghouse believes that the AP1000 RTNSS evaluation is fully consistent with SECY-94-084. In this SECY, the NRC says that the issue with passive systems is the limited operating experience and the low driving force available which leads to phenomenological uncertainties. In the discussion of the specific RTNSS evaluation process, this SECY says that in the Baseline PRA, uncertainties need to be addressed, including appropriate sensitivity and uncertainty analysis. There is no mention of uncertainty analysis in the subsequent discussion on the Focused PRA.

In the AP1000, as in the AP600, we have performed extensive thermal hydraulic analysis to demonstrate that T/H uncertainty is not risk important for the AP1000. As directed in SECY-94-084, we have used the PRA risk importance ratings and sensitivity studies to evaluate uncertainties in the AP1000 baseline PRA in both initiating event frequencies and in the

reliability of components. In addition, we have provided a discussion of uncertainties in the PRA as they relate to RTNSS. This discussion is contained in section 2.3 of the RTNSS WCAP-15985. The scope of this discussion was expanded to include information from revised RAI responses (RAI 720.027 rev. 1, RAI 720.030 rev. 1, and 720.039 rev. 2).

The discussion in the revised RTNSS WCAP, concluded that some of these uncertainties are not RTNSS important. In other cases, that conclusion could not be made, so nonsafety features were identified that could compensate for the uncertainties. These features are identified as RTNSS important and appropriate additional regulatory oversight measures have been adopted. These measures include short-term availability controls. The base Focused PRA does not include these features because they are not necessary to allow the AP1000 to meet the CDF and LRF safety goals identified in SECY-94-084. Westinghouse believes that the AP1000 RTNSS evaluation provides a well defined link between the PRA results and the additional regulatory oversight proposed for the AP1000 RTNSS features and is fully consistent with SECY-94-084; it is also consistent with the RTNSS evaluations we performed for AP600.

We do not think that an attempt should be made to quantify uncertainties in the AP1000 Focused PRA. First, it is not necessary or required by SECY-94-084. Second, we don't think that it is possible to accurately quantify these uncertainties. In the baseline PRA, we have performed sensitivity studies on uncertainties (as suggested by SECY-94-084). However these sensitivity studies have a very different objective. The objective of the baseline sensitivity studies is to determine how much the CDF / LRF changes given an arbitrary change in the reliability of a component. It is a much more difficult to quantify the actual uncertainty in the reliability of a component so that it could be shown that the addition of a nonsafety feature compensates for that uncertainty and that the plant still meets the safety goals. We think that it is sufficient to identify nonsafety features that can compensate for these uncertainties.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.1-4

Original RAI Number(s): 720.027

Summary of Issue: Impact of Uncertainties on PRA Results and Conclusions

The staff review has identified two AP1000-specific areas of uncertainty which individually, or collectively with other areas of uncertainty (e.g., uncertainty associated with failure probabilities of squib valves), have the potential to affect the PRA results and conclusions regarding the need for "certification requirements," such as ITAACs, RTNSS and COL action items. These uncertainties have also the potential to increase the number of "low margin risk significant" sequences which should be analyzed conservatively to bound thermal-hydraulic (T-H) uncertainty and determine success criteria for systems and operator actions. These two areas of uncertainty are discussed below.

One area of uncertainty is related to initiating event frequencies assumed in the PRA. The staff requested additional information (see RAI 720.027) about differences in initiating event category frequencies used in the AP600 and the AP1000 PRAs for large LOCAs and SGTR accidents. The applicant's response to RAI 720.027 did not address adequately the basis for the decrease of such initiating event frequencies which have a significant impact on the PRA results. For the large LOCA category, the applicant states that in the AP1000 PRA "operating experience" data reported in NUREG/CR-5750 for pipe breaks were used. However, the NUREG/CR-5750 data rely on expert opinion and include significant uncertainty. In addition, since NUREG/CR-5750 was published additional information (e.g., Davis Besse finding) is available. For SGTR events, the frequency used in the AP1000 PRA is based on a more recent calculation that was performed in conjunction with a replacement steam generator project which is proprietary to the applicant. The staff believes that the impact of uncertainties on PRA results and insights, associated with the frequencies of large LOCAs and SGTR accidents assumed in the AP1000 PRA, needs to be investigated and addressed appropriately by the design certification process.

A second area of uncertainty is related to the success criteria assumed in the AP1000 PRA for passive containment cooling by air flow. The AP1000 PRA event trees include a top event for containment cooling (event CHR). It is stated that *"For success paths that result in steam release to the containment, the success of containment cooling (PCS or RNS) is modeled. If containment cooling is successful, then the path ends in an OK state. If PCS water cooling is not successful, then the path goes to a special OK end state to allow containment integrity sensitivity studies to be made."* This "special OK" end state is labeled "late containment failure (LCF)" end state and defined as an end state *"...where the containment heat removal by either passive containment cooling system (PCS) or component cooling water (CCS) heat exchangers via normal residual heat removal (RHR) fails."* The staff requested clarification (see RAI 720.030) about the meaning of the "special Ok" status. The applicant responded that a sensitivity study shows that even if the LCF state is considered to be a core damage, the plant CDF would increase by only 29 percent. The staff needs further information regarding the impact of this assumption on the focused PRA, where no credit is taken for the non-safety-related systems, and on the RTNSS process.

The impact of these two areas of uncertainty on the results of the PRA, including the PRA results used in the RTNSS process, should be addressed in the design certification process. This is Open Item 19.1.10.1-4.

Westinghouse Response:

Westinghouse revised its response to RAI 720.027 in order to address the NRC concerns about the initiating event frequency of large LOCAs. The response to RAI 720.030 was also revised in order to address the NRC concerns about the initiating event frequency of steam generator tube ruptures. These revised responses (rev. 1) were submitted to the NRC on March 25, 2003 in letter DCP/NRC1556. Westinghouse also revised the discussion on uncertainties in the AP1000 RTNSS evaluation (WCAP-15985, rev. 1) to reflect these RAI responses as well as other uncertainties. This revision was included in a revised response to RAI 720.039 (rev. 2). This revised response was submitted to the NRC on April 4, 2003 in letter DCP/NRC1565.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.1-5

Original RAI Number(s): 720.009, 720.012, 720.013, 720.014, 720.017, 720.021, 720.024, 720.025

Summary of Issue:

In conclusion, the applicant has utilized a systematic approach in categorizing success paths for the PRA for the purpose of minimizing the number of analyses needed to justify success. In many cases the MAAP4 code was used to identify the limiting sequences. To justify that the limiting sequences provide for adequate core cooling, the applicant has performed bounding analyses using conservative computer codes that the NRC staff has reviewed for design basis accidents. In some instances the NRC staff has identified limiting sequences that have not been bounded. Other sequences have not been analyzed for AP1000 but success has been inferred by the applicant from analyses performed for AP600. These deficiencies are an open item in the AP1000 DSER.

The deficiencies are listed below with reference to the NRC staff RAI where the issue was first raised:

(a) Additional justification in needed for long-term cooling analyses for which the initial and boundary conditions were obtained from analyses using MAAP4 for input into WCOBRA/TRAC (RAI 720.013)

(b) Additional justification should be provided that a large break LOCA can be mitigated if one of the two CMTs fail (RAI 720.012-2)

(c) Additional justification should be provided that adequate water can be maintained within the containment to provide for long term core cooling if containment isolation fails (RAIs 720.021 and 720.024)

(d) Additional justification should be provided that one of the two startup feedwater pumps can deliver adequate water to the two steam generators following an ATWS event (RAI 720.024)

(e) Additional justification should be provided that evaluations made for AP600 are appropriate to be used in the AP1000 PRA Table 6-1 and in the response to RAI 720.025 where the applicant assumes that 30 minutes of core cooling is available following a small break LOCA, steam generator tube rupture or transient with no accumulator injection (RAIs 720.024 and 720.025)

(f) Additional justification should be provided that sequences which assume failure of one of the four ADS stage 4 valves and also assume failure of containment isolation, will end in successful core cooling (RAIs 720.012-1,4, 720.009 and 720.017).

This is Open Item 19.1.10.1-5.

Westinghouse Response:

a) Westinghouse revised its response to RAI 720.013 in order to address the NRC concern about the use of MAAP to determine the boundary conditions input to WCOBRA-TRAC for long-term core cooling analysis. This revised response (rev. 1) was submitted to the NRC on March 31, 2003 in letter DCP/NRC1559.

b) Westinghouse revised its response to RAI 720.012-2 in order to address the NRC concern about the use of one CMT to mitigate a large LOCA. This revised response (rev. 1) was submitted to the NRC on April 1, 2003 in letter DCP/NRC1560.

c) Westinghouse revised its response to RAI 720.021 in order to address the NRC concern that adequate water can be maintained within containment to provide for long term core cooling if containment isolation fails. This revised response (rev. 1) was submitted to the NRC on March 31, 2003 in letter DCP/NRC1559.

d) Westinghouse revised its response to RAI 720.024 in order to address the NRC concern about the use of one SFW pump feeding two SGs during an ATWS. This revised response (rev. 1) was submitted to the NRC on April 1, 2003 in letter DCP/NRC1560.

e) Westinghouse revised its response to RAI 720.025 in order to address the NRC concern that there is 30 minutes of operator action time available following a small LOCA, SGTR or transient with no accumulator injection. This revised response (rev. 1) was submitted to the NRC on March 31, 2003 in letter DCP/NRC1559.

f) Westinghouse provided its response to RAI 720.017 in order to address the NRC concern about providing successful short-term core cooling with 3 of 4 ADS 4 valves and failure of containment isolation. This response (rev. 0) was submitted to the NRC on November 11, 2002 in letter DCP/NRC1531. Westinghouse also revised its response to RAI 720.009 and RAI 720.017 in order to address the NRC concern about providing successful long-term core cooling with 3 of 4 ADS 4 valves and failure of containment isolation. These responses (rev. 1) were submitted to the NRC on April 1, 2003 in letter DCP/NRC1560.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.2-1

Original RAI Number(s): 720.099

Summary of Issue: Shutdown Risk Due to Vacuum Refill Operations

The reported CDF from internal events during shutdown operation (1.2E-07/year) covers two plant operational states:

- safe shutdown/cold shutdown with the RCS filled and intact, and
- mid-loop/vessel flange operations with the RCS vented and drained.

Mid-loop/vessel flange operations include: (1) draining to mid-loop, and (2) drained maintenance, and post-refueling maintenance.

Vacuum refill of the RCS from drained conditions (mid-loop) was mentioned in the PRA. However, no risk assessment was performed for this configuration. Vacuum refill of the RCS helps to reduce non-condensible gas pockets in the RCS, eliminating the need for dynamic venting of the RCS and the multiple reactor coolant pump start and stop operations that it requires.

The applicant stated that the shutdown risk due to vacuum refill operations is included in the calculation of shutdown risk during vented drained conditions. The staff is reviewing the applicant's response to RAI 720.99 to determine if the shutdown risk due to vacuum refill operations is included in the calculation of shutdown risk during vented drained conditions. The staff noted during their review of the applicant's response to RAI 720.99 that Investment Protection Short term Availability Controls do not include RNS and its support systems such as Component Cooling Water System, Service Water system, and ac power supplies during vacuum refill operations. Assuming an extended loss of RNS during vacuum refill operations, the staff questions using the RNS suction relief valve to relief RCS pressure should the operators not open the ADS valves. The operators may instead isolate the RNS suction relief valve to isolate RCS leakage. As discussed in Section 19.1.10.2 of this report, this vacuum refill issue is considered to be Open Item 19.1.10.2-1.

Westinghouse Response:

Westinghouse provided its response to RAI 720.099 in order to address this NRC concern about whether vacuum refill operations are bounded by the current AP1000 shutdown PRA. This response (rev. 0) was submitted to the NRC on March 28, 2003 in letter DCP/NRC1558.

The following discussion provides further support of the treatment of vacuum refill operation in the AP1000 PRA. The short-term availability controls provided for AP1000 do not require the RNS and its support systems to be available during vacuum degassing. This is considered reasonable because of the following reasons:

1. The decay heat during vacuum degassing will be about 50% of that during drained conditions early in a shutdown.

2. Although ADS stage 1/2/3 will be closed, 9 of the 10 ADS paths are required by Technical Specifications to be operable. As a result, at least 3 of 4 ADS stage 4 valves will be operable instead of the 2 of 4 during RCS drained / open conditions.

3. The time spent in vacuum degassing is small compared to drained / open shutdown conditions.

4. Just prior to entering vacuum degassing operations, both RNS pumps and support systems are required to be available by the short-term availability controls. It is very unlikely that the RNS or its support systems would have a failure in the short duration of vacuum degassing.

Also, in case of a loss of RNS cooling during vacuum degassing the operators would not isolate the RNS suction lines before they opened the ADS stage 1/2/3 lines. First, Technical Specification LCO 3.4.15 requires the RNS suction relief valves to be operable (or the RCS open) to provide the LTOP function when the plant is performing vacuum degassing operations in MODE 5. Second, the Shutdown Emergency Response Guidelines direct the operators to open ADS 1/2/3 lines in this situation; they do not direct the operators to close the RNS lines.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.2-2

Original RAI Number(s): None

Summary of Issue:

Dominant Shutdown Accident Sequences

The applicant did not report the dominant shutdown accident sequences in the AP1000 shutdown PRA. The staff requests Westinghouse to report the dominant shutdown accident sequences in the AP1000 shutdown PRA. This is Open Item 19.1.10.2-2.

Westinghouse Response:

The process of using the cutset file from AP600 PRA as the starting point for the AP1000 Shutdown Risk estimation, as explained in Section 54 of AP1000 PRA, does not allow us to generate dominant accident sequences automatically, only CDF cutsets.

We did examine the top initiating event categories that contribute 95% of the plant CDF (Table 54-4 of AP1000 PRA). These initiating events are:

IEV-CCWD with 68.5% contribution
IEV-LOSP with 14.13 % contribution
IEV-RNSD with 9.27% contribution
IEV-RCSOD with 14.13 % contribution.

The CDF sequences from these initiating events are listed as potential dominant accident sequences for shutdown in Table 1. These sequences defined in the ET models of Figures 54-1 through 54-10. Note that this process does not provide the sequence frequencies.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Table 1. Potential Dominant Accident Sequences for AP1000 Shutdown Risk

	Initiating Event	Sequence	Successful Nodes	Failed Nodes
1	IEV-CCWD	6	None	RCS Depressurization
2	IEV-CCWD	5	ADS Depressurization	Gravity Injection Fails Gravity Injection via RNS fails
3	IEV-CCWD	2, 4	ADS Depresurization Gravity Injection	Containment Sump Recirculation Fails
4	IEV-LOSPD	8,14	None	RCS Depressurization
5	IEV-LOSPD	7,13	ADS Depressurization	Gravity Injection Fails Gravity Injection via RNS fails
6	IEV-LOSPD	4,6,10,12	ADS Depressurization Gravity Injection	Containment Sump Recirculation Fails
7	IEV-RNSD	6	None	RCS Depressurization
8	IEV-RNSD	5	ADS Depressurization	Gravity Injection Fails Gravity Injection via RNS fails
9	IEV-RNSD	2,4	ADS Depressurization Gravity Injection	Containment Sump Recirculation Fails
10	IEV-RCSOD	6,12	None	RCS Depressurization
11	IEV-RCSOD	5,11	ADS Depressurization	Gravity Injection Fails Gravity Injection via RNS fails
12	IEV-RCSOD	2,4,8,10	ADS Depressurization Gravity Injection	Containment Sump Recirculation Fails

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.2-3

Original RAI Number(s): 720.038

Summary of Issue:

Shutdown Risk Importance Analysis

As requested by the staff in the follow up to RAI 720.038, the applicant did not provide any importance analyses (such as risk achievement and risk worth) in their response to RAI 720.038 (dated 03/28/03 and 4/12/03). This is Open Item 19.1.10.2-3.

Westinghouse Response:

In the attached Tables 54-18, 54-19, 54-20, and 54-21, we provide the risk achievement and risk reduction importance measures of the basic events that show up in the base AP1000 Shutdown PRA (previously summarized by Table 54-6), and the Sensitivity Case 2 for no-credit for standby non-safety systems (previously Summarized by Table 54-10).

Design Control Document (DCD) Revision:

None

PRA Revision:

Revision of Section 54.7.1 of Chapter 54, Low-Power and Shutdown Risk Assessment

54.7.1 Discussion of Results

The AP1000 Level 1 shutdown PRA has an estimated CDF of 1.23E-07 events/year. This CDF is conservative because credit is not taken for the design enhancement in using diverse squib valves in the recirculation lines. The failure of the recirculation function is represented by basic event IWX-EV4-SA (CCF of 2 of 2 LP squib valves) with a probability of 2.6E-05. However, the failure of the recirculation function would require other combinations of valves, in addition to failure of these low pressure squib valves. Thus, the cutsets with basic event IWX-EV4-SA (such as cutset #3) are overly conservative. The combined common-cause failure of valves (i.e., combinations of check valves, squib valves and motor-operated valves) that could fail the recirculation function has a probability judged to be less than 1.0E-6. If the failure of the valves in the recirculation lines is assigned a conservative CCF probability of 1.0E-06, the estimated CDF of the AP1000 Level 1 shutdown PRA becomes 1.0E-07 events/year. Therefore, if credit is taken for the diverse squib valves in the recirculation lines of the AP1000 plant, the estimated CDF of the Level 1 shutdown PRA would be the same for the AP1000 and AP600 plants.

The risk importances of basic events appearing in CDF cutsets are presented in Tables 54-18 and 54-19 for RAW and RRW risk importance measures.

Revision of Section 54.9.2 of Chapter 54, Low-Power and Shutdown Risk Assessment

Table 54-12 gives the contribution of initiating events to plant CDF. Results of the table show that three events per 100 years of plant operation are postulated. This corresponds to about one event per plant lifetime. If such an event occurs, and is assumed not to be mitigated by nonsafety systems of RNS, DAS, and DGs, the average conditional core damage probability (CDP) of the AP1000 is 4E-05. This result indicates that the plant is robust against shutdown accidents even with only safety front-line systems credited to mitigate such events. When the above-mentioned nonsafety systems are credited, the average conditional core damage probability becomes 4E-06 (1.23E-07/2.94E-02). This is a low CDP, given a challenge to the plant systems occur during low power and shutdown operations.

The risk importances of basic events appearing in case 2 CDF cutsets are presented in Tables 54-20 and 54-21 for RAW and RRW risk importance measures.

Following Tables 54-18, 54-19, 54-20 and 54-21 are added in Chapter 54, Low-Power and Shutdown Risk Assessment

Table 54-18 AP1000 Shutdown PRA Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
1	CCX-SFTW	32	1.20E-06	5.37E+04	SOFTWARE CCF OF ALL CARDS
2	ADX-EV-SA	244	3.00E-05	7.35E+03	CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN
3	IWX-EV4-SA	227	2.60E-05	7.34E+03	CCF OF 2 OUT 2 LOW PRESSURE RECIRCULATION SQUIB VALVES
4	REX-FL-GP	168	1.20E-05	7.34E+03	CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS
5	IWX-FL-GP	168	1.20E-05	7.34E+03	CCF OF STRAINERS IN IRWST TANK
6	IWX-EV-SA	266	2.60E-05	7.19E+03	CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN
7	CCX-ORY-SPX	112	3.63E-06	7.18E+03	CCF OF ORIFICES
8	CCX-XMTRX	97	2.63E-06	7.17E+03	CCF OF PRESSURE TRANSMITTERS
9	IEV-RCSOD	523	5.28E-06	5.77E+03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EVENT
10	CCX-EP-SAM	232	8.62E-06	1.47E+03	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
11	IEV-RNSD	1075	9.69E-05	9.58E+02	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS
12	IEV-LOCA24D	488	1.15E-05	9.57E+02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAINED
13	IEV-CCWD	2182	7.16E-04	9.57E+02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS
14	IEV-LOCA24ND	718	1.73E-05	9.54E+02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILLED
15	CCX-BY-PN	376	4.70E-05	4.03E+02	COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B
16	CCX-IV-XR	290	2.40E-05	3.99E+02	COMMON CAUSE FAILURE OF THE INVERTER
17	IWX-CV-AO	398	3.00E-05	1.96E+02	CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN
18	IWX-XMTR	123	2.01E-04	7.47E+01	CCF OF IRWST LEVEL TRANSMITTERS
19	ALL-IND-FAIL	31	1.00E-06	7.05E+01	INDICATION FAILURE
20	IEV-LOCAPRND	187	1.61E-05	5.98E+01	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS
21	CCX-PMAMOD1-SW	134	1.10E-05	3.88E+01	SOFTWARE CCF OF OUTPUT LOGIC I/Os
22	CCX-PMAMOD1X	195	4.63E-05	3.86E+01	CCF OF ACTUATION LOGIC GROUPS
23	CCX-PMA030X	130	1.38E-05	3.84E+01	CCF OF LOGIC GROUP PROCESSING
24	CCX-EP-SAMX	87	2.94E-06	3.83E+01	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
25	IWB-PLUG	443	2.40E-04	3.53E+01	IRWST DISCHARGE LINE "B" STRAINER PLUGGED
26	IEV-LOSPD	3154	5.28E-03	2.76E+01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED
27	CCX-INPUT-LOGIC	29	1.03E-04	1.73E+01	COMMON MODE FAILURE OF INPUT LOGIC GROUPS

Table 54-18 AP1000 Shutdown PRA Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
28	CCX-ORY-SP	19	2.77E-04	1.57E+01	CCF OF ORIFICES
29	CCX-XMTR195	16	2.01E-04	1.55E+01	CCF OF PRESSURE TRANSMITTERS
30	LPM-MAN05	37	6.83E-04	1.33E+01	OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZATION
31	IWN-MAN00	189	1.15E-03	7.72E+00	OPERATOR FAILS TO ACTUATE IRWST INJECTION
32	RNX-PM-FS	59	7.70E-04	7.45E+00	CCF TO START OF THE PUMPS
33	RNX-KV-GO	52	6.10E-04	7.45E+00	CCF TO OPEN OF THE STOP CHECK VALVES
34	CCX-PL4MOD1	27	1.41E-04	7.40E+00	CMF OF OUTPUT LOGIC I/Os
35	CCX-PL403	22	9.69E-05	7.37E+00	CMF OF OUTPUT LOGIC GROUPS
36	RNX-CV-GO	20	5.10E-05	7.35E+00	CCF TO OPEN OF THE CHECK VALVES
37	RNX-PM-ER	17	1.60E-05	7.25E+00	CCF TO RUN OF THE PUMPS
38	SWX-PM-ER	16	1.40E-05	7.20E+00	CCF TO RUN OF THE MOTOR PUMPS
39	CCX-PM-ER	16	1.40E-05	7.20E+00	DUE TO CCF OF CCS PUMPS TO RUN
40	CCX-PL4MOD1-SW	14	1.10E-05	7.07E+00	SOFTWARE CCF OF OUTPUT LOGIC I /Os (CCX-P##MOD1)
41	CCX-EP-SA	14	8.62E-06	7.07E+00	CCF OF THE POWER INTERFACE OUTPUT BOARD (CCX-EP-SA)
42	PXX-AV-LA	190	1.92E-04	5.82E+00	FAILURE OF PRHR DUE TO COMMON CAUSE OF AOVs
43	IWNTK001AF	20	2.40E-06	5.60E+00	FAILURE OF THE PRHR DUE TO IRWS TANK FAILURE
44	PRX-HR-ML	10	1.20E-07	5.48E+00	CCF PLUG/LEAK OF PRHR HEAT EXCHANGERS
45	ED1MOD03	123	2.70E-03	5.09E+00	BATTERY DB1 UNAVAILABLE
46	ECX-CB-GO	93	1.20E-03	5.08E+00	COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN
47	ZOX-PD-ES	112	2.00E-03	5.08E+00	CCF TO START OF ENGINE-DRIVEN FUEL PUMPS
48	ED1MOD113	59	3.17E-04	5.08E+00	FIXED COMPONENTS FAILURE
49	ED1MOD11	59	3.17E-04	5.08E+00	FIXED COMPONENTS FAILURE
50	ECX-CB-GC	74	7.30E-04	5.07E+00	COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE
51	ZOX-DG-DR	59	4.40E-04	5.05E+00	COMMON CAUSE FAILURE STANDBY DG TO RUN
52	ZOX-DG-DS	54	2.80E-04	5.03E+00	COMMON CAUSE FAILURE STANDBY DG TO START
53	ZOX-PD-ER	36	1.30E-04	4.97E+00	CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS
54	CCX-BY-PN1	20	5.70E-05	4.85E+00	COMMON CAUSE FAILURE OF THE BATTERY
55	ZOX-BL-ES	20	6.00E-05	4.84E+00	CCF TO START DG ROOM VENT FANS

Table 54-18 AP1000 Shutdown PRA Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
56	IEV-RNSND	127	1.02E-03	4.60E+00	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS
57	IEV-CCWND	164	3.99E-03	4.59E+00	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS
58	PL5MOD11	76	2.09E-03	4.58E+00	FAILURE OF PLS OUTPUT LOGIC I/Os
59	PL50301BSA	52	1.16E-03	4.57E+00	PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND
60	PL50301ASA	52	1.16E-03	4.57E+00	PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND
61	ED1MOD01	29	5.04E-04	4.55E+00	FIXED COMPONENT FAILURES
62	ED1MOD13	22	3.17E-04	4.53E+00	FIXED COMPONENTS FAILURE
63	ED1MOD07	22	3.05E-04	4.53E+00	EDS1 EA 1 DISTR. PNL FAILURE OR T&M
64	CCX-PL7MOD1	14	1.41E-04	4.51E+00	CMF OF OUTPUT LOGIC I/Os
65	CCX-PL1MOD1	14	1.41E-04	4.51E+00	CMF OF OUTPUT LOGIC I/Os
66	EC5EPMGB1SA	14	1.71E-04	4.51E+00	FAILURE OF OUTPUT DRIVER
67	CCX-PL703	12	9.69E-05	4.51E+00	CMF OF OUTPUT LOGIC GROUPS
68	CCX-PL103	12	9.69E-05	4.51E+00	CMF OF OUTPUT LOGIC GROUPS
69	PL5XS00ASA	12	8.00E-05	4.51E+00	FAILURE OF OUTPUT LOGIC GROUP SELECTOR
70	CCX-IV-XR1	11	2.40E-05	4.49E+00	COMMON CAUSE FAILURE INVERTER
71	CCX-HE-AF	5	1.20E-06	4.35E+00	DUE TO CCF OF CCS H/X (PLUG OR LEAK)
72	CCX-PL1MOD1-SW	8	1.10E-05	4.35E+00	SOFTWARE CCF OF OUTPUT LOGIC I /Os (CCX-P##MOD1)
73	CCX-PL7MOD1-SW	8	1.10E-05	4.35E+00	SOFTWARE CCF OF OUTPUT LOGIC I /Os (CCX-P##MOD1)
74	ED1BSDS1LF	7	4.80E-06	4.19E+00	EDS1 DS 1 SWITCHGEAR FAILURE
75	ADX-EV2-SA	70	6.00E-05	4.12E+00	OPERATOR FAILS TO ACTUATE ADS AFTER CORE DAMAGE
76	CCX-LS-FA	32	5.37E-06	4.12E+00	CCF OF LIMIT SWITCHES
77	IW1OR170SPX	34	9.46E-05	3.94E+00	ORIFICE FAILURE DUE TO PLUGGING
78	IW2OR160SPX	34	9.46E-05	3.94E+00	ORIFICE FAILURE DUE TO PLUGGING
79	IW1TL170UFX	33	6.84E-05	3.93E+00	LEVEL TRANSMITTER FAILURE
80	IW2TL160UFX	33	6.84E-05	3.93E+00	LEVEL TRANSMITTER FAILURE
81	RN23MOD5S	912	2.21E-03	3.36E+00	MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN
82	IDDBSDS1TM	411	3.00E-04	3.25E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
83	IDDBSDD1TM	411	3.00E-04	3.25E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE

Table 54-18 AP1000 Shutdown PRA Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
84	REB-PLUG	121	2.40E-04	3.20E+00	SUMP SCREEN B PLUGS AND PREVENTS FLOW
85	REA-PLUG	121	2.40E-04	3.20E+00	SUMP SCREEN A PLUGS AND PREVENTS FLOW
86	RHN-MAN05	781	1.60E-03	3.18E+00	OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023
87	IDDBSDK1TM	388	3.00E-04	3.13E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
88	RNDEP023SA	291	1.71E-04	3.03E+00	FAILURE OF OUTPUT DRIVER
89	CCX-PMDMOD1	278	1.41E-04	2.98E+00	CMF OF OUTPUT LOGIC I/Os
90	CCX-PMD030	190	9.69E-05	2.86E+00	CMF OF OUTPUT LOGIC GROUPS
91	IDBBSDS1TM	165	3.00E-04	2.83E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
92	IDBBSDD1TM	165	3.00E-04	2.83E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
93	IWA-PLUG	136	2.40E-04	2.80E+00	IRWST DISCHARGE LINE "A" STRAINER PLUGGED
94	IRWMOD05S	360	3.00E-03	2.76E+00	MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN
95	IDBBSDK1TM	151	3.00E-04	2.73E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
96	IDBFD013RQ	15	1.20E-05	2.73E+00	FUSE DISCONNECT SWITCH (FD13) SPURIOUSLY OPENS
97	IDBBSDD1LF	11	4.80E-06	2.72E+00	BUS IDSB-DD-1 FAILS (ALL MODES)
98	IDBBSDS1LF	11	4.80E-06	2.72E+00	BUS IDSB-DS-1 FAILS (ALL MODES)
99	IRAEP121ASAX	42	5.83E-05	2.65E+00	FAILURE OF POWER INTERFACE OUTPUT BOARD
100	CCX-PMDMOD4	133	4.98E-05	2.64E+00	CMF OF MUX LOGIC GROUPS
101	IDBFD014RQ	10	1.20E-05	2.64E+00	FUSE DISCONNECT SWITCH (FD14) SPURIOUSLY OPENS
102	IDBBSDK1LF	7	4.80E-06	2.63E+00	BUS IDSB-DK-1 FAILS (ALL MODES)
103	ADN-MAN01	56	4.93E-04	2.55E+00	OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE
104	CCX-PMAMOD1	126	1.41E-04	2.55E+00	CCF OF OUTPUT LOGIC I/O BOARDS
105	REN-MAN04	104	1.00E-02	2.46E+00	OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE
106	CCX-VS-FA	8	3.84E-05	2.39E+00	CCF OF CMT LEVEL SWITCHES (CMX -VS-FA)
107	CCX-PMA030	92	9.69E-05	2.37E+00	CCF OF LOGIC GROUP PROCESSING
108	IDABSDS1TM	295	3.00E-04	2.35E+00	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
109	IDAMOD05	354	5.16E-04	2.34E+00	FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS
110	ZOX-BL-ER	2	1.36E-06	2.32E+00	CCF TO RUN DG ROOM VENT FANS

Table 54-18 AP1000 Shutdown PRA Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
111	ZOX-FL-GP	2	1.30E-06	2.31E+00	COMMON CAUSE FAILURE - PLUGGING OF FUEL FILTERS
112	IDAMOD04	340	3.17E-04	2.29E+00	LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS
113	IDDFD019RQ	63	1.20E-05	2.27E+00	FUSE DISCONNECT SWITCH (FD19) SPURIOUSLY OPENS
114	IWX-XMTRLW	2	9.20E-09	2.22E+00	CCF OF MOVS ON RECIRC LINES TO OPEN
115	CCX-PMAMOD2X	22	8.58E-05	2.19E+00	CCF OF ACTUATION LOGIC GROUPS
116	IDDFD020RQ	58	1.20E-05	2.18E+00	FUSE DISCONNECT SWITCH (FD20) SPURIOUSLY OPENS
117	CCX-PMDMOD1-SW	56	1.10E-05	2.18E+00	SOFTWARE CCF OF OUTPUT LOGIC I /Os (CCX-P##MOD1)
118	CCX-PMDMOD4-SW	56	1.10E-05	2.18E+00	SOFTWARE CCF OF MUX LOGIC GROUPS (CCX-P##MOD4-SW)
119	CCX-INPUT-LOGICX	12	2.59E-05	2.17E+00	CCF OF INPUT LOGIC GROUPS
120	CCX-IN-LOGIC-SW	8	1.10E-05	2.17E+00	CCF OF SOFTWARE FOR INPUT LOGIC GROUPS
121	CCX-PMAMOD2-SW	8	1.10E-05	2.17E+00	CCF OF SOFTWARE FOR ACTUATION LOGIC GROUPS
122	PMAMOD11	326	2.09E-03	2.16E+00	FAILURE OF PMS OUTPUT LOGIC I/Os
123	PMA0301BSA	227	1.16E-03	2.13E+00	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
124	PMA0301ASA	227	1.16E-03	2.13E+00	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
125	IDDBSDD1LF	35	4.80E-06	2.05E+00	BUS IDSD-DD-1 FAILS (ALL MODES)
126	IDDBSDS1LF	35	4.80E-06	2.05E+00	BUS IDSD-DS-1 FAILS (ALL MODES)
127	IDDBSDK1LF	31	4.80E-06	1.96E+00	BUS IDSD-DK-1 FAILS (ALL MODES)
128	CCX-PMDEH0	29	4.03E-06	1.96E+00	CCF OF MUX TRANSMITTERS (CCX-# ##EH0)
129	ED3MOD07	40	3.05E-04	1.77E+00	EDS3 EA 1 DISTR. PNL FAILURE OR T&M

Table 54-19 AP1000 Shutdown PRA Basic Event Risk Importances - RRW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RRW	
1	IEV-CCWD	2182	7.16E-04	3.174	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS
2	ADX-EV-SA	244	3.00E-05	1.283	CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN
3	IWX-EV4-SA	227	2.60E-05	1.236	CCF OF 2 OUT 2 LOW PRESSURE RECIRCULATION SQUIB VALVES
4	IWX-EV-SA	266	2.60E-05	1.230	CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN
5	IEV-LOSPD	3154	5.28E-03	1.164	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED
6	OTH-R1	2934	4.20E-01	1.118	FAILURE TO RECOVER AC POWER IN 1 HOUR
7	IEV-RNSD	1075	9.69E-05	1.102	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS
8	IWX-FL-GP	168	1.20E-05	1.097	CCF OF STRAINERS IN IRWST TANK
9	REX-FL-GP	168	1.20E-05	1.097	CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS
10	CCX-SFTW	32	1.20E-06	1.069	SOFTWARE CCF OF ALL CARDS
11	SUC-R1S	220	5.80E-01	1.037	OFFSITE AC POWER RECOVERED IN 1 HOUR
12	IEV-RCSOD	523	5.28E-06	1.031	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EVENT
13	CCX-ORY-SPX	112	3.63E-06	1.027	CCF OF ORIFICES
14	RHN-MAN05C	27	1.50E-01	1.026	COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)
15	RHN-MAN04	255	5.50E-02	1.020	OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE
16	CCX-BY-PN	376	4.70E-05	1.019	COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B
17	CCX-XMTRX	97	2.63E-06	1.019	CCF OF PRESSURE TRANSMITTERS
18	IWN-MAN00C	23	5.00E-02	1.019	COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)
19	IEV-LOCA24ND	718	1.73E-05	1.017	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILLED
20	IWX-XMTR	123	2.01E-04	1.015	CCF OF IRWST LEVEL TRANSMITTERS
21	REN-MAN04	104	1.00E-02	1.015	OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE
22	IEV-CCWND	164	3.99E-03	1.015	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS
23	CCX-EP-SAM	232	8.62E-06	1.013	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
24	RHN-MAN04-SUCC	429	9.45E-01	1.012	SUCCESS OF OPERATOR TO ALIGN AND ACTUATE THE RNS
25	ED1MOD03	123	2.70E-03	1.011	BATTERY DB1 UNAVAILABLE
26	IEV-LOCA24D	488	1.15E-05	1.011	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAINED

Table 54-19 AP1000 Shutdown PRA Basic Event Risk Importances - RRW

BASIC EVENT ID	CUTSETS	BEV PROB.	RRW	
27 CCX-IV-XR	290	2.40E-05	1.010	COMMON CAUSE FAILURE OF THE INVERTER
28 REC-MANDASC	46	5.06E-01	1.009	COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATION)
29 ZO1MOD01	628	2.02E-02	1.009	D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE
30 LPM-MAN05	37	6.83E-04	1.008	OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZATION
31 IWB-PLUG	443	2.40E-04	1.008	IRWST DISCHARGE LINE "B" STRAINER PLUGGED
32 ZOX-PD-ES	112	2.00E-03	1.008	CCF TO START OF ENGINE-DRIVEN FUEL PUMPS
33 IWN-MAN00	189	1.15E-03	1.008	OPERATOR FAILS TO ACTUATE IRWST INJECTION
34 PL5MOD11	76	2.09E-03	1.008	FAILURE OF PLS OUTPUT LOGIC I/Os
35 REC-MANDAS	181	1.16E-02	1.008	FAILURE OF MANUAL DAS ACTUATION
36 MDAS	184	1.00E-02	1.007	FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE
37 IWX-CV-AO	398	3.00E-05	1.006	CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN
38 EC1CB100VO	483	1.23E-02	1.005	BREAKER 100 FAILS TO OPEN [#3,5]
39 ZO2MOD01	233	2.02E-02	1.005	D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE
40 IRWMOD05S	380	3.00E-03	1.005	MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN
41 RN23MOD5S	912	2.21E-03	1.005	MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN
42 RNX-PM-FS	59	7.70E-04	1.005	CCF TO START OF THE PUMPS
43 ECX-CB-GO	93	1.20E-03	1.005	COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN
44 IEV-LOSPND	56	1.82E-02	1.004	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED
45 PL50301BSA	52	1.16E-03	1.004	PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND
46 PL50301ASA	52	1.16E-03	1.004	PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND
47 CCX-ORY-SP	19	2.77E-04	1.004	CCF OF ORIFICES
48 SWBMOD02	176	2.44E-02	1.004	PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW
49 RNX-KV-GO	52	6.10E-04	1.004	CCF TO OPEN OF THE STOP CHECK VALVES
50 RNBMOD07S	184	1.53E-02	1.004	PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO
51 RNAMOD06S	134	1.53E-02	1.004	PUMP 01A FAILS; STOP CK V007A, CB & RELAY FTC; CB ECS122 SPO
52 IEV-RNSND	127	1.02E-03	1.004	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS
53 RHN-MAN05	781	1.60E-03	1.004	OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023

Table 54-20 AP1000 Shutdown PRA Case 2 Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
1	CCX-SFTW	13	1.20E-06	23610.000	SOFTWARE CCF OF ALL CARDS
2	CCX-EP-SAM	13	8.62E-06	23600.000	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
3	ADX-EV-SA	25	3.00E-05	4975.000	CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN
4	IWX-EV4-SA	24	2.60E-05	4975.000	CCF OF 2 OUT 2 LOW PRESSURE RECIRCULATION SQUIB VALVES
5	REX-FL-GP	24	1.20E-05	4971.000	CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS
6	IWX-FL-GP	24	1.20E-05	4971.000	CCF OF STRAINERS IN IRWST TANK
7	IWX-EV-SA	7	2.60E-05	4960.000	CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN
8	CCX-XMTRX	7	2.63E-06	4957.000	CCF OF PRESSURE TRANSMITTERS
9	CCX-ORY-SPX	7	3.63E-06	4956.000	CCF OF ORIFICES
10	CCX-IV-XR	110	2.40E-05	1804.000	COMMON CAUSE FAILURE OF THE INVERTER
11	CCX-BY-PN	165	4.70E-05	1800.000	COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B
12	IEV-RCSOD	509	5.28E-06	585.200	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EVENT
13	IEV-LOSPD	140	5.28E-03	137.200	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED
14	IEV-LOCA24ND	595	1.73E-05	116.500	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILLED
15	IEV-RNSD	1059	9.69E-05	103.700	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS
16	IEV-LOCA24D	476	1.15E-05	103.700	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAINED
17	IEV-CCWD	2146	7.16E-04	103.600	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS
18	IWX-XMTR	33	2.01E-04	50.880	CCF OF IRWST LEVEL TRANSMITTERS
19	IWX-CV-AO	299	3.00E-05	44.390	CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN
20	IWB-PLUG	286	2.40E-04	32.410	IRWST DISCHARGE LINE "B" STRAINER PLUGGED
21	IEV-LOCAPRND	166	1.61E-05	15.350	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS
22	CCX-PMAMOD1X	189	4.63E-05	14.220	CCF OF ACTUATION LOGIC GROUPS
23	RN23MOD5S	542	2.21E-03	11.900	MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN
24	RHN-MAN05	457	1.60E-03	11.880	OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023
25	IDDBSDS1TM	323	3.00E-04	11.810	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
26	IDDBSDD1TM	323	3.00E-04	11.810	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
27	IDDBSDK1TM	300	3.00E-04	11.800	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE

Table 54-20 AP1000 Shutdown PRA Case 2 Basic Event Risk Importances - RAW

BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
28 RNDEP023SA	235	1.71E-04	11.410	FAILURE OF OUTPUT DRIVER
29 CCX-PMDMOD1	227	1.41E-04	11.160	CMF OF OUTPUT LOGIC I/Os
30 CCX-PMD030	158	9.69E-05	11.100	CMF OF OUTPUT LOGIC GROUPS
31 PMAMOD11	29	2.09E-03	10.800	FAILURE OF PMS OUTPUT LOGIC I/Os
32 IDAMOD05	243	5.16E-04	10.780	FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS
33 PMA0301ASA	19	1.16E-03	10.750	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
34 PMA0301BSA	19	1.16E-03	10.750	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
35 IDABSDS1TM	232	3.00E-04	10.690	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
36 IDAMOD04	277	3.17E-04	10.670	LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS
37 CCX-PMAMOD1	26	1.41E-04	10.390	CCF OF OUTPUT LOGIC I/O BOARDS
38 CCX-PMA030	25	9.69E-05	10.090	CCF OF LOGIC GROUP PROCESSING
39 CCX-PMDMOD4	122	4.98E-05	9.986	CMF OF MUX LOGIC GROUPS
40 PMAXS00ASA	6	8.00E-05	9.493	FAILURE OF MIMIC BUS SELECTOR BOARD
41 IEV-RNSND	120	1.02E-03	9.313	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS
42 IEV-CCWND	155	3.99E-03	9.295	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS
43 CCX-PMAMOD1-SW	126	1.10E-05	8.854	SOFTWARE CCF OF OUTPUT LOGIC I/Os
44 IEV-LOSPND	5	1.82E-02	8.836	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED
45 ALL-IND-FAIL	31	1.00E-06	7.955	INDICATION FAILURE
46 IDDFD019RQ	62	1.20E-05	4.877	FUSE DISCONNECT SWITCH (FD19) SPURIOUSLY OPENS
47 CCX-PMDMOD1-SW	55	1.10E-05	4.870	SOFTWARE CCF OF OUTPUT LOGIC I /Os (CCX-P##MOD1)
48 CCX-PMDMOD4-SW	55	1.10E-05	4.870	SOFTWARE CCF OF MUX LOGIC GROUPS (CCX-P##MOD4-SW)
49 IDDFD020RQ	57	1.20E-05	4.868	FUSE DISCONNECT SWITCH (FD20) SPURIOUSLY OPENS
50 CCX-PMA030X	127	1.38E-05	4.733	CCF OF LOGIC GROUP PROCESSING
51 CCX-EP-SAMX	85	2.94E-06	4.730	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
52 CCX-INPUT-LOGIC	20	1.03E-04	4.151	COMMON MODE FAILURE OF INPUT LOGIC GROUPS
53 CCX-ORY-SP	11	2.77E-04	3.848	CCF OF ORIFICES
54 CCX-XMTR195	10	2.01E-04	3.813	CCF OF PRESSURE TRANSMITTERS
55 LPM-MAN05	18	6.83E-04	3.559	OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZATION

Table 54-20 AP1000 Shutdown PRA Case 2 Basic Event Risk Importances - RAW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RAW	
56	REA-PLUG	114	2.40E-04	2.244	SUMP SCREEN A PLUGS AND PREVENTS FLOW
57	REB-PLUG	114	2.40E-04	2.244	SUMP SCREEN B PLUGS AND PREVENTS FLOW
58	IDBBSDS1TM	156	3.00E-04	2.206	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
59	IDBBSDD1TM	156	3.00E-04	2.206	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
60	IWA-PLUG	129	2.40E-04	2.204	IRWST DISCHARGE LINE "A" STRAINER PLUGGED
61	IDBBSDK1TM	142	3.00E-04	2.197	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE
62	IRWMOD05S	323	3.00E-03	2.193	MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN
63	REN-MAN04	21	1.00E-02	1.992	OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE
64	PXX-AV-LA	185	1.92E-04	1.919	FAILURE OF PRHR DUE TO COMMON CAUSE OF AOVs
65	IWN-MAN00	188	1.15E-03	1.672	OPERATOR FAILS TO ACTUATE IRWST INJECTION

Table 54-21 AP1000 Shutdown PRA Case 2 Basic Event Risk Importances - RRW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RRW	
1	IEV-LOSPD	140	5.28E-03	3.611	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED
2	OTH-R1	117	4.20E-01	1.697	FAILURE TO RECOVER AC POWER IN 1 HOUR
3	SUC-R1S	23	5.80E-01	1.454	OFFSITE AC POWER RECOVERED IN 1 HOUR
4	CCX-EP-SAM	13	8.62E-06	1.259	CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS
5	ADX-EV-SA	25	3.00E-05	1.176	CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN
6	IEV-LOSPND	5	1.82E-02	1.170	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED
7	IWX-EV4-SA	24	2.60E-05	1.149	CCF OF 2 OUT 2 LOW PRESSURE RECIRCULATION SQUIB VALVES
8	IWX-EV-SA	7	2.60E-05	1.148	CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN
9	SUC-R2S	2	7.60E-01	1.124	OFFSITE AC POWER RECOVERED IN 2 HOURS
10	CCX-BY-PN	165	4.70E-05	1.092	COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B
11	IEV-CCWD	2146	7.16E-04	1.079	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS
12	IWX-FL-GP	24	1.20E-05	1.064	CCF OF STRAINERS IN IRWST TANK
13	REX-FL-GP	24	1.20E-05	1.064	CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS
14	CCX-IV-XR	110	2.40E-05	1.045	COMMON CAUSE FAILURE OF THE INVERTER
15	OTH-R2	2	2.40E-01	1.036	FAILURE TO RECOVER AC POWER IN 2 HOURS
16	IEV-CCWND	155	3.99E-03	1.034	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS
17	CCX-SFTW	13	1.20E-06	1.029	SOFTWARE CCF OF ALL CARDS
18	RN23MOD5S	542	2.21E-03	1.025	MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN
19	PMAMOD11	29	2.09E-03	1.021	FAILURE OF PMS OUTPUT LOGIC I/Os
20	CCX-ORY-SPX	7	3.63E-06	1.018	CCF OF ORIFICES
21	RHN-MAN05	457	1.60E-03	1.018	OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023
22	CCX-XMTRX	7	2.63E-06	1.013	CCF OF PRESSURE TRANSMITTERS
23	PMA0301ASA	19	1.16E-03	1.011	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
24	PMA0301BSA	19	1.16E-03	1.011	FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING
25	IWX-XMTR	33	2.01E-04	1.010	CCF OF IRWST LEVEL TRANSMITTERS
26	REN-MAN04	21	1.00E-02	1.010	OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE

Table 54-21 AP1000 Shutdown PRA Case 2 Basic Event Risk Importances - RRW

	BASIC EVENT ID	CUTSETS	BEV PROB.	RRW	
27	IEV-RNSD	1059	9.69E-05	1.010	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS
28	IEV-RNSND	120	1.02E-03	1.009	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS
29	IWB-PLUG	286	2.40E-04	1.008	IRWST DISCHARGE LINE "B" STRAINER PLUGGED
30	IDAMOD05	243	5.16E-04	1.005	FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS
31	IRWMOD05S	323	3.00E-03	1.004	MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.2-4

Original RAI Number(s): None

Summary of Issue:

The staff will confirm that the results of the sensitivity studies (including cutsets) are documented into the AP1000 Shutdown PRA. This is Open Item 19.1.10.2-4.

In the bases of AP1000 TS, there is no discussion that planned maintenance of these three systems should be avoided during cold shutdown. The frequency and duration of IRWST, ADS, and RNS maintenance performed by a future COL holder has considerable uncertainty. Therefore, the staff asked the applicant to perform a sensitivity study assuming minimal compliance with AP1000 TS. This sensitivity study provides an upper bound of the shutdown CDF assuming the COL holder chooses to always perform planned maintenance on one IRWST injection path and recirculation path, two ADS stage 4 valves, and RNS valve V-23 during cold shutdown. The shutdown CDF for this sensitivity study increases to 2.2E-06 per year (a factor of ten higher than the full power CDF). Since no cutsets were submitted in the RAI response for this sensitivity study, this documentation issue is considered part of Open Item 19.1.10.2-4

Westinghouse Response:

The sensitivity case 1 in AP1000 PRA Section 54.9.1 examines the case where there is minimum equipment allowed by tech specs during shutdown drained conditions. The CDF from the drained conditions for this case was reported to be 1.95E-06/year. The dominant cutsets, as requested in this OI, are given in Table 1 below.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Table 1. Dominant CDF Cutsets for Drained Conditions only for AP1000 Shutdown PRA Sensitivity Case 1

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDS1TM
2	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDD1TM
3	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDK1TM
4	1.72E-07	8.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
5	1.72E-07	8.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CONTAINMENT SUMP LINE B STRAINER PLUGGED	2.40E-04	REB-PLUG
6	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CHECK VALVE 123B FAILS TO OPEN	8.76E-03	IWBCV123AO
			CHECK VALVE 124B FAILS TO OPEN	8.76E-03	IWBCV124AO
7	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CHECK VALVE 122B FAILS TO OPEN	8.76E-03	IWBCV122AO
			CHECK VALVE 125B FAILS TO OPEN	8.76E-03	IWBCV125AO
8	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CHECK VALVE 123B FAILS TO OPEN	8.76E-03	IWBCV123AO
			CHECK VALVE 125B FAILS TO OPEN	8.76E-03	IWBCV125AO
9	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CHECK VALVE 122B FAILS TO OPEN	8.76E-03	IWBCV122AO
			CHECK VALVE 124B FAILS TO OPEN	8.76E-03	IWBCV124AO

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
10	4.17E-08	2.14	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF POWER INTERFACE OUTPUT BOARD	5.83E-05	IRAEP121BSAX
11	3.32E-08	1.7	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
12	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDD1TM
13	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDK1TM
14	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDS1TM
15	2.86E-08	1.47	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	4.00E-05	IWX-CV-AO
16	2.72E-08	1.39	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.80E-05	ADX-EV-SA
17	2.36E-08	1.21	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	3.30E-05	IWX-EV4-SA
18	2.33E-08	1.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
19	2.33E-08	1.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CONTAINMENT SUMP LINE B STRAINER PLUGGED	2.40E-04	REB-PLUG
20	1.86E-08	0.95	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EV-SA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
21	1.50E-08	0.77	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
22	1.45E-08	0.74	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.50E-02	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-02	IWN-MAN00C
23	1.25E-08	0.64	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
24	1.25E-08	0.64	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
25	9.88E-09	0.51	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
26	9.27E-09	0.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
27	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
28	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
29	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FUSE DISCONNECT SWITCH (FD7) SPURIOUSLY OPENS	1.20E-05	IDCFD007RQ
30	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FUSE DISCONNECT SWITCH (FD8) SPURIOUSLY OPENS	1.20E-05	IDCFD008RQ
31	7.88E-09	0.4	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
32	7.53E-09	0.39	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA
33	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CHECK VALVE 123B FAILS TO OPEN	8.76E-03	IWBCV123AO
			CHECK VALVE 124B FAILS TO OPEN	8.76E-03	IWBCV124AO
34	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CHECK VALVE 122B FAILS TO OPEN	8.76E-03	IWBCV122AO
			CHECK VALVE 125B FAILS TO OPEN	8.76E-03	IWBCV125AO
35	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CHECK VALVE 123B FAILS TO OPEN	8.76E-03	IWBCV123AO
			CHECK VALVE 125B FAILS TO OPEN	8.76E-03	IWBCV125AO
36	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CHECK VALVE 122B FAILS TO OPEN	8.76E-03	IWBCV122AO
			CHECK VALVE 124B FAILS TO OPEN	8.76E-03	IWBCV124AO
37	6.95E-09	0.36	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
38	6.95E-09	0.36	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
39	5.74E-09	0.29	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	1.15E-03	IWN-MAN00
40	5.65E-09	0.29	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			FAILURE OF POWER INTERFACE OUTPUT BOARD	5.83E-05	IRAEP121BSAX
41	5.56E-09	0.28	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
42	5.14E-09	0.26	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
43	5.14E-09	0.26	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
44	4.49E-09	0.23	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
45	3.88E-09	0.2	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	4.00E-05	IWX-CV-AO

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
46	3.68E-09	0.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.80E-05	ADX-EV-SA
47	3.67E-09	0.19	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
48	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDS1TM
49	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDK1TM
50	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDCBSDD1TM
51	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS IDSC-DS-1 FAILS (ALL MODES)	4.80E-06	IDCBSDS1LF
52	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS IDSC-DK-1 FAILS (ALL MODES)	4.80E-06	IDCBSDK1LF
53	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS IDSC-DD-1 FAILS (ALL MODES)	4.80E-06	IDCBSDD1LF
54	3.38E-09	0.17	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
55	3.20E-09	0.16	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	3.30E-05	IWX-EV4-SA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
56	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
57	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
58	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
59	2.76E-09	0.14	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
60	2.76E-09	0.14	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
61	2.66E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
62	2.60E-09	0.13	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
63	2.52E-09	0.13	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EV-SA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
64	2.29E-09	0.12	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
65	2.28E-09	0.12	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
66	2.11E-09	0.11	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	2.94E-06	CCX-EP-SAMX
67	2.04E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
68	2.03E-09	0.1	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
69	1.90E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
70	1.89E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
71	1.88E-09	0.1	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
72	1.88E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
73	1.88E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
74	1.83E-09	0.09	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
75	1.80E-09	0.09	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
76	1.70E-09	0.09	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
77	1.53E-09	0.08	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
78	1.47E-09	0.08	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
79	1.47E-09	0.08	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
80	1.44E-09	0.07	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
81	1.44E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
82	1.44E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
83	1.43E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
84	1.41E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
85	1.39E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
86	1.37E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
87	1.34E-09	0.07	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
88	1.33E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
89	1.30E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
90	1.27E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
91	1.27E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
92	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
93	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
94	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
95	1.20E-09	0.06	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
96	1.20E-09	0.06	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
97	1.16E-09	0.06	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
98	1.16E-09	0.06	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP
99	1.15E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
100	1.15E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
101	1.13E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
102	1.13E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
103	1.11E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
104	1.11E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
105	1.10E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
106	1.07E-09	0.05	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
107	1.06E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
108	1.06E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
109	1.05E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
110	1.05E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
111	1.02E-09	0.05	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA
112	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
113	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
114	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
115	9.74E-10	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
116	9.16E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
117	9.16E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
118	8.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
119	8.59E-10	0.04	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
120	8.44E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
121	8.44E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
122	8.35E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
123	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
124	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
125	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
126	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
127	7.98E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
128	7.95E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
129	7.95E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
130	7.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
131	7.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
132	7.20E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
133	7.20E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
134	7.01E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
135	6.54E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
136	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
137	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
138	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
139	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
140	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
141	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
142	6.27E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	5.00E-04	REBMOV117TM
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
143	6.25E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
144	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301BSA
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
145	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301ASA
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
146	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301ASA
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
147	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301BSA
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
148	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
149	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
150	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
151	6.03E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
152	5.93E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
153	5.80E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF LOGIC GROUP PROCESSING	9.69E-05	CCX-PMA030
154	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
155	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
156	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
157	5.66E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
158	5.66E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
159	5.64E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
160	5.49E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA
161	5.40E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
162	5.40E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
163	5.32E-10	0.03	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
164	5.23E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	5.00E-04	REBMOV117TM
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
165	5.13E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
166	5.03E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
167	4.86E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
168	4.84E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
169	4.84E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
170	4.79E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF MIMIC BUS SELECTOR BOARD	8.00E-05	PMAXS00ASA
171	4.67E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
172	4.60E-10	0.02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	4.00E-05	IWX-CV-AO
173	4.49E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			CCF OF LOGIC GROUP PROCESSING	9.69E-05	CCX-PMA030
174	4.48E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO OPEN OF THE STOP CHECK VALVES	6.10E-04	RNX-KV-GO
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
175	4.48E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO OPEN OF THE STOP CHECK VALVES	6.10E-04	RNX-KV-GO
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
176	4.46E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
177	4.37E-10	0.02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.80E-05	ADX-EV-SA
178	4.30E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			CCF OF LOGIC GROUP PROCESSING	9.69E-05	CCX-PMA030
179	4.10E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
180	4.10E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
181	4.08E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF UNDERVOLTAGE RELAY	4.36E-03	EC1REDG2GA
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
182	3.89E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
183	3.89E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
184	3.80E-10	0.02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	3.30E-05	IWX-EV4-SA
185	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
186	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDK1TM
187	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
188	3.75E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
189	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
190	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
191	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301ASA
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
192	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301BSA
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
193	3.55E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF MIMIC BUS SELECTOR BOARD	8.00E-05	PMAXS00ASA
194	3.54E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
195	3.52E-10	0.02	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
196	3.46E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
197	3.43E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
198	3.34E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
199	3.34E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
200	3.29E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.2-5

Original RAI Number(s): 720.038

Summary of Issue:

Documentation of Shutdown Focused PRA Results

The "focused" PRA shutdown CDF was estimated to be 1.23E-6. Over eighty five percent of the risk resulted from a loss of offsite power during drained conditions and during non-drained conditions. Some of the dominant cutsets have the basic event IWX-MV-GO1. In the early versions of the AP600 PRA, the basic event, IWX-MV-GO1 , was used to model common cause failure of the 4 out of 4 IRWST injection motor operated valves (MOVs) to open. The later versions of the AP600 design and the API 000 design changed the 4 MOVs to squib valves. In the AP1000 design, the low pressure squib valves (120 A/B) in the recirculation lines were changed to high pressure squib valves. In preparing the AP600 cutset file for use &s the starting point in creating the AP1000 shutdown mode, the basic event IWX-MV-GO1 was changed to, IWX-EV-SA, common cause failure of IRWST squib valves. This basic event has a failure probability of 2.6E-5, As a follow-up to RAI 720.38, the staff needs to understand why basic event IWX-MV-GO1 appears in the "Focused PRA" cutsets for the AP1000 design. The staff also needs a list of basic events and their description for the AP1000 shutdown model. This is Open Item 19.1.10.2-5.

Westinghouse Response:

In the base case, IWX-MV-GO1 is used to represent the failure mode "CCF of 6/6 IRSWT HP SQUIB VALVES TO OPEN" with a probability of 2.6E-05. In the cutset files, the basic event id is left as is, only the probability was changed to 2.6E-05 and calculations are made. At the end of the analysis, editorial changes are made to the summary table (Table 54-6), replacing the string IWX-MV-GO1 with IWX-EV-SA, and typing in its basic event description.

The sensitivity cases use the same process. Except, at the end, the editorial change from IWX-EV-SA is not done in the summary tables. That is why IWX-MV-GO1 shows up in Tables 54-10, 54-13, and 54-15 of AP1000 PRA revision 2. The numerical results and the cutset logic are as intended.

To make all tables consistent (base and sensitivity cases), Tables 54-10, 54-13, and 54-15 are corrected and attached to this document.

The basic event descriptions are given in attached cutset Tables 54-10, 54-13, and 54-15.

Design Control Document (DCD) Revision:

None

PRA Revision:

Tables 54-10, 54-13 and 54-15 of Chapter 54, Low Power and Shutdown Risk Assessment are revised. (see Attachment)

Table 54-10 (Sheet 1 of 5)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 2 CDF CUTSETS

NUMBER	~~CUTSET PROB.~~CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	1.19E-07	9.67	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			OFFSITE AC POWER RECOVERED IN 2 HOURS	7.60E-01	SUC-R2S
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
2	1.04E-07	8.46	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B	4.70E-05	CCX-BY-PN
3	9.19E-08	7.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
4	7.96E-08	6.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EV-SA
5	7.96E-08	6.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES	2.60E-05	IWX-EV4-SA
6	6.65E-08	5.41	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
7	5.77E-08	4.69	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EV-SA
8	5.77E-08	4.69	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES	2.60E-05	IWX-EV4-SA
9	5.32E-08	4.33	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE OF THE INVERTER	2.40E-05	CCX-IV-XR
10	3.77E-08	3.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			FAILURE TO RECOVER AC POWER IN 2 HOURS	2.40E-01	OTH-R2
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM

Table 54-10 (Sheet 2 of 5)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 2 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
11	3.67E-08	2.98	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
12	3.67E-08	2.98	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
13	3.44E-08	2.80	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
14	2.66E-08	2.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			~~REX-FL-GP~~CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP
15	2.66E-08	2.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
16	2.64E-08	2.15	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
17	2.15E-08	1.75	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
18	1.91E-08	1.55	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
19	1.86E-08	1.51	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN~~IWX-MV-GO1~~	2.60E-05	IWX-EMV-SA~~GO1~~
20	1.86E-08	1.51	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~IWX-EV4-SA~~CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES	2.60E-05	IWX-EV4-SA
21	1.66E-08	1.35	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			OFFSITE AC POWER RECOVERED IN 2 HOURS	7.60E-01	SUC-R2S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW

Table 54-10 (Sheet 3 of 5)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 2 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
22	1.11E-08	.90	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
23	1.02E-08	.83	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
24	8.79E-09	.71	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
25	8.59E-09	.70	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
26	8.59E-09	.70	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
27	8.05E-09	.65	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
28	8.05E-09	.65	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
29	7.42E-09	.60	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
30	6.17E-09	.50	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
31	6.16E-09	.50	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	1.00E-02	REN-MAN04

Table 54-10 (Sheet 4 of 5)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 2 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
32	5.83E-09	.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
33	5.69E-09	.46	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
34	5.69E-09	.46	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
35	5.24E-09	.43	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			FAILURE TO RECOVER AC POWER IN 2 HOURS	2.40E-01	OTH-R2
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
36	4.79E-09	.39	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
37	4.46E-09	.36	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	1.00E-02	REN-MAN04
38	4.12E-09	.33	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
39	4.12E-09	.33	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
40	3.67E-09	.30	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW

Table 54-10 (Sheet 5 of 5)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 2 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
41	2.91E-09	.24	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
42	2.66E-09	.22	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
43	2.60E-09	.21	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
44	2.53E-09	.21	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
45	2.52E-09	.20	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN~~IWX-MV-GO1~~	2.60E-05	IWX-EMV-~~GO1~~SA
46	2.52E-09	.20	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
47	2.20E-09	.18	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN	3.00E-03	IRWMOD05S
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
48	2.18E-09	.18	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EVENT	5.28E-06	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.50E-02	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. F ILS TO ACTUATE I WST INJ)	5.00E-02	IWN-MAN00C
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	1.50E-01	RHN-MAN05C
49	1.88E-09	.15	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
50	1.83E-09	.15	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05

Table 54-13 (Sheet 1 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	2.66E-05	48.08	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			~~RHN-MAN04-SUCC~~OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
2	2.66E-05	48.08	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
3	2.80E-07	0.51	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
4	2.03E-07	0.37	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
5	1.40E-07	0.25	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPER. FAILS TO ALIGN PRHR~~PRN-MAN01~~	5.00E-01	PRN-MAN01
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
6	1.18E-07	0.21	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
7	1.18E-07	0.21	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S

Table 54-13 (Sheet 2 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
8	1.04E-07	0.19	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
9	1.01E-07	0.18	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPER. FAILS TO ALIGN PRHR~~PRN-MAN01~~	5.00E-01	PRN-MAN01
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
10	7.20E-08	0.13	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~IWX-XMTR~~CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
11	7.15E-08	0.13	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
12	5.19E-08	0.09	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
13	2.66E-08	0.05	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
14	2.15E-08	0.04	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
15	1.87E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01

Table 54-13 (Sheet 3 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
16	1.86E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~IWX-MV-GO1~~CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	~~IWX-MV-GO1~~IWX-EV-SA
17	1.86E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
18	1.72E-08	0.03	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
19	1.71E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW1OR170SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
20	1.71E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW2OR160SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
21	1.69E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW2OR160SPX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
22	1.69E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW1OR170SPX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
23	1.66E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
24	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDD1TM

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
25	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDS1TM
26	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDK1TM
27	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDK1TM
28	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDD1TM
29	1.60E-08	0.03	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDS1TM
30	1.54E-08	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ACTUATION LOGIC GROUPS	8.58E-05	CCX-PMAMOD2X
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
31	1.28E-08	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG

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NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
32	1.28E-08	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
33	1.24E-08	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW2TL160UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
34	1.24E-08	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW1TL170UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
35	1.22E-08	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW2TL160UFX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
36	1.22E-08	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW1TL170UFX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
37	1.07E-08	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	3.00E-05	IWX-CV-AO
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
38	1.07E-08	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
39	1.07E-08	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
40	9.74E-09	0.02	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
41	9.11E-09	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			FAILURE OF OUTPUT DRIVER	1.71E-04	RNDEP023SA
42	9.11E-09	0.02	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			FAILURE OF OUTPUT DRIVER	1.71E-04	RNDEP023SA
43	8.59E-09	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
44	8.59E-09	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
45	8.30E-09	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILL	1.82E-02	IEV-LOSPND
			OFFSITE AC POWER RECOVERED IN 2 HOURS	7.60E-01	SUC-R2S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
46	7.51E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			CMF OF OUTPUT LOGIC I/Os	1.41E-04	CCX-PMDMOD1

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
47	7.51E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			CMF OF OUTPUT LOGIC I/Os	1.41E-04	CCX-PMDMOD1
48	6.26E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
49	5.53E-09	0.01	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
50	5.16E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			CMF OF OUTPUT LOGIC GROUPS	9.69E-05	CCX-PMD030
51	5.16E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			CMF OF OUTPUT LOGIC GROUPS	9.69E-05	CCX-PMD030
52	4.94E-09	0.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
53	4.64E-09	0.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF INPUT LOGIC GROUPS	2.59E-05	CCX-INPUT-LOGICX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
54	4.63E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
55	4.40E-09	0.01	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
56	4.01E-09	0.01	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
57	3.94E-09	0.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
58	3.67E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
59	3.47E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
60	3.47E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
61	3.20E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
62	3.20E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
63	3.09E-09	0.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
64	2.91E-09	0.01	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
65	2.78E-09	0.01	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
66	2.78E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
67	2.77E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN ~~IWX-MV-GO1~~	2.60E-05	IWX-EV-SA~~IWX-MV-GO1~~
68	2.77E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
69	2.77E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC

			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
70	2.77E-09	0.01	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN ~~IWX-MV-GO1~~	2.60E-05	IWX-EV-SA~~IWX-MV-GO1~~
71	2.76E-09	0	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPER. FAILS TO ALIGN PRHR~~PRN-MAN01~~	5.00E-01	PRN-MAN01
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
72	2.66E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
73	2.65E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF MUX LOGIC GROUPS	4.98E-05	CCX-PMAMOD4
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
74	2.65E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF MUX LOGIC GROUPS	4.98E-05	CCX-PMAMOD4
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
75	2.65E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			CMF OF MUX LOGIC GROUPS	4.98E-05	CCX-PMDMOD4
76	2.65E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			CMF OF MUX LOGIC GROUPS	4.98E-05	CCX-PMDMOD4
77	2.62E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILL	1.82E-02	IEV-LOSPND
			FAILURE TO RECOVER AC POWER IN 2 HOURS	2.40E-01	OTH-R2

			SOFTWARE CCF OF ALL CARDS FAILURE OF MANUAL DAS ACTUATION	1.20E-06 5.00E-01	CCX-SFTW REC-MANDAS

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
78	2.60E-09	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
79	2.57E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
80	2.57E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
81	2.55E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW2OR160SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
82	2.55E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW1OR170SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
83	2.53E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
84	2.52E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN ~~IWX-MV-GO1~~	2.60E-05	IWX-EV-SA~~IWX-MV-GO1~~
85	2.52E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD

			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
86	2.47E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
87	2.47E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
88	2.39E-09	0	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
89	2.32E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW2OR160SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
90	2.32E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW1OR170SPX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
91	2.29E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW2OR160SPX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
92	2.29E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			ORIFICE FAILURE DUE TO PLUGGING	9.46E-05	IW1OR170SPX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
93	2.24E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
94	2.08E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ACTUATION LOGIC GROUPS	8.58E-05	CCX-PMAMOD2X
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
95	2.05E-09	0	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
96	2.00E-09	0	LOSS OF CCS/SWS WITH RCS FILLED INITIATING EVENT OCCURS	3.99E-03	IEV-CCWND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPER. FAILS TO ALIGN PRHR~~PRN-MAN01~~	5.00E-01	PRN-MAN01
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
97	1.97E-09	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF SOFTWARE FOR INPUT LOGIC GROUPS	1.10E-05	CCX-IN-LOGIC-SW
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
98	1.97E-09	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF SOFTWARE FOR ACTUATION LOGIC GROUPS	1.10E-05	CCX-PMAMOD2-SW
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
99	1.88E-09	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
100	1.84E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW2TL160UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
101	1.84E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW1TL170UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
102	1.74E-09	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
103	1.69E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
104	1.68E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW1TL170UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
105	1.68E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW2TL160UFX
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
106	1.66E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW2TL160UFX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
107	1.66E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			LEVEL TRANSMITTER FAILURE	6.84E-05	IW1TL170UFX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
108	1.60E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	3.00E-05	IWX-CV-AO
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
109	1.60E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	3.00E-05	IWX-CV-AO
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
110	1.54E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
111	1.54E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
112	1.54E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
113	1.45E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	3.00E-05	IWX-CV-AO
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
114	1.41E-09	0	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
115	1.28E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
116	1.28E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
117	1.28E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
118	1.28E-09	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
119	1.21E-09	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01
120	1.21E-09	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
121	1.16E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
122	1.16E-09	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
123	1.16E-09	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
124	1.14E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
125	1.14E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
126	1.13E-09	0	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS	1.61E-05	IEV-LOCAPRND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
127	1.05E-09	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	2.94E-06	CCX-EP-SAMX
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
128	1.03E-09	0	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
129	1.02E-09	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
130	9.49E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
131	9.46E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
132	9.39E-10	0	OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
			LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
133	9.39E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
134	8.98E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
135	8.80E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	AND-MAN01

Table 54-13 (Sheet 19 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
136	8.80E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
137	8.59E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
138	8.19E-10	0	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS	1.61E-05	IEV-LOCAPRND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			CCF OF PRESSURE TRANSMITTERS	2.01E-04	CCX-XMTR195
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
139	8.09E-10	0	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS	1.61E-05	IEV-LOCAPRND
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
140	7.35E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
141	7.35E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
142	7.35E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-13 (Sheet 20 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
143	7.35E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
144	7.16E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
145	7.03E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
146	6.95E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
147	6.87E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
148	6.69E-10	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-13 (Sheet 21 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
149	6.65E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
150	6.49E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
151	6.39E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			FUSE DISCONNECT SWITCH (FD19) SPURIOUSLY OPENS	1.20E-05	IDDFD019RQ
152	6.39E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			FUSE DISCONNECT SWITCH (FD20) SPURIOUSLY OPENS	1.20E-05	IDDFD020RQ
153	6.39E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			FUSE DISCONNECT SWITCH (FD19) SPURIOUSLY OPENS	1.20E-05	IDDFD019RQ
154	6.39E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			FUSE DISCONNECT SWITCH (FD20) SPURIOUSLY OPENS	1.20E-05	IDDFD020RQ
155	6.34E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-13 (Sheet 22 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
156	6.34E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
157	6.31E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
158	6.31E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
159	6.31E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
160	6.27E-10	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF INPUT LOGIC GROUPS	2.59E-05	CCX-INPUT-LOGICX
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
161	6.12E-10	0	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
162	6.02E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
163	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
164	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			SOFTWARE CCF OF MUX LOGIC GROUPS (CCX-P##MOD4-SW)~~CCX-PMDMOD4-SW~~	1.10E-05	CCX-PMDMOD4-SW
165	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			SOFTWARE CCF OF MUX LOGIC GROUPS (CCX-P##MOD4-SW)~~CCX-PMDMOD4-SW~~	1.10E-05	CCX-PMDMOD4-SW
166	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			CCF OF SOFTWARE FOR MUX LOGIC GROUPS	1.10E-05	CCX-PMAMOD4-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
167	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			SOFTWARE CCF OF OUTPUT LOGIC I/Os (CCX-P##MOD1)~~CCX-PMDMOD1-SW~~	1.10E-05	CCX-PMDMOD1-SW
168	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF SOFTWARE FOR MUX LOGIC GROUPS	1.10E-05	CCX-PMAMOD4-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
169	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
170	5.86E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD

			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			SOFTWARE CCF OF OUTPUT LOGIC I/Os (CCX-P##MOD1)~~CCX-PMDMOD1-SW~~	1.10E-05	CCX-PMDMOD1-SW

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
171	5.76E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
172	5.76E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
173	5.66E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
174	5.66E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
175	5.64E-10	0	LOCA/RNS PIPE RUPTURE WITH RCS FILLED INIT. EVENT OCCURS	1.61E-05	IEV-LOCAPRND
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			CCF OF ORIFICES	2.77E-04	CCX-ORY-SP
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COND. PROB. OF ADN-MAN01 (OPER. FAILS TO ACT. ADS)~~ADN-MAN01C~~	5.00E-01	ADN-MAN01C

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SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
176	5.61E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os~~PMAMOD21X~~	1.16E-03	PMAMOD21X
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
177	5.61E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os~~PMAMOD21X~~	1.16E-03	PMAMOD21X
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
178	5.61E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os~~PMAMOD21X~~	1.16E-03	PMAMOD21X
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	5.00E-01	RHN-MAN05C
179	5.33E-10	0	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
180	5.25E-10	0	LOSS OF RNS WITH RCS FILLED INITIATING EVENT OCCURS	1.02E-03	IEV-RNSND
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05
181	5.25E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-13 (Sheet 26 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
182	5.25E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
183	5.19E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
184	5.19E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	3.00E-05	IWX-CV-AO
185	5.16E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN	3.00E-03	IRWMOD05S
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
186	4.99E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
187	4.99E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
188	4.99E-10	0	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
189	4.87E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-13 (Sheet 27 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
190	4.66E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
191	4.59E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-01	IWN-MAN00C
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
192	4.59E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.00E-01	RHN-MAN04
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
193	4.59E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			FAILURE OF MANUAL DAS ACTUATION	5.00E-01	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
194	4.59E-10	0	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	2.13E-04	IEV-RCSOD
			OPERATOR ACTUATES SUMP RECIRC. GIVEN IRWST LEVEL SIGNAL FAILURE~~RHN-MAN04-SUCC~~	5.00E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	5.00E-01	IWN-MAN00
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
195	4.51E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO ACTUATE ADS BEFORE CORE DAMAGE	5.00E-01	ADN-MAN01
196	4.51E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACTUATI	5.06E-01	REC-MANDASC
			COMMON MODE FAILURE OF INPUT LOGIC GROUPS	1.03E-04	CCX-INPUT-LOGIC
			OPERATOR FAILS TO RECOGNIZE THE NEED FOR RCS DEPRESSURIZAT	5.00E-01	LPM-MAN05

Table 54-13 (Sheet 28 of 28)

SHUTDOWN PRA SENSITIVITY CASE 3

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
197	4.50E-10	0	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS FILL	1.73E-05	IEV-LOCA24ND
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
198	4.46E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			CCF OF IRWST LEVEL TRANSMITTERS~~IWX-XMTR~~	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE~~REN-MAN04~~	5.00E-01	REN-MAN04
199	4.36E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05
200	4.22E-10	0	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	5.00E-01	RHN-MAN05

Table 54-15 (Sheet 1 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	1.04E-07	10.69	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B	4.70E-05	CCX-BY-PN
2	9.19E-08	9.44	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
3	7.96E-08	8.18	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
4	7.96E-08	8.18	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN~~IWX-MV-GO1~~	2.60E-05	IWX-EMV-~~GO1~~SA
5	6.65E-08	6.83	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
6	5.77E-08	5.93	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			~~IWX-MV-GO1~~CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EMV-~~GO1~~SA
7	5.77E-08	5.93	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
8	5.32E-08	5.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE OF THE INVERTER	2.40E-05	CCX-IV-XR
9	3.67E-08	3.77	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			~~REX-FL-GP~~CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP

Table 54-15 (Sheet 2 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
10	3.67E-08	3.77	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
11	2.66E-08	2.73	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS~~REX-FL-GP~~	1.20E-05	REX-FL-GP
12	2.66E-08	2.73	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
13	2.15E-08	2.21	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
14	1.91E-08	1.96	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM
15	1.86E-08	1.91	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~IWX-MV-GO1~~CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EMV-SA~~GO1~~
16	1.86E-08	1.91	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
17	1.11E-08	1.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
18	1.02E-08	1.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S

Table 54-15 (Sheet 3 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
19	8.59E-09	0.88	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
20	8.59E-09	0.88	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~REX-FL-GP~~CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP
21	8.05E-09	0.83	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
22	8.05E-09	0.83	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
23	7.42E-09	0.76	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
24	6.16E-09	0.63	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			~~IWX-XMTR~~CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			~~REN-MAN04~~OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
25	5.83E-09	0.6	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
26	5.69E-09	0.58	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S

Table 54-15 (Sheet 4 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
27	5.69E-09	0.58	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
28	4.46E-09	0.46	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			~~IWX-XMTR~~CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			~~REN-MAN04~~OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
29	4.12E-09	0.42	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
30	4.12E-09	0.42	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
31	3.67E-09	0.38	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
32	2.91E-09	0.3	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ADS 4TH S AGE SQUIB VALVES TO OPEN	3.00E-05	ADX-EV-SA
33	2.66E-09	0.27	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
34	2.60E-09	0.27	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX

Table 54-15 (Sheet 5 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
35	2.53E-09	0.26	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
36	2.52E-09	0.26	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 2 OUT OF 2 LOW PRESSURE RECIRCULATION SQUIB VALVES~~IWX-EV4-SA~~	2.60E-05	IWX-EV4-SA
37	2.52E-09	0.26	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 6 OUT OF 6 IRWST HP SQUIB VALVES TO OPEN~~IWX-MV-GO1~~	2.60E-05	IWX-EMV-SA~~GO1~~
38	2.20E-09	0.23	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN	3.00E-03	IRWMOD05S
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
39	2.18E-09	0.22	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EVENT	5.28E-06	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.50E-02	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. F ILS TO ACTUATE I WST INJ)	5.00E-02	IWN-MAN00C
			COND. PROB. OF RHN-MAN05 (OP. FAILS TO OPEN RNS MOV V023)	1.50E-01	RHN-MAN05C
40	1.88E-09	0.19	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF PRESSURE TRANSMITTERS	2.63E-06	CCX-XMTRX
41	1.83E-09	0.19	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			OPERATOR FAILS TO RECOGNIZE NEED AND TO OPEN RNS MOV V023	1.60E-03	RHN-MAN05
42	1.60E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			MECHANICAL FAILURE CAUSES MOV 121A TO FAIL-TO-OPEN	3.00E-03	IRWMOD05S
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG

Table 54-15 (Sheet 6 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
43	1.55E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
44	1.47E-09	0.15	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			MECHANICAL FAILURE CAUSES MOV 023 TO FAIL-TO-OPEN	2.21E-03	RN23MOD5S
45	1.44E-09	0.15	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			~~IWX-XMTR~~CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			~~REN-MAN04~~OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
46	1.39E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDK1TM
47	1.39E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDD1TM
48	1.39E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAINED	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDDBSDS1TM
49	1.38E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			OFFSITE AC POWER RECOVERED IN 2 HOURS	7.60E-01	SUC-R2S
			FAILURE OF MANUAL DAS ACTUATION	1.16E-02	REC-MANDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM

Table 54-15 (Sheet 7 of 7)

AP1000 SHUTDOWN PRA SENSITIVITY CASE 4 CDF CUTSETS

NUMBER	CUTSET PROB.	PERCENTAGE	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
50	1.19E-09	0.12	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS FILLED	1.82E-02	IEV-LOSPND
			OFFSITE AC POWER RECOVERED IN 2 HOURS	7.60E-01	SUC-R2S
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	8.62E-06	CCX-EP-SAM

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19.1.10.3-2

Original RAI Number(s): None

Summary of Issue:

Major Contributors to System Failures

The major causes of reactor cavity flooding failure and hydrogen igniter failure in AP1000 have not been provided. Such information is useful for identifying major contributors to system failure and confirming that reasonable measures have been taken to reduce risk. The staff will request that the applicant provide this information for AP1000. This is Open Item 19.1.10.3-2.

Westinghouse Response:

The major causes of reactor cavity flooding and hydrogen igniter failure are given in Tables 1 and 2. These are the top cutsets that fail these systems.

For reactor cavity flooding failure, almost 90% of the failure probability come from common cause failure of recirculation MOVs to open or operator action failure to open recirculation MOVs.

For hydrogen igniter failure, 75% of the failure probability comes from the first four contributors in Table 2, which are common cause failure of hydrogen igniters, failure of 12 VAC distribution panel, failure of manual actuation, and common cause failure of sensors.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Table 1. AP1000 PRA REACTOR CAVITY FLOODING CUTSETS

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	4.40E-03	55.75	CCF OF RECIRC MOVs TO OPEN	4.40E-03	IWX-MV-GO
2	3.40E-03	43.08	OPERATOR FAILURE TO OPEN RECIRC MOVs	3.40E-03	REN-MAN03
3	5.80E-05	0.73	CCF OF 2 OUT 2 LOW PRESSURE RECIRCULATION SQUIB VALVES	5.80E-05	IWX-EV4-SA
4	1.20E-05	0.15	CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
5	1.10E-05	0.14	CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
6	8.62E-06	0.11	CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
7	4.78E-06	0.06	CCF OF TANK LEVEL TRANSMITTERS	4.78E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
8	2.13E-06	0.03	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
9	1.28E-06	0.02	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
10	1.28E-06	0.02	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
11	1.20E-06	0.02	SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
12	7.67E-07	0.01	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
13	4.38E-07	0.01	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
14	4.38E-07	0.01	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
15	4.38E-07	0.01	HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDS1TM
16	4.38E-07	0.01	HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDD1TM
17	3.50E-07	0	SUMP SCREEN A PLUGS AND PREVENTS FLOW	2.40E-04	REA-PLUG
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
18	3.50E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
19	2.63E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDS1TM
20	2.63E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDD1TM
21	2.63E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
22	2.63E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
23	2.50E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			FAILURE OF OUTPUT DRIVER	1.71E-04	IRCEP118ASA

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
24	2.50E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			FAILURE OF THE POWER INTERFACE BOARD (###EP####SA)	1.71E-04	IRDEP118BSA
25	2.10E-07	0	SUMP SCREEN A PLUGS AND PREVENTS FLOW	2.40E-04	REA-PLUG
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
26	2.10E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
27	2.06E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PMBMOD1
28	2.06E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PMAMOD1
29	1.50E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			FAILURE OF OUTPUT DRIVER	1.71E-04	IRCEP118ASA
30	1.50E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			FAILURE OF THE POWER INTERFACE BOARD (###EP####SA)	1.71E-04	IRDEP118BSA
31	1.41E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PMB030
32	1.41E-07	0	HARDWARE FAILURE OF SQUIB VALVE 118A	1.46E-03	IRWMOD09
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PMA030
33	1.24E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PMBMOD1

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
34	1.24E-07	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PMAMOD1
35	9.00E-08	0	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDS1TM
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
36	9.00E-08	0	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDS1TM
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
37	9.00E-08	0	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDD1TM
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
38	9.00E-08	0	BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDBBSDD1TM
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
39	8.49E-08	0	RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PMB030
40	8.49E-08	0	RELAY FAILS TO OPERATE	8.76E-04	IWBRS118AFA
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PMA030

Table 2. AP1000 PRA HYDROGEN IGNITOR CUTSETS

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
1	3.20E-04	27.71	CCF OF THE HYDROGEN IGNITERS	3.20E-04	VLX-HI-SA
2	3.05E-04	26.41	FAILURE OF THE 12 VAC DISTRIBUTION PANEL	3.05E-04	EDSMOD01
3	1.68E-04	14.55	COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			OPERATOR FAILS TO RECOGNIZE NEED AND FAILS TO START HYDROGEN CONTROL SYSTEM	3.32E-04	VLN-MAN01
4	7.58E-05	6.56	CCF OF HYDROGEN ANALYZER SENSORS	7.58E-05	VLX-ANLYZ
5	4.24E-05	3.67	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS001TM
6	4.24E-05	3.67	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS013TM
7	4.24E-05	3.67	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS132TM
8	1.07E-05	0.93	STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO2DG002TM
9	1.02E-05	0.88	CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
10	7.29E-06	0.63	UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			UNAVAILABILITY OF BUS ECS ES 2 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC2BS002TM

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
11	7.29E-06	0.63	UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS023TM
12	7.29E-06	0.63	UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS232TM
13	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS013TM
			UNAVAILABILITY OF BUS ECS ES 2 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC2BS002TM
14	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS013TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS023TM
15	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS013TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS232TM
16	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS132TM
			UNAVAILABILITY OF BUS ECS ES 2 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC2BS002TM
17	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS132TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS023TM
18	7.29E-06	0.63	BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS132TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC2BS232TM
19	4.72E-06	0.41	D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO2DG002TM
20	4.72E-06	0.41	STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
21	3.71E-06	0.32	COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
22	3.67E-06	0.32	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
23	3.32E-06	0.29	FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			OPERATOR FAILS TO RECOGNIZE NEED AND FAILS TO START HYDROGEN CONTROL SYSTEM	3.32E-04	VLN-MAN01
24	2.24E-06	0.19	COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
25	2.13E-06	0.18	COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	4.20E-04	ECX-CB-GO
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
26	2.07E-06	0.18	D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
27	1.64E-06	0.14	FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PL3MOD1
28	1.61E-06	0.14	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
29	1.42E-06	0.12	COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
30	1.41E-06	0.12	FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF OUTPUT LOGIC I/Os (CCX- P##MOD1)	1.41E-04	CCX-PL3MOD1
31	1.12E-06	0.1	FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PL303
32	1.00E-06	0.09	INDICATION FAILURE	1.00E-06	ALL-IND-FAIL
33	9.81E-07	0.08	BREAKER 100 FAILS TO OPEN [#3,5]	4.20E-03	EC1CB100VO
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO2DG002TM
34	9.81E-07	0.08	STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			BREAKER 200 FAILS TO OPEN [#3,5]	4.20E-03	EC2CB200VO
35	9.69E-07	0.08	FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF THE LOGIC GROUP PROCESSING (CCX-###03)	9.69E-05	CCX-PL303
36	7.54E-07	0.07	TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
			FIXED COMPONENT FAULTS	4.80E-05	EC1MOD13
37	6.78E-07	0.06	TRANSFORMER, STATIC XFER SW SPUR FAIL, OR CKT BKR OPENS	4.32E-05	EDSMOD11
			TRANSFORMER, STATIC XFER SW FAIL TO SW, OR CKT BKR OPENS	1.57E-02	EDSMOD12
38	6.71E-07	0.06	STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			FIXED COMPONENTS FAILURE	3.17E-04	ED4MOD112
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO2DG002TM

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
39	6.71E-07	0.06	STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO1DG001TM
			FIXED COMPONENTS FAILURE	3.17E-04	ED4MOD11
			STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	4.60E-02	ZO2DG002TM
40	6.60E-07	0.06	CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19A.2-2

Original RAI Number(s): None

Summary of Issue:

Variability exists between the design capacity and the test capacity. This phenomenon is inherent in the manner in which an actual structure redistributes loads based on redundancy, excess capacity provided by design, end constraints and other factors. The applicant has not explained how this factor was used in its probabilistic fragility analysis. This is Open Item 19A.2-2.

Westinghouse Response:

Variable strength factors are defined by a margin factor and lognormal standard deviations (LSDs). They are used in the formulas given in Probabilistic Fragility Analysis item of AP1000 PRA section 55.2.2.3, Analysis of Structure Response. The NRC, as part of the AP600 licensing process, reviewed these strength factors and LSDs. The same strength margin factors and LSDs are used for the AP1000 plant as employed for the AP600 plant. NRC AP600 Open Item 720.447F and AP600 FSER 19A.2.1.2.1 addressed these factors with LSD recommendations. The NRC recommends that variable strength composite LSDs used for certain primary component supports be increased to be consistent with values given in EPRI TR-103959. The components addressed in these open items are shown below as examples of the variable strength factors used for the AP1000 plant. Westinghouse used the standard deviations (LSD) with an associated margin factors based on the failure that is being evaluated for the structural element being analyzed.

RPV High-Strength Bolts

Failure is based on shear with the margin factor equal to the ratio of the bolt shear strength to the allowable shear strength that is equal to 0.42 of the ultimate stress. A LSD value of 0.10 is used with this margin factor consistent with AP600 FSER 19A.2.1.2.1.

Pressurizer Upper Support Strut Weld

Failure is based on shear with the margin factor equal to the ratio of the weld shear strength to the allowable shear strength that is equal to 0.42 of the ultimate stress. A LSD value of 0.19 is used with this margin factor consistent with AP600 FSER 19A.2.1.2.1.

Steam Generator Upper Support Ring Girder Flange Bolt

The AP1000 plant does not have an upper support ring girder, and therefore this structural support component does not apply to the AP1000 plant.

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19A.2-6

Original RAI Number(s): None

Summary of Issue:

The applicant used the CDFM method to calculate the HCLPF value of the shield building using strength, inelastic energy absorption and damping as areas where the shield building capacity is increased over the design capacity to determine the cumulative effect of those factors. The applicant has increased the shear capacity of a concrete section by increasing the shear modulus to account for the shear strength of reinforcement bars where the shear load exceeds the shear strength of concrete alone. The ACI 349 Code, the applicable concrete design code, allows the addition of reinforcement strength, but not by increasing the shear modulus of the concrete section. The shield building tension ring has a HCLPF value of 0.51g (Table 55-1, Sheet 1 of 4). Therefore, a validation of the capacity of the shield building shear walls is important. With respect to inelastic energy absorption and damping factors, it is not clear as to whether or not the applicant has double counted damping values through the use of hysteretic damping for inelastic energy absorption and a damping value of 10 percent. The applicant needs to justify the details of the CDFM approach for calculating HCLPF values for important structures and equipment. It should be noted that the containment internal structure and the nuclear island basemat are predicted to lift up under the SSE loading. As noted in Section 3.7 of this report, the effect of uplift due to design basis seismic excitation is an open area. Consequently, at 0.5g review level earthquake, the capacity of the tension ring could potentially be lower. Therefore, the validation of HCLPF values calculated by the CDFM approach is Open Item 19A.2-6.

Westinghouse Response:

Shear Modulus

The shear modulus was not modified to increase shear capacity, but to reflect the section properties with cracking. The analysis of the Shield Building Roof is performed in steps starting with a monolithic stiffness associated with an uncracked section. Based on the results from analysis using this structural configuration (no cracking), section properties were modified to reflect cracking. Using the results obtained that account for concrete cracking and redistribution of the load within the Shield Building Roof, structural margin for the critical sections (columns, tension ring, at PCS Tank Location, PCCS tank walls) were calculated based on the maximum load that these critical elements can transfer without failure.

The total section shear strength is calculated with contributions of concrete and reinforcement together. The total in-plane shear strength including concrete and rebars contributions uses Reference 19A.2-6-1, Appendix L, "Shear Strength of Concrete Walls". Taking into account the axial compression, the total out-of-plane shear concrete strength is based on beam action behavior.

The PRA report, Chapter 55 will be modified to remove the confusion.

CDFM Method

The conservative deterministic failure margin (CDFM) is an accepted approach to estimate HCLPF capacity (Reference 19A.2-6-1). The CDFM approach for calculating HCLPF values was approved by the USNRC for the AP600 plant. The same CDFM methodology, described in FSER 19A.2.2, is used for the AP1000 plant. The structural capacity is calculated based on concrete cracking and redistribution as described above under the heading Shear Modulus. The values calculated for the shield wall, and documented in Chapter 55 of the AP1000 Probabilistic Risk Assessment report are:

Shield building Roof - Tension Ring	0.51g
Shield building Roof - at PCS Tank	0.63g
Shield building Roof - PCS Tank Wall	1.30g
Shield building Roof – Columns, Out of Plane Shear	0.74g
Shield building Roof – Columns, In Plane Shear	0.57g

As seen from above, the tension ring has the smallest capacity and consequently controls the shield-building roof HCLPF value. Also, since tension control the HCLPF value, shear strength does not.

It is noted that the HCLPF values given are conservative since they do not reflect additional capacity due to damping and inelastic energy absorption. Therefore, there is no double counting of damping values through the use of hysteretic damping for inelastic energy absorption and a damping value of 10 percent. These margin factors were removed to address AP600 USNRC Open Items 720.449F Inelastic Energy Absorption, and 720.450F Damping (also discussed in AP600 FSER 19A.2.2.2 Inelastic Energy Absorption & FSER 19A.2.2.3 Damping).

Westinghouse's opinion is that the revisions as required by the NRC result in very conservative HCLPF values. Using damping and inelastic energy absorption as appropriate will result in realistic HCLPF values. Westinghouse is of the opinion that with the higher-level earthquake, a damping factor of 1.1 can be used to represent the decrease in demand due to excessive cracking in the shield building. Further, a ductility factor 1.19 could be applied to the tension ring capacity that controls the HCLPF value. Therefore, a realistic HCLPF value for the shield building roof will be greater than 0.6g.

Uplift Effect of Foundation

See Westinghouse's response to DSER 19A.2-8.

References

19A.2-6-1 EPRI NP - 6041 - SL Rev. 1 August 1991: A Methodology for Assessment of Nuclear Power Plant Seismic Margin - Appendix L.

Design Control Document (DCD) Revision:

None

PRA Revision:

Modify the following sections under 5.5.2.3, Analysis of Structure Response, and Section 55.6, References.

Strength

This margin factor is defined from the finite element analysis based on the increase in seismic acceleration to failure based on ultimate stress criteria. ACI 349 provisions have been used to define ultimate strength for axial and flexure loads. For shear loads, the concrete and rebar capacities have been evaluated. **The total section shear strength is calculated with contributions of concrete and reinforcement together. The total in-plane shear strength including concrete and rebars contributions uses Reference 55-12, Appendix L, "Shear Strength of Concrete Walls". The total out-of-plane shear concrete strength is based on beam action behavior taking into account the axial compression,**
~~If the design shear load is greater than the concrete shear strength, the shear modulus has been increased to account for the shear strength in the reinforcement.~~

55.6 References

Add Reference 55-12

55-12 "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Electric Power Research Institute, EPRI NP-6041, Revision 1, August 1991.

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 19A.2-7

Original RAI Number(s): None

Summary of Issue:

The applicant determined the HCLPF values on the basis of the estimated lower bound of qualification test results. When natural frequencies were not known, it was assumed that the equipment natural frequency coincides with the response spectra peak. When equipment frequencies are known and used for comparing the required response spectra (RRS) to the test response spectra (TRS), this information is to be included in the design specification. The applicant has not identified any equipment for which such design specification will be included. Although the applicant appears to have used a conservative approach to obtain the equipment HCLPF value from test results, it is not clear how the use of known natural frequency values for equipment within the standard design scope will be implemented. Since there are many electrical components with HCLPF values at 0.54g and one at 0.53g, electrical components may become critical in determining the Plant HCLPF value. This is Open Item 19A.2-7.

Westinghouse Response:

The design specification is part of the procurement package. The requirements to which the equipment is to be purchased are included in the design specification. This includes all those pieces or classes of equipment that have known frequencies that are used to define the HCLPF by comparing the RRS and TRS. These frequencies will be included in the design specification for the equipment to assure that the dynamic characteristics are the same as those expected.

Electrical components for non-safety systems are not critical in determining the plant HCLPF value since all SMA sequences are evaluated with loss of offsite power and loss of onsite AC power leading to a station blackout event. With the loss of power it has been shown that the plant design is robust against seismic event sequences each of which contain station blackout coupled with other seismic or random failures.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 20.7-1

Original RAI Number(s): None

Summary of Issue:

Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

This bulletin was issued to obtain information needed to determine the adequacy of pressurized water reactor (PWR) plants' boric acid corrosion control (BACC) programs. Within 60 days of the date of this bulletin, all PWR addressees were required to submit to the NRC the basis for concluding that their boric acid corrosion control program for the reactor coolant pressure boundary (RCPB) is providing reasonable assurance of compliance with the applicable regulatory requirements. Bulletin 2002-01 indicated that the information submitted will be used by the staff to determine the need for, and to guide the development of, additional regulatory actions to address degradation of the reactor pressure vessel head and/or other portions of the reactor coolant pressure boundary.

Experience with currently operating PWRs continues to show cracking of Alloy 600 components. Recent experience appears to indicate that cracking has even occurred in welds or components not previously expected to crack based on the temperature of the weld or component and the time in service. The staff believes that the use of Alloy 690 materials in contact with reactor coolant is a substantial improvement over the use of materials currently in wide use in the industry. However, data is not presently available to demonstrate that cracking in these welds and components will not occur over the projected 60 year lifetime of an AP1000 plant. Bare metal visual inspection of these locations is highly effective in identifying locations where cracking occurs. Technical specification requirements prohibit through wall leakage of the RCPB. Therefore, Westinghouse needs to provide information to describe the extent to which the insulation of all Alloy 600/690 components and welds in the reactor coolant pressure boundary (not just upper reactor vessel head penetrations) will be designed to readily facilitate bare metal visual inspection during refueling outage conditions. This is Open Item 20.7-1.

Westinghouse Response:

Westinghouse provided the response to this Open Item in the response to RAI 252.011 which was transmitted to the NRC via Westinghouse letter DCP/NRC1592 (dated May 21, 2003).

Design Control Document (DCD) Revision:

None

PRA Revision:

None

AP1000 DESIGN CERTIFICATION REVIEW

Draft Safety Evaluation Report Open Item Response

DSER Open Item Number: 21.1-1

Original RAI Number(s): None

Summary of Issue:

This safety evaluation report provides the U.S. Nuclear Regulatory Commission (the NRC or staff) staff's assessment of the application to the AP1000 of the AP600 passive core cooling system test program and the LOFTRAN, NOTRUMP, and WCOBRA/TRAC analysis codes to the AP1000 standard plant design. The assessment of the AP1000 passive containment cooling system and the WGOTHIC code is addressed separately in this chapter. The staff's evaluation documented in this chapter concentrates on the differences between the AP1000 and the AP600 design with the understanding that the AP600 testing and computer codes were found to be acceptable for the AP600 design in accordance with the staff's evaluation documented in Chapter 21 of NUREG-1512, "Final Safety Evaluation Report Related to Certification of the AP600 Standard Design," September 1998. This chapter currently contains references to NUREG-1512, which provides the basis for accepting the AP600 testing and computer codes. Prior to issuing the final safety evaluation report for the AP1000, the staff will remove these references and replace the references with the basis for its conclusion that the testing and computer codes are acceptable for the AP1000. This is DSER Open Item 21.1-1.

Westinghouse Response:

Westinghouse and the NRC conducted a pre-application review of the AP1000 to determine the applicability of the AP600 testing program and analysis codes to the AP1000 standard plant. The NRC documented the results of their review in the NRC letter "Applicability of AP600 Standard Plant Design Analysis Codes, Test Program and Exemptions to the AP1000 Standard Plant Design" dated March 25, 2002. In this letter, the NRC concluded that the AP600 tests were applicable to the AP1000, and identified the issues that should be resolved during AP1000 Design Certification. The Westinghouse response to RAI 440.054 that was submitted in Westinghouse letter DCP/NRC1529 dated 11/1/2002 provides a summary of how these issues have been addressed for AP1000 Design Certification.

Design Control Document (DCD) Revision:

None

PRA Revision:

None