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Dominion®

March 9, 2009

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Serial No.: 09-028
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Docket No.: 50-305
License No.: DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION

By letter dated January 8, 2009, the NRC requested additional information regarding the license renewal application (LRA) for Kewaunee Power Station. The attachment to this letter contains the responses to the request for additional information regarding severe accident mitigation alternatives (SAMA) for Kewaunee Power Station.

Should you have any questions regarding this submittal, please contact Mr. Paul C. Aitken at (804) 273-2818.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Support Services

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President – Nuclear Support Services of Dominion Energy Kewaunee, Inc. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 9th day of March, 2009.

My Commission Expires: 4/30/13.

Notary Public

A135
NRR

GINGER L. ALLIGOOD
Notary Public
Commonwealth of Virginia
310847
My Commission Expires Apr 30, 2013

Attachment:

Response to Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives for Kewaunee Power Station (KPS).

Commitments made in this letter:

1. The concurrent implementation of SAMAs 81, 160, 166 and 167 will be further reviewed as part of Dominion's ongoing performance improvement programs.
2. The implementation of temporary screenhouse ventilation will be further reviewed as part of Dominion's ongoing performance improvement programs.

cc:

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ATTACHMENT

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ANALYSIS OF SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR KEWAUNEE POWER STATION (KPS)

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

Introduction

By letter dated January 8, 2009, the NRC requested additional information regarding the license renewal application for KPS. Each question and associated response is provided below.

NRC RAI 1

Provide the following information regarding the Probabilistic Risk Assessment (PRA) models used for the Severe Accident Mitigation Alternative (SAMA) analysis:

a. The first paragraph of Section F.2.1 states that logic changes were made to the Level 1 model to address internal flooding related design changes planned for completion prior to the license renewal period. Describe these design and logic changes.

b. The last paragraph on page F-8 indicates that a proposed change to elevate supply breakers would be scheduled in the future. This design change was apparently credited in the current PRA. Another change, re-routing a wire to the Turbine Building fan coil unit, has apparently been made but not included in the PRA used for the SAMA analysis. However, a related discussion in Section F.7.6 implies that at least a portion of the planned breaker modification has been made. Provide additional details regarding design changes, the associated PRA models, and the estimated date for the breaker modification, if it is still planned.

c. On page F-9, it is stated that station blackout (SBO) contributes 13.6% of the core damage frequency (CDF), while in Items 16 and 29 (and others) of Table F-3 it is stated that SBO contributes 4.3% of the CDF. Confirm which value is correct.

d. The CDF increased by a factor of 24 from the 8/2003 model to the 12/2004 model and then decreased by a factor of almost 10 in the K101AASAMA model, all subsequent to the Westinghouse Owners Group (WOG) peer review. Discuss the major reasons for the large increase and subsequent decrease in CDF, with particular attention to the evolution of the internal flooding model.

e. One of the unresolved WOG Peer Review Fact and Observations (F&Os) is related to not treating loss of ventilation as a unique initiating event. The discussion of this F&O (IE-1) in Table F-5 indicates that manual shutdown may be required for loss of certain ventilation systems and that these events are subsumed in the reactor trip with main feedwater initiating event. This latter initiating event will presumably have all HVAC initially operating normally rather than having a failure that caused the manual shutdown, and

the likelihood of a random HVAC failure during this event would be small. Justify that treatment of a loss of ventilation initiating event in this manner is appropriately bounding, and would not adversely impact the identification of HVAC-related SAMAs.

f. ***KPS License Amendment Request 242 of September 11, 2008 provides information on the K107Aa PRA model of July 15, 2008, which post-dates the PRA version used for the SAMA analysis. The CDF and large early release frequency (LERF) reported therein are approximately half of the values in the SAMA PRA. An independent assessment of the K107Aa PRA against the supporting requirements of the ASME PRA standard was also briefly described.***

   i. ***Provide the principal reasons for the reduction in CDF from the SAMA PRA to the K107Aa PRA, and address the impact of these changes on the SAMA analysis.***

   ii. ***Identify who performed the independent assessment and discuss the impact that any unmet supporting requirements might have on the SAMA analysis.***

   iii. ***Confirm whether a review of the importance analysis for the K107Aa model leads to the identification of any additional potentially cost-beneficial SAMAs.***

g. ***In a June 17, 2005 submittal on risk-informed in-service inspection, NMC's response to RAI 3.7 indicated that 6 weaknesses were identified in the IPE. Confirm that none of these items remain applicable to the PRA used for the SAMA assessment.***

h. ***Provide a more detailed description of the Level 1 and 2 PRA update process, the quality control of PRA model changes, and the independent review and approval of the PRA model update documentation mentioned at the end of Section F.2.5 (including scope of review, independence of reviewers, and documentation of review comments).***

i. ***The contributions to CDF by initiating event given in Table F-1 total only 77% of the CDF. Characterize the remaining 23% as to initiator or initiator type and any noteworthy attributes.***

<u>Dominion Response to RAI 1</u>

<u>Response to 1.a</u>

As stated in LRA Appendix E, Attachment F, Section F.2.1, changes to the Level 1 model included incorporating logic changes needed to address internal flooding-related design changes that were discussed with the NRC on November 30, 2006 [ADAMS

Accession Number ML063460495]. As further stated in Section F.2.1 (fifth paragraph), three of the four design changes have been completed. Each of the design changes and associated logic changes are described below.

1. Replacement of Fire Door 8

The first design change replaced the fire door (door 8) separating the Auxiliary Building basement from safeguards alley with a watertight door. The fire door used for door 8 in the original plant design would have failed if the water level in the Auxiliary Building basement reached four feet in depth. Failure of door 8 would have resulted in a surge of water into safeguards alley from the Auxiliary Building. This surge of water was assumed to fail both trains of safety-related 480 VAC buses and result in core damage.

In the June 2006 internal flooding PRA model, flooding events were evaluated for the potential to result in the accumulation of four feet of water in the Auxiliary Building basement. For each potential flooding event, failure to isolate the flood source before releasing a volume of water capable of threatening door 8 was included in an event tree sequence that directly resulted in core damage. After installation of watertight door 8, propagation of water from the Auxiliary Building basement directly to safeguards alley would not be credible. Therefore, these direct-to-core-damage sequences were eliminated.

2. Installation of flood detection instrumentation in Auxiliary Building basement

The second design change installed flood detection instruments in the Auxiliary Building basement. In the June 2006 internal flooding PRA model, cues for flooding in the Auxiliary Building were provided by indirect indications such as high deaerated drain tank level or low refueling water storage tank (RWST) level. Since only indirect indications of flooding were available, operator actions to isolate such floods were delayed by the amount of time needed to transition between the procedures and the time necessary to determine that flooding was in progress. With the addition of the new flood detection instruments, alarm response procedures now direct immediate investigation should one of the alarms actuate and also direct rapid transition to procedures needed to isolate and mitigate an Auxiliary Building flood. These procedural changes have been incorporated into the human reliability analysis (HRA) and human error probability calculations for flood isolation.

3. Installation of spray shields on service water piping in safeguards alley

The third design change incorporated into the PRA model was the installation of spray shields on service water piping in safeguards alley. Specifically, spray shields were installed to protect A-train switchgear from a leak in B-train service water piping and to protect B-train switchgear from a leak in A-train service water piping. These spray shields are designed for pipe leaks of up to 100 gpm, which is within the capacity of the area floor drains. In the June 2006 internal flooding PRA model, spray from any pipe leak was assumed to fail all equipment located in the room where the leak occurred. The addition of spray shields on the service water piping prevents spray from a small (less than 100 gpm) leak on the shielded pipe from impacting and failing equipment in the room. Fault tree models for equipment located in safeguards alley were changed to eliminate spray-induced failures caused by small leaks on shielded pipes.

4. Raise certain circuit breakers

The fourth design change, which has not been implemented, would raise the elevation of the supply circuit breakers for certain safety-related MCCs from breaker cubicles located in cubicles at the bottom of their associated buses (floor level) to breaker cubicles located higher in the main 480 VAC buses. For Kewaunee, the 480 VAC circuit breakers in the main safety-related buses (buses 51, 52, 61, and 62) would fail open when the water level in the 480 VAC switchgear rooms reaches 2.75 inches. Circuit breakers 15206 and 16206 are located in the bottom of their associated buses and supply key safety-related MCCs. For the June 2006 internal flooding PRA model, the failure probability of operator action to isolate flooding events was calculated using the release time for the volume of water needed to raise the level in the 480 VAC switchgear rooms to 2.75 inches. At that time, breakers located on the bottom of the buses were assumed to fail open. Raising these circuit breakers to a higher elevation breaker cubicle ensure that the breakers would remain available until the water level reached 11 inches in the 480 VAC switchgear rooms. The HRA for operator actions to isolate flood events that could propagate between rooms in safeguards alley were re-evaluated to consider the additional time available to isolate flooding before a level of 11 inches was reached and the new failure probability values for these events were included in the quantification.

Response to 1.b

A design change to move breakers 15206 and 16206 from the bottom row of breakers on buses 52 and 62, respectively, has not been completed. Current plans are to raise breaker 16206 during the next available opportunity that would require bus 62 to be de-energized. Since the benefit of raising 15206 is much lower than that of 16206, breaker 15206 will not be raised. Relocation of breaker 16206 was included in the model used for the SAMA analysis, but is not in the current Kewaunee internal events PRA model (K107Aa).

An additional change, to re-route a wire connecting the supply breaker for Turbine Building basement fan coil unit B and auxiliary relays, was completed in 2008. This change is not included in the model used for the SAMA analysis, but is included in the current PRA model.

The relocation of breakers 15206 and 16206 was proposed in 2006 to reduce the flooding risk to these breakers. A flood height of 2.75 inches is assumed to disable all breakers in the bottom row of the panel. The remaining breakers do not fail until the buswork is submerged, at 11 inches. The affected breakers supply power to certain safety-related equipment that is important in the PRA model. The primary benefit of the proposed modification was to reduce risk due to flooding from pipe breaks in the A-train emergency diesel generator room, which would propagate to the adjacent 480 VAC switchgear rooms to a height above 2.75 inches.

Subsequent to the proposed design change, but before the K101AASAMA model (used for the SAMA analysis) was completed; model changes were made that reduced the importance of the proposed breaker relocation. In the K101AASAMA model, raising breakers 15206 and 16206 results in a core damage frequency (CDF) reduction of 2% (from 7.9E-5/yr to 7.7E-5/yr). The important basic events most impacted are turbine driven auxiliary feedwater pump failures and floods in the A-train emergency diesel generator room.

The current Kewaunee internal events PRA model (K107Aa), which does not include raising of the breakers, has a CDF of 4.8E-5/yr. This is 38% lower than the K101AASAMA model CDF (7.7E-5/yr). The K107Aa model includes the re-routing of a wire between the breaker for Turbine Building fan coil unit B and auxiliary relays to ensure it is not submerged. The K107Aa model also includes model enhancements to remove certain conservatisms. The CDF decrease shows that other improvements have more than offset the small reduction in CDF due to raising of the breakers. With regard to changes in importances, the importances from the K101AASAMA model are evaluated in the response to question 1.f.iii.

Response to 1.c

The SBO contribution of 13.6% of the CDF on page F-9 is incorrect. The correct value for the SBO contribution to the CDF is 4.3%, as indicated in LRA Appendix E, Attachment F, Table F-3.

Response to 1.d

The primary difference between the 8/2003, 12/2004, and K101AASAMA models is associated with the flood risk.

The 8/2003 model used a flood model that had very little difference from the IPE and resulted in a flooding CDF of 3.6E-7/yr.

The 12/2004 model was a conservative model created to bound actual flooding conditions until a best-estimate model could be developed. The 12/2004 model incorporated the following:

- Consideration of piping failures up to the maximum flow rate.
- Evaluation of flow through drain lines and under doors for the entire event.
- Evaluation of flood isolation from a human reliability perspective.
- Use of EPRI Report TR-102255, "Pipe Failure Study Update", to generate updated flooding frequencies.
- Examination and modeling of spray as a failure mode, as applicable.

This model resulted in a flooding CDF of 6.8E-4/yr, with the majority of the risk due to the following two scenarios:

- Rupture of a condenser expansion joint with flood water propagating to safeguards alley via floor drains and under doors.
- Break of safety injection piping from the refueling water storage tank joint with flood water propagating through a failed door into safeguards alley.

In 2005, check valves were installed in drain lines, flood barriers were built around doors from the Turbine Building basement to safeguards alley, and instrumentation was installed which automatically trips the circulating water pumps on high flood level in the Turbine Building. These modifications resulted in an overall decrease in CDF and were credited in the K101AASAMA model along with the changes discussed in LRA Appendix E, Attachment F, Section F.2.1.

Other changes that were reflected in the K101AASAMA model include:

- Use of EPRI Report EPRI 1012302, Final Report, Revision 1, "Pipe Rupture Frequencies for Internal Flooding PRAs," which accounts for the size of the break to generate updated flooding frequencies.
- Breakdown of flooding initiating events into small, moderate, and large sizes to address the differences in isolation timing.
- Recalculation of (failure to isolate) probabilities based on more realistic estimates for time to perform the required actions and time to equipment damage.
- Explicit inclusion of spray for all scenarios except those deterministically evaluated to not be spray scenarios.
- Walkdown and examination of all significant piping flood sources in the plant for inclusion in the model.

The flooding CDF for the K101AASAMA model is 4.5E-5/yr.

Response to 1.e

A loss of ventilation initiating event would be a slowly developing event, which would allow time for a controlled shutdown. Operators would declare a safety-related component inoperable if its design ambient air temperature cannot be maintained. For events only affecting one train of safeguards equipment, operators would have up to the Technical Specification Allowed Outage Time of the most limiting system to take action to provide ventilation. Procedural guidance exists for the required operator actions to restore ventilation in time to prevent a plant shutdown. For loss of ventilation events that affect both trains of safeguards equipment, operators would implement the

Technical Specification standard shutdown sequence. The Technical Specification standard shutdown sequence requires a controlled shutdown that would not put as much stress on the plant as a reactor trip.

Equipment that is needed during power operations and equipment required during recovery from a reactor trip or accident are in different plant locations (primarily the Turbine Building for power operations; and safeguards alley, the Auxiliary Building, the emergency diesel generator rooms, etc. for recovery from a trip or accident). During power operations, the basement of the Turbine Building gets hot, so there is a potential for equipment required to keep the plant on-line to fail if the ventilation fails. Such a failure could result in a trip, which would not be significantly different from a normal transient, since safety-related equipment (located in other areas) would not be affected, and the main source of heat to the Turbine Building (steam filled lines) would be significantly reduced due to the reactor trip.

Conversely, the plant areas with safety-related equipment (safeguards alley, the Auxiliary Building, the emergency diesel generator rooms, etc.) remain cool during normal operations. The limiting temperatures for these areas are post-accident temperatures rather than normal operating temperatures. Therefore, the HVAC failure would not be the initiating event, but would be a supporting system during recovery from another initiating event. The ventilation systems are modeled as a support system for equipment requiring ventilation.

Therefore, loss of ventilation does not need to be modeled as an initiator at Kewaunee.

Response to 1.f.i

Identified below are changes that were made between the time of the K101AASAMA PRA model and the current revision of the PRA model (K107Aa):

1. Incorporation of several minor corrections.
2. Update of the basic event database, which was completed in 2007.
3. Update to the internal flooding hazard contribution based on evaluation of the "as installed" configuration of the plant modifications described in the K101AASAMA model.
4. Change of the flooding failure height for the breaker to Turbine Building basement fan coil unit B from 3 inches to 7.5 inches to reflect a wiring change in the plant.
5. Revision of the flooding initiating event frequencies for service water piping in the A-train emergency diesel generator room by creating a new initiator for piping from the Turbine Building header.
6. Addition of Auxiliary Building normal ventilation as a backup to Auxiliary Building safeguards ventilation.
7. Addition of Turbine Building basement ventilation as a support system for station and instrument air compressor G.

8. Addition of Screenhouse ventilation to the model as a support system for service water.

Of these changes, the majority of the risk reduction was due to items 2 and 4 above. The database update (item 2 above) resulted mostly in decreases to component failure probabilities. The largest effect was in the Auxiliary Feedwater System, where lower failure rates resulted in a decrease of importance. The change to the flooding failure height for the Turbine Building basement fan coil unit B breaker (item 4 above) resulted in a decreased importance for service water train A floods in the Auxiliary Building. These floods result in a loss of all safeguards alley ventilation if the breaker to the Turbine Building fan coil unit B fails due to submergence.

The aggregate effects of the above changes are include in the tables of the response to question 1.f.iii.

Table 1.f.i-1 provides the evolution of the Kewaunee PRA model from the Individual Plant Examination (IPE) to the present.

Table 1.f.i-1: Kewaunee PRA Historical Summary

Version	Description/changes from previous model	CDF	LERF
IPE	Original IPE	6.6×10^{-5}	NC
Revised IPE 6/1996	Revised in Response to RAIs, including new Human Reliability Analysis	1.1×10^{-4}	NC
1/1997	Major changes included: - Credited operator to refill RWST - Modeled alternate cooling for air compressors	3.9×10^{-5}	2.2×10^{-6}
4/1998	Removed asymmetric modeling	3.6×10^{-5}	1.9×10^{-6}
12/2001	- Converted from GRAFTER code to WinNUPRA code - Incorporated plant failure and initiating event data - Included consideration of replacement SGs. - Reviewed in 6/2002 Westinghouse Owners Group peer review	4.1×10^{-5}	4.8×10^{-6}
8/2003	- WOG seal LOCA model incorporated - Important Human Error Probabilities reevaluated - Level 2 success criteria updated for power uprate - Medium LOCA and ISLOCA models updated - Steam line break analysis revised to include pressurized thermal shock - Quantitative shutdown model added - Numerous peer review comments resolved	3.0×10^{-5}	5.3×10^{-6}

Table 1.f.i-1: Kewaunee PRA Historical Summary			
Version	**Description/changes from previous model**	**CDF**	**LERF**
12/2004	- Added need to stop safety injection following steam line break - Added dependence of letdown on component cooling water - Power recovery and 480 VAC bus cross-ties added - Success criteria updated to include power uprate - Revised internal flooding model incorporated	7.2×10^{-4}	5.0×10^{-6}
K101A 6/2006	- Incorporated new internal flooding model which included plant changes to address flooding concerns - Incorporated revised diesel generator reliability data - Incorporated reactor coolant system cooldown and depressurization following RCP seal LOCA to avoid core damage	2.7×10^{-4}	5.7×10^{-6}
K101AA 10/2006	- Incorporated flood barriers to protect RHR pumps - Incorporated operator actions to address flooding of battery room, AFW room and switchgear room ventilation - Incorporated procedure changes addressing service water isolation - Removed other isolation conservatisms	1.3×10^{-4}	7.0×10^{-6}
K101AASAMA 11/2006	One time only model for SAMA. Updates were carried through to future revisions as specified - Restructured Level 1 event trees to support revised Level 2 model - Revised service water model for some internal flooding sequences - Incorporated planned internal flooding design changes	7.7×10^{-5} (8.1×10^{-5})	9.5×10^{-6} (9.9×10^{-6})
K101AB 5/2007	Update to K101AA - Revised service water model for some internal flooding sequences Note: internal flooding modifications are not in this model in any form	1.1×10^{-4}	5.7×10^{-6}
K107A 8/2007	Subjected to independent review 1/2008 - Updated database - Updated internal flooding model to remove conservatisms - Restructured Level 1 event trees to support revised Level 2 model Note: internal flooding modifications are not in this model in any form	7.6×10^{-5}	9.8×10^{-6}
K107Aa 7/2008	Updated model to "as- installed" configuration of internal flooding modifications included in K101AASAMA model.	4.8×10^{-5}	6.4×10^{-6}
K107AaILRT 7/15/2008	Re-evaluated few significant conservative operator actions	4.2×10^{-5} (4.3×10^{-5})	4.9×10^{-6} (4.9×10^{-6})

NC - Not Calculated
Values in parentheses are sum of sequence frequencies and include some non-minimal cutsets

Response to 1.f.ii

Using the guidance provided in NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives Analysis—Guidance Document," the SAMA submittal included a description of the reviews that were performed since the IPE. For example, a Peer Review (Certification) of the Kewaunee PRA model, using the WOG Peer Review Certification Guidelines, was performed in June 2002. Also, in a continuous effort to improve PRA quality, an independent assessment of the Kewaunee PRA has been performed against the requirements of the ASME PRA standard (ASME RA-Sa-2003). An assessment of the potential impact of "Not Met" SRs on the SAMA analysis is provided below.

The independent assessment was performed by a team from Maracor Software and Engineering, Inc. (MSE) and the Dominion PRA group. The primary assessment responsibilities resided with the MSE staff, with the results of the assessment reviewed by Dominion staff.

The scope of this assessment was to compare the current PRA model, K107Aa, against ASME RA-Sa-2003 to determine if each of the requirements of Capability Category II had been met and sufficiently documented. The approach of the assessment was to develop a comprehensive list of all potential areas for improvement and to pursue model enhancement by conservatively characterizing a SR as "Not Met" if one or more areas for improvement were identified. This conservative philosophy is different than that which is used for PRA model peer reviews that are performed in accordance with NEI 05-04, Revision 2, "Process for Performing PRA Peer Reviews Using the ASME PRA Standard (Internal Events)," where "findings" and "suggestions" are used to characterize such observations. Using this conservative philosophy, the assessment characterized several SRs as not meeting Capability Category II requirements. Based on a comparison of the findings and suggestions listed in the assessment report with the guidance in NEI 05-04, it was determined that many of the instances where a SR was indicated as "Not Met" could have been characterized as a "suggestion."

Due to the scope (i.e., focus on Capability Category II requirements) and the conservative nature of the assessment, the "Not Met" SRs were reviewed to:

- Identify those "Not Met" SRs that do not have an impact on the risk insights provided in support of SAMA (e.g., documentation only issues).
- Identify potential sensitivity studies that can be performed to ensure that the risk insights are not significantly affected by the "Not Met' findings.

As a result of this review, the following conclusions were reached:

1. Most "Not Met" SR issues pertained to documentation only. A review of the "Not Met" SRs by the MSE lead engineer concluded that the majority of the "Not Met" SRs were characterized as such solely because of documentation issues.

Enhancements to the documentation would not change the model and, therefore, would have no impact on the SAMA analysis.

2. A number of "Not Met" SRs were related to initiating event identification, such as the process used to identify plant systems that have the potential to cause an initiating event. However, although new initiating events may have been identified, based on the MSE experience with these types of "Not Met" SRs for other plant IPEs, it is judged that 1) the accident progression for these potential initiating events is similar to the progression for initiating events already included in the model, and 2) the frequency of these newly identified initiating events is lower than the existing initiating event frequencies. Therefore, the impact on the SAMA analysis (from either identification or cost points of view) is negligible. It should be noted that one of the Initiating Event (IE) related items was concerned with not considering the specific cues that would be present for loss of HVAC events in Safeguards Alley. Several SAMA items related to HVAC in Safeguards Alley were evaluated in the SAMA analysis. Therefore, it is expected that resolving this group of "Not Met" SRs would not alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

3. A number of additional "Not Met" SRs pertained to the Accident Sequence (AS) element. One issue that resulted in characterizing an AS-related SR as not meeting Capability Category II is that the basis for some system success criteria is not documented and that, as a result of developing the documentation, changes could occur. No expected changes or outliers were identified, so resolution of this item likely would not impact the SAMA results. Three of these "Not Met" SRs related to the completeness of accident sequence modeling, but these items were for insignificant sequences, e.g., ATWS after a LOCA. Another item was that sources of uncertainty were not documented. Based on the discussion above, it is not expected that resolving the "Not Met" SRs that pertain to the AS element with model changes would alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

4. A few "Not Met" SRs were assessed to have no impact on the CDF/LERF estimate. For example, the AS-A6 SR is characterized as "Not Met" because reviewers found that, although the sequence of top events shown on the event trees follows the expected accident sequence, the High Pressure Injection (HPI) node in the Station Blackout event trees follows the initiating event, but prior to secondary decay heat removal. This sequence was assessed to have a minimal impact on the CDF/LERF results on the basis that the ordering of the top events; 1) was determined by the original reviewers to be adequate in almost all cases, and 2) in one instance, based on discussion with the Kewaunee PRA Engineer and a sensitivity run, the reviewers concluded that the sequence is not critical. Therefore, the sequence does not change the CDF/LERF results.

5. Additional "Not Met" SRs pertained to the Systems (SY) element. These SRs were related to the need for HVAC as a support system. The Kewaunee models were changed to require HVAC for all systems unless a clear and documented basis for

not needing HVAC was available. SAMA items related to important HVAC systems were included in the SAMA analysis. Therefore, it is not expected that resolving the "Not Met" SRs for the SY element with model changes would alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

6. Certain "Not Met" SRs were related to identification, screening, and modeling of pre-initiator operator errors. Numerous pre-initiator operator errors are included in the PRA model. Although a rigorous analysis of such events could result in the identification of additional items, pre-initiator operator errors are typically not important to the overall PRA results so it is not expected that resolving the "Not Met" SRs for the pre-initiator Human Reliability (HR) element with the potential for model changes would alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

7. A number of "Not Met" SRs were related to post-initiator operator actions. None of these items noted any major weaknesses, so it is not expected that resolving the "Not Met" SRs for the post-initiator HR element with the potential for model changes would alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

8. A number of "Not Met" items were related to internal flooding and are discussed below. However, it should be noted that since Dominion has implemented a number of plant modifications in the last few years to reduce the flooding hazard at Kewaunee, it is judged that these potential modeling issues are not significant.

   One potential "Not Met" SR issue is that pipe whip was not considered. Since all active components, located in a room where flooding begins are assumed failed, pipe whip would only change accident progression if a high-energy pipe were located near a passive component and the whip could impact the pressure boundary of that component. It is unlikely that such cases would be significant.

   Another "Not Met" SR related to flooding was that barrier unavailability was not considered. Flood barriers that are credited at Kewaunee are not easily or routinely removed and no change to the overall results is expected if flood barrier unavailability was considered.

   A third "Not Met" SR is that parametric uncertainty data for flooding events was not available. Although resolving this item could change uncertainty distributions, it would not change the point estimate results used to evaluate potential benefits.

   The last "Not Met" SR was that documentation for quantification of internal flooding needs to be enhanced in accordance with the requirements of the Quantification (QU) High Level Requirements (HLR). Because internal flooding events are included in the model, they were considered in the SAMA analysis. Therefore, it is not expected that resolving the "Not Met" SRs for the Internal Flooding (IF) element with the potential for model changes would alter the findings of the SAMA analysis presented in LRA Appendix E, Attachment F.

In conclusion, a review of the "Not Met" SRs does not change to conclusions of the SAMA analysis.

Response to 1.f.iii

A listing of basic events with a Fussell-Vesely importance of greater than 0.5% with respect to CDF is shown in Table 1.f.iii-1. For each basic event in this table that appeared in LRA Appendix E, Attachment F, Table F-3, the item number of Table F-3 is listed. Each basic event that did not appear in Table F-3 has been evaluated to determine if an existing SAMA item could result in a reduction in risk presented by the event or if a new SAMA could be identified.

A listing of basic events with a Fussell-Vesely importance of greater than 0.5% with respect to LERF is shown in Table 1.f.iii-2. For each basic event in this table that appeared in LRA Appendix E, Attachment F, Table F-8, the item number of Table F-8 is listed. Each basic event that did not appear in Table F-8 has been evaluated to determine if an existing SAMA item could result in a reduction in risk presented by the event or if a new SAMA could be identified.

The results of the evaluations show that one contributor to risk in the current model, loss of Screenhouse ventilation, was not included in the PRA results produced by the model used in the original SAMA analysis. To mitigate the potential risk posed by a loss of Screenhouse ventilation, a SAMA item to provide temporary Screenhouse ventilation could be proposed.

The goal of SAMA items 81, 82, 83, 160, 166, 167, 170, and 171 is to mitigate the chance of losing ventilation to the emergency diesel generator rooms, 480 VAC switchgear rooms, and safeguards alley rooms and, if a loss of HVAC occurs, to improve the ability to detect and mitigate such a loss. These SAMAs would install alarms to detect high room temperatures and provide temporary ventilation equipment and procedures to be used following a loss of installed ventilation equipment serving the rooms.

At Kewaunee, the Screenhouse is accessed through safeguards alley and any temporary ventilation to the electrical or safeguards alley area would likely draw cool air from the Screenhouse into the electrical and safeguards alley areas. As discussed in LRA Appendix E, Attachment F, Section F.7.7, synergies may be possible if the SAMA items described above are implemented concurrently. Although it would seem that a SAMA to provide temporary Screenhouse ventilation could be implemented independently, the physical arrangement of structures at Kewaunee causes concurrent implementation to be impractical. That is, providing temporary ventilation to the Screenhouse areas would require the addition of only one or two additional temperature detectors in addition to those required to implement the SAMA items for safeguards alley and the electrical areas. As a result, it is concluded that the SAMA items to implement temporary ventilation for safeguards alley mentioned above should include the provision of temporary ventilation for the Screenhouse and that implementing these items could be cost beneficial.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
1	IE-TRA	1.10E+00	1.94E-01	TRANSIENT WITH MAIN FEEDWATER AVAILABLE OCCURS	9
2	MULT-TAV	1.50E-02	1.46E-01	MULTIPLIER FOR TAV FRACTION OF YEAR SUBJECT TO HI TEMPS	This event indicates the fraction of time during the year when outside air temperatures are high enough that Screenhouse ventilation is required. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.
3	LOSP-24	3.39E-03	1.26E-01	LOSS OF ALL POWER FROM GRID DURING 24 HOURS	2
4	IE-SGTR	3.80E-03	9.60E-02	STEAM GENERATOR TUBE RUPTURE OCCURS	13
5	27A-OR2----RDHE	1.41E-01	7.44E-02	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - SGTR	22
6	06--OC4------HE	1.85E-01	6.94E-02	OPERATOR FAILS TO CD AND DEPRES RCS IN ECA-3.1/3.2	25
7	IE-LOSP	3.74E-02	6.70E-02	LOSS OF OFFSITE POWER OCCURS	19
8	16-FNEKPSCCF12	1.53E-04	6.66E-02	DOUBLE COMMON CAUSE FAILURE (CCF) SCREEN HOUSE EXHAUST FANS FAIL TO START	This event indicates a failure of both sceenhouse exhaust fans due to common cause. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
9	05B-CST-DIAG-HE	8.66E-04	6.40E-02	OPERATOR FAILS TO DIAGNOSE NEED FOR ALTERNATE AFW SRC	3
10	06--OC3------HE	2.33E-02	5.66E-02	OPERATOR FAILS TO CD AND DEPRES RCS TO STOP TUBE LEAK	30
11	10-GE-DG1A---PR	1.65E-02	4.64E-02	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO RUN	16
12	36--LHS-DIAG-HE	1.73E-03	4.63E-02	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK	32
13	10-GE-DG1A---TM	1.70E-02	4.11E-02	DIESEL GENERATOR A UNAVAILABLE DUE TO TEST OR MAINTENANCE	29
14	IE-TSW	3.65E+02	3.66E-02	MULTIPLIER FOR LOSS OF SERVICE WATER IE FREQUENCY	43
15	36--LHS-DEP--HE	1.00E-06	3.61E-02	OPERATOR ERRORS LEAD TO LOSS OF HEAT SINK	59
16	34—RHR------HE	8.24E-02	3.60E-02	OPERATOR FAILS TO ESTABLISH RHR	78
17	10-GE-DG1B---PR	1.65E-02	3.27E-02	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO RUN	34
18	16-DMEKFOCCF12	7.25E-05	3.15E-02	DOUBLE COMMON CAUSE FAILURE (CCF) TAV-63A/B FO	This event indicates a failure of both Screenhouse exhaust dampers due to common cause. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
19	02-SWHDRISOXPHE	1.48E-02	2.85E-02	OPERATOR FAILS TO ISOLATE MODERATE SW BREAK IN BATTERY RM	53
20	IE-TMF	1.13E-01	2.83E-02	LOSS OF MAIN FEEDWATER OCCURS	55
21	10-GE-DG1B---TM	1.70E-02	2.74E-02	DIESEL GENERATOR B UNAVAILABLE DUE TO TEST OR MAINTENANCE	66
22	05BPT—AFW1C-PS	1.13E-02	2.72E-02	INDEPENDENT FAILURETD AFW PUMP FAILS TO START	21
23	36--OBF------HE	2.45E-02	2.63E-02	OPERATOR FAILS TO ESTABLISH BLEED AND FEED	27
24	35--CH2------HE	1.16E-01	2.46E-02	OPERATOR FAILS TO ESTABLISH CHARGING FLOW DURING SBO	60
25	SL76	8.00E-01	2.41E-02	SMALL REACTOR COOLANT PUMP SEAL LOCA (21,57,76 GPM)	63
26	IE-SB-8B--U	3.30E-03	2.39E-02	MODERATE TRAIN B SW PIPE BREAKS IN ROOM 8B	11
27	05BFAFWB-CAL-AE	8.16E-04	2.39E-02	TECHNICIAN MISCALIBRATES AFW TRAIN B FLOW	64
28	05BFAFWA-CAL-AE	8.16E-04	2.39E-02	TECHNICIAN MISCALIBRATES AFW TRAIN A FLOW	65
29	10-GE-KPRCCF12	1.02E-03	2.37E-02	DOUBLE COMMON CAUSE FAILURE (CCF) EDGS FAIL TO RUN	44
30	05B-DOOR-AFW-HE	6.09E-03	2.27E-02	OPERATOR FAILS TO OPEN DOORS TO AFW ROOM B FOR VNTLTN	14
31	04--LO-LEVEL-FB	9.91E-04	2.26E-02	LOW FOREBAY LEVEL	114

Table 1.f.iii-1: Basic Event Importance with Respect to CDF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-3 or Disposition**
32	IE-S-5B14-M	1.05E-06	2.25E-02	MAJOR FLOOD FROM SW HEADER IN SAFEGUARDS ALLEY	77
33	IE-W-5B24-U	1.29E-04	2.20E-02	AFW PIPE FLOOD IN SAFEGUARDS ALLEY EXCEEDS DRAIN CAPAC	61
34	IE-SB-403-U	4.47E-03	2.12E-02	SW TRAIN B FLOOD IN ROOM 403	45
35	02-SWHDRISOXEHE	2.89E-02	1.95E-02	OPERATOR FAILS TO ISOLATE MAJOR SW BREAK IN SCREENHOUS	104
36	IE-SOPORV	4.29E-02	1.92E-02	STUCK OPEN PORV OCCURS	42
37	IE-SB-5B--U	8.97E-07	1.92E-02	TRAIN B SW FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	40
38	IE-W-5B24-S	2.34E-04	1.91E-02	AFW PIPE FLOOD IN SAFEGUARDS ALLEY WITHIN DRAIN CAPAC.	84
39	IE-F--2B--M	1.12E-05	1.89E-02	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 2B	111
40	SUCC-CHG	8.08E-01	1.87E-02	CHARGING SUCCESS	This event represents the probability that charging will be successful after recovery of offsite power on blackout sequences. This event is analogous to item 69 of LRA Appendix E, Attachment F, Table F-3.
41	33--2TRN-REC-HE	2.13E-02	1.84E-02	OPERATOR FAILS TO ESTABLISH RECIRC (1 OF 2 TRAINS)	70
42	27A-ORR------HE	9.21E-02	1.80E-02	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - NO CD	23
43	49-ROD-MECH--FA	1.80E-06	1.78E-02	CONTROL RODS FAIL TO DROP INTO THE CORE	109

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
44	AC-0221	2.68E-01	1.78E-02	OFFSITE POWER NOT RECOVERED WITHIN 2 HOURS, 21 MINUTES	73
45	05BPT—AFW1C-TM	7.42E-03	1.76E-02	TD AFW PUMP UNAVAILABLE DUE TO TEST OR MAINTENANCE	105
46	02-PMRKPRCCF1-4	1.76E-07	1.75E-02	GLOBAL FAILURE OF SW PUMPS TO RUN	52
47	10-GE-DG1A---PS	6.12E-03	1.67E-02	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO START	56
48	IE-SLO	2.45E-03	1.66E-02	SMALL BREAK LOSS OF COOLANT ACCIDENT OCCURS	67
49	IE-SL-5B1-S	1.24E-03	1.64E-02	LOCALLY ISOL SW FLD IN ROOM 5B-1 WITHIN DRAIN CAPACITY	Spray shields were placed over piping in safeguards alley that could not be locally isolated to stop a flooding event. This is a new initiating event developed after completing this modification to evaluate the risk from breaks of locally-isolable piping. This event is important to core damage because of the potential for propagation to other rooms in safeguards alley. SAMA item 176 in LRA Appendix E, Attachment F, Table F-17 would address this issue.
50	05BPMOKPSCCF123	5.66E-05	1.58E-02	TRIPLE COMMON CAUSE FAILURE (CCF) ALOP-1A/1B/1C PS	68
51	IE-SA-129-U	4.61E-05	1.51E-02	TRAIN A SW FLOOD IN ROOM 129 EXCEEDS DRAIN CAPACITY	89
52	IE-SB-130-U	4.39E-05	1.41E-02	TRAIN B SW FLOOD IN ROOM 130 EXCEEDS DRAIN CAPACITY	97

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
53	36--SGTRDIAG-HE	1.12E-03	1.39E-02	OPERATOR FAILS TO DIAGNOSE SGTR	110
54	IE-SB-156-S	2.72E-03	1.35E-02	SMALL TRAIN B SW PIPE BREAKS IN ROOM 156	24
55	47-RERKRBCCF1-8	1.37E-05	1.33E-02	GLOBAL FAILURE OF RX TRP RLYS (BOUND)	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and Chemical and Volume Control Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
56	49-CB-KFOCCF12	1.29E-05	1.26E-02	DOUBLE COMMON CAUSE FAILURE (CCF) CB-RTA/RTB FO	48
57	SL182	1.98E-01	1.23E-02	MEDIUM REACTOR COOLANT PUMP SEAL LOCA (182 GPM)	86
58	AC-1632	2.74E-02	1.21E-02	OFFSITE POWER RECOVERED WITHIN 16 HOURS, 32 MINUTES	117
59	IE-W--14B-U	1.51E-04	1.20E-02	MODERATE BREAK FROM AFW PIPE IN ROOM 14B	49
60	IE-F--4B--M	6.93E-06	1.18E-02	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 4B	142

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	*Corresponding Item from Table F-3* or Disposition
61	08-FPHDRISOX8HE	1.00E+00	1.18E-02	OPERATOR FAILS TO ISOLATE A MAJOR FP BREAK IN ROOM 4B	143
62	IE-SB-14B-S	1.55E-03	1.18E-02	SPRAY EVENT FROM TRAIN B SW IN AUX BUILDING BASEMENT	81
63	10-GE-DG1B---PS	6.12E-03	1.17E-02	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO START	98
64	IE-TIA	3.65E+02	1.11E-02	MULTIPLIER FOR LOSS OF INSTRUMENT AIR IE FREQUENCY	96
65	27A-RMST-CST-HE	1.24E-03	1.10E-02	OPERATOR FAILS TO CROSS-TIE CSTS AND RMSTS	103
66	PORV-A	5.00E-01	1.08E-02	STUCK OPEN PORV IS PR-2A	71
67	02-SWHDRISOXBHE	2.90E-03	1.07E-02	OPERATOR FAILS TO ISOLATE A MOD. SW BRK IN SGA BEF 9"	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 76 of LRA Appendix E, Attachment F, Table F-3 is analogous to this event for the SAMA model. SAMA item 176 would similarly address this new basic event.
68	06--IS2------HE	4.28E-03	1.03E-02	OPERATOR FAILS TO ISOLATE 1 OF 2 STEAM GENERATORS	129
69	UET-2PORVS	1.62E-01	1.02E-02	UNFAVORABLE EXPOSURE TIME FOR 2 PORVS AVAILABLE	147
70	IE-TCC	3.65E+02	1.02E-02	MULTIPLIER FOR LOSSOF COMPONENT COOLING IE FREQ	10

Table 1.f.iii-1: Basic Event Importance with Respect to CDF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-3 or Disposition**
71	05B-AFW-ISO-8-HE	3.59E-03	9.95E-03	OPERATOR FAILS TO ISOLATE A MODERATE AFW LEAK BEF 9"	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 87 of LRA Appendix E, Attachment F, Table F-3 is analogous to this event for the SAMA model. SAMA item 176 would similarly address this new basic event.
72	06--OC2------HE	4.72E-02	9.63E-03	OPERATOR FAILS TO CD AND DEPRES RCS FOR CHARGING	119
73	IE-SA-301-U	2.73E-03	9.35E-03	TRAIN A SW FLOOD IN ROOM 301	128

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
74	IE-S--4B--U	1.73E-03	9.31E-03	SERVICE WATER FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	A moderate service water pipe break in the Cardox room rapidly propagates to the B-train switchgear room and causes a loss of offsite power. The dominant accident sequences for this event involve failure of the A-train diesel generator thereby resulting in a station blackout. The Kewaunee PRA models assume that any internal flooding event that results in a station blackout results in core damage. However, detailed evaluation of station blackout events would likely show that some mitigation of flood-induced station blackouts could occur, thereby decreasing the importance of this event. Since this event is of low importance and more detailed modeling of existing procedures and equipment would lessen the importance, no SAMA items are developed from this event.
75	IE-SA-2B--M	5.39E-06	9.08E-03	MAJOR FLOOD FROM SW TRAIN A IN ROOM 2B	118
76	27A-OR2----LDHE	1.51E-01	8.54E-03	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - SLO	125
77	33--ORI------HE	1.50E-02	8.47E-03	OPERATOR FAILS TO RESTORE RCS INVENTORY IN SBO	140
78	PORV-B	5.00E-01	8.40E-03	STUCK OPEN PORV IS PR-2B	93

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
79	IE-ST-5B--S	8.74E-04	8.40E-03	SW TURBINE HDR FLOOD IN ROOM 5B WITHIN DRAIN CAP	Spray shields were placed over piping in safeguards alley that could not be locally isolated to stop a flooding event. This is a new initiating event developed after completing this modification to evaluate the risk from breaks of locally-isolable piping. This event is important to core damage because of the potential for propagation to other rooms in safeguards alley. SAMA item 176 in LRA Appendix E, Attachment F, Table F-17 would address this issue.
80	02-SWHDRISOXGHE	1.30E-02	8.33E-03	OPERATOR FAILS TO ISOLATE A MAJOR SW BRK IN ROOM 156	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 31 of LRA Appendix E, Attachment F, Table F-3 is analogous to this event for the SAMA model. SAMA item 176 would similarly address this new basic event.
81	AC-0715	7.64E-02	8.25E-03	OFFSITE POWER NOT RECOVERED WITHIN 7 HOURS, 15 MINUTES	139
82	IE-SB-22B2M	1.32E-05	8.23E-03	MAJOR FLOOD FROM SW TRAIN B IN ROOM 22B-2	131
83	IE-SA-22B1M	1.31E-05	8.17E-03	MAJOR FLOOD FROM SW TRAIN A IN ROOM 22B-1	This event would have similar consequences to the event shown immediately above (item 82). SAMA item 182 would address this event.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-3 or Disposition**
84	16-DMIKFOCCF1-4	1.85E-05	8.02E-03	GLOBAL FAILURE TAV-60A1/A2/B1/B2 FAILS TO OPEN	This event indicates a failure of all Screenhouse roof intake dampers due to common cause. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.
85	10-GE-DG1A---FL	2.86E-03	7.60E-03	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO LOAD	102
86	IE-SA-8B--U	2.17E-03	7.51E-03	MODERATE TRAIN A SW PIPE BREAKS IN ROOM 8B	8
87	IE-SB-5B3-U	1.10E-04	7.42E-03	TRAIN B SW FLOOD IN ROOM 5B-3 EXCEEDS DRAIN CAPACITY	106
88	IE-SLB	6.17E-03	7.32E-03	STEAM OR FEEDWATER LINE BREAK OCCURS	135

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
89	47-CNRKRCCCF1-8	7.41E-06	7.18E-03	GLOBAL FAILURE OF RX TRP RLYS (CNTCS)	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
90	IE-ISL	1.00E+00	7.12E-03	INTERFACING SYSTEM LOSS OF COOLANT ACCIDENT OCCURS	This event is a tag event to indicate cutsets that result for interfacing systems LOCAs. The basic event itself does not represent any physical failures so no SAMA items could be identified to lessen the importance of this event specifically. SAMA items to mitigate specific contributions to ISLOCA are identified in items 111 through 118 in LRA Appendix E, Attachment F, Table F-17.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
91	16-SVAKFCCCF35	1.64E-05	7.11E-03	DOUBLE COMMON CAUSE FAILURE (CCF) SOVS-33774,454,455	This event indicates a failure of solenoids in the Screenhouse ventilation system. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.
92	16-SVAKFCCCF23	1.64E-05	7.11E-03	DOUBLE COMMON CAUSE FAILURE (CCF) SOVS-33732,733,774,	This event indicates a failure of solenoids in the Screenhouse ventilation system. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.
93	IE-VEF	3.22E-07	6.91E-03	VESSEL FAILURE OCCURS	80
94	05BPMSKPSCCF123	2.50E-05	6.86E-03	TRIPLE COMMON CAUSE FAILURE (CCF) AFW-1A/1B/TD PS	54
95	27AXV-DW20---FO	4.80E-04	6.83E-03	MANUAL VALVE DW-20 FAILS TO CLOSE	This event is related to failure to provide an alternate source of water to the CSTs. Item 103 in LRA Appendix E, Attachment F, Table F-3 is also related to CST makeup. A SAMA item to mitigate inadequate AFW suction is addressed under item 71 in LRA Appendix E, Attachment F, Table F-17.
96	27A-OR2------HE	9.63E-02	6.80E-03	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST-WITH CD	132

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
97	IE-SA-14B-S	1.45E-03	6.73E-03	SPRAY EVENT FROM TRAIN A SW IN AUX BUILDING BASEMENT	123
98	IE-SB-2B--M	3.08E-07	6.61E-03	MAJOR FLOOD FROM SW TRAIN B IN ROOM 2B	A major rupture of the service water pipe in the A-train switchgear room causes a loss of the A-train switchgear and leads to a loss of offsite power. The dominant contributors to accident sequences following this event are failures of the B-train diesel. Providing a path for water to leave the room before level reaches 18 inches would preclude a loss of offsite power and minimize the need for the B-train diesel generator. Refer to SAMA item 181.
99	31-PM-KPRCCF12	6.96E-06	6.56E-03	DOUBLE COMMON CAUSE FAILURE (CCF) CCW-1A/-1B PR	26
100	STBY-ABBFD	5.00E-01	6.56E-03	AUX BLDG BSMT FAN COIL UNIT D IS IN STANDBY	127
101	10-GE-KPSCCF12	2.75E-04	6.25E-03	DOUBLE COMMON CAUSE FAILURE (CCF) EDGS FAIL TO START	126
102	10-GE-TSC-DG-PR	3.06E-02	6.20E-03	TSC DIESEL GENERATOR FAILS TO RUN	148
103	33-PM-KPSCCF12	2.35E-04	6.07E-03	DOUBLE COMMON CAUSE FAILURE (CCF) 33-PM-KPSCCF12	Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added.
104	IE-SA-403-U	4.65E-03	6.06E-03	SW TRAIN A FLOOD IN ROOM 403	149
105	05BMVI-MS102-FO	2.66E-03	6.02E-03	MOV MS-102 FAILS TO OPEN	145

Table 1.f.iii-1: Basic Event Importance with Respect to CDF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-3 or Disposition**
106	PORV-CHALLENGE	2.08E-02	5.95E-03	PORV IS CHALLENGED BY THE INITIATOR	Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added.
107	02-SWHDRISOX7HE	1.00E+00	5.89E-03	OPERATOR FAILS TO ISOLATE A MAJOR SW BREAK IN DG A ROOM	120
108	39-CB-KFCCCF12	1.22E-04	5.86E-03	DOUBLE COMMON CAUSE FAILURE (CCF) BKRS 307, 407 FTO	Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added.
109	IE-TDA	3.65E+02	5.61E-03	MULTIPLIER FOR LOSS OF 125 V DC BUS BRA-104 IE FREQ	133
110	16-FNAKPRCCF123	3.12E-06	5.60E-03	TRIPLE COMMON CAUSE FAILURE (CCF) AFWA, TBBAB FCU FTR	18
111	02-SWHDRISOX6HE	3.45E-02	5.54E-03	OPERATOR FAILS TO ISOLATE A MOD. SW BRK IN ROOM 5B	39
112	IE-W--8B5-U	6.38E-05	5.51E-03	MODERATE BREAK FROM AFW PIPE IN ROOM 8B5	This initiating event leads to core damage due to flood-induced failure of equipment needed to maintain RCP seal cooling, specifically, failure of MCCs 52E, 62E, and 62H. Loss of these MCCs leads to a loss of charging pumps and a loss of ventilation needed to ensure continued functioning of CCW pumps. Refer to SAMA item 169.
113	IE-SB-5B3-S	8.05E-04	5.46E-03	TRAIN B SW FLOOD IN ROOM 5B-3 WITHIN DRAIN CAPACITY	113

Table 1.f.iii-1: Basic Event Importance with Respect to CDF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-3 or Disposition**
114	10-GE-DG1B---FL	2.86E-03	5.24E-03	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO LOAD	This basic event represents a failure of the same effect addressed in items 10 and 13 above. No new SAMA items would be generated as a result of this event.
115	IE-F--2B--U	4.62E-05	5.19E-03	FIRE PROTECTION FLOOD < 2000 GPM IN ROOM 2B	A moderate rupture of the fire protection water pipe in the A-train switchgear room causes a loss of the A-train switchgear and leads to a loss of offsite power. The dominant contributors to accident sequences following this event are failures of the B-train diesel. Providing a path for water to leave the room before level reaches 18 inches would preclude a loss of offsite power and minimize the need for the B-train diesel generator. Refer to SAMA item 181.
116	IE-SA-156-M	1.67E-05	5.15E-03	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 156	This initiating event leads to core damage due to flood-induced failure of equipment needed to maintain RCP seal cooling, specifically, failure of MCCs 52E, 62E, and 62H. Loss of these MCCs leads to a loss of charging pumps and a loss of ventilation needed to ensure continued functioning of CCW pumps. Refer to SAMA item 169.

Table 1.f.iii-1: Basic Event Importance with Respect to CDF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-3 or Disposition
117	03-CVS-MU301-FO	4.23E-05	5.13E-03	CHECK VALVE MU-301 FAILS TO OPEN	This event is related to failure to provide water from the CSTs to AFW. A SAMA item to mitigate inadequate AFW suction is addressed under item 71 in LRA Appendix E, Attachment F, Table F-17.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
1	LERF-02	1.42E-01	4.24E-01	LARGE EARLY RELEASE FREQUENCY FOR PLANT DAMAGE STATE 2	This basic event is a flag-type of event used to facilitate the overall quantification and represents no physical failures. No SAMA items are generated as a result of this basic event.
2	LERF-62	1.00E+00	2.90E-01	LARGE EARLY RELEASE FREQUENCY FOR PLANT DAMAGE STATE 62	This basic event is a flag-type of event used to facilitate the overall quantification and represents no physical failures. No SAMA items are generated as a result of this basic event.
3	IE-SGTR	3.80E-03	2.75E-01	STEAM GENERATOR TUBE RUPTURE OCCURS	3
4	LERF-30	2.35E-01	2.67E-01	LARGE EARLY RELEASE FREQUENCY FOR PLANT DAMAGE STATE 30	This basic event is a flag-type of event used to facilitate the overall quantification and represents no physical failures. No SAMA items are generated as a result of this basic event.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
5	27A-OR2----RDHE	1.41E-01	1.61E-01	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - SGTR	9
6	05B-CST-DIAG-HE	8.66E-04	1.05E-01	OPERATOR FAILS TO DIAGNOSE NEED FOR ALTERNATE AFW SRC	1
7	06--OC4------HE	1.85E-01	1.02E-01	OPERATOR FAILS TO CD AND DEPRES RCS IN ECA-3.1/3.2	15
8	36--SGTRDIAG-HE	1.12E-03	1.00E-01	OPERATOR FAILS TO DIAGNOSE SGTR	12
9	LOSP-24	3.39E-03	9.64E-02	LOSS OF ALL POWER FROM GRID DURING 24HOURS	7
10	IE-LOSP	3.74E-02	7.84E-02	LOSS OF OFFSITE POWER OCCURS	17
11	06--IS2------HE	4.28E-03	7.47E-02	OPERATOR FAILS TO ISOLATE 1 OF 2 STEAM GENERATORS	19
12	34--RHR------HE	8.24E-02	7.42E-02	OPERATOR FAILS TO ESTABLISH RHR	21
13	IE-TRA	1.10E+00	7.16E-02	TRANSIENT WITH MAIN FEEDWATER AVAILABLE OCCURS	11
14	36--LHS-DIAG-HE	1.73E-03	4.89E-02	OPERATOR FAILS TO DIAGNOSE LOSS OF HEAT SINK	31
15	IE-S-5B14-M	1.05E-06	4.50E-02	MAJOR FLOOD FROM SW HEADER IN SAFEGUARDS ALLEY	37
16	10-GE-DG1B---PR	1.65E-02	4.46E-02	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO RUN	27
17	SL76	8.00E-01	4.21E-02	SMALL REACTOR COOLANT PUMP SEAL LOCA (21,57,76 GPM)	33
18	10-GE-DG1A---PR	1.65E-02	3.82E-02	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO RUN	25

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
19	10-GE-DG1B---TM	1.70E-02	3.77E-02	DIESEL GENERATOR B UNAVAILABLE DUE TO TEST OR MAINTENANCE	52
20	36--LHS-DEP--HE	1.00E-06	3.73E-02	OPERATOR ERRORS LEAD TO LOSS OF HEAT SINK	50
21	05BPT--AFW1C-PS	1.13E-02	3.52E-02	INDEPENDENT FAILURE TD AFW PUMP FAILS TO START	16
22	02-SWHDRISOXEHE	2.89E-02	3.34E-02	OPERATOR FAILS TO ISOLATE MAJOR SW BREAK IN SCREENHOUS	93
23	IE-ISL	1.00E+00	3.31E-02	INTERFACING SYSTEM LOSS OF COOLANT ACCIDENT OCCURS	69
24	33-PM-KPSCCF12	2.35E-04	3.29E-02	DOUBLE COMMON CAUSE FAILURE (CCF) 33-PM-KPSCCF12	83
25	10-GE-DG1A---TM	1.70E-02	3.10E-02	DIESEL GENERATOR A UNAVAILABLE DUE TO TEST OR MAINTENANCE	36
26	10-GE-KPRCCF12	1.02E-03	3.09E-02	DOUBLE COMMON CAUSE FAILURE (CCF) EDGS FAIL TO RUN	32
27	35--CH2------HE	1.16E-01	3.08E-02	OPERATOR FAILS TO ESTABLISH CHARGING FLOW DURING SBO	38
28	02-SWHDRISOXPHE	1.48E-02	2.92E-02	OPERATOR FAILS TO ISOLATE MODERATE SW BREAK IN BATTERY RM	43
29	FAULT-B	5.00E-01	2.86E-02	STEAM GENERATOR B IS FAULTED	54
30	36--OBF------HE	2.45E-02	2.84E-02	OPERATOR FAILS TO ESTABLISH BLEED AND FEED	24
31	FAULT-A	5.00E-01	2.82E-02	STEAM GENERATOR A IS FAULTED	55

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
32	IE-F--2B--M	1.12E-05	2.75E-02	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 2B	70
33	05BFAFWA-CAL-AE	8.16E-04	2.53E-02	TECHNICIAN MISCALIBRATES AFW TRAIN A FLOW	57
34	05BFAFWB-CAL-AE	8.16E-04	2.53E-02	TECHNICIAN MISCALIBRATES AFW TRAIN B FLOW	58
35	IE-TSW	3.65E+02	2.53E-02	MULTIPLIER FOR LOSS OF SERVICE WATER IE FREQUENCY	63
36	SUCC-CHG	8.08E-01	2.46E-02	CHARGING SUCCESS	This event represents the probability that charging will be successful after recovery of offsite power on blackout sequences. This event is analogous to item 69 of LRA Appendix E, Attachment F, Table F-3.
37	05BPT--AFW1C-TM	7.42E-03	2.30E-02	TD AFW PUMP UNAVAILABLE DUE TO TEST OR MAINTENANCE	84
38	IE-W-5B24-U	1.29E-04	2.26E-02	AFW PIPE FLOOD IN SAFEGUARDS ALLEY EXCEEDS DRAIN CAPAC	34
39	AC-1632	2.74E-02	2.07E-02	OFFSITE POWER RECOVERED WITHIN 16 HOURS, 32 MINUTES	71
40	04--LO-LEVEL-FB	9.91E-04	2.05E-02	LOW FOREBAY LEVEL	96
41	AC-0221	2.68E-01	1.97E-02	OFFSITE POWER NOT RECOVERED WITHIN 2 HOURS, 21 MINUTES	65
42	IE-W-5B24-S	2.34E-04	1.95E-02	AFW PIPE FLOOD IN SAFEGUARDS ALLEY WITHIN DRAIN CAPAC.	77
43	LERF-61	5.00E-01	1.88E-02	LARGE EARLY RELEASE FREQUENCY FOR PLANT DAMAGE STATE 61	81

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
44	IE-F--4B--M	6.93E-06	1.72E-02	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 4B	89
45	08-FPHDRISOX8HE	1.00E+00	1.72E-02	OPERATOR FAILS TO ISOLATE A MAJOR FP BREAK IN ROOM 4B	90
46	05BPMOKPSCCF123	5.66E-05	1.71E-02	TRIPLE COMMON CAUSE FAILURE (CCF) ALOP-1A/1B/1C PS	60
47	10-GE-DG1B---PS	6.12E-03	1.62E-02	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO START	78
48	IE-TMF	1.13E-01	1.62E-02	LOSS OF MAIN FEEDWATER OCCURS	53
49	27A-ORR------HE	9.21E-02	1.59E-02	OPERATOR FAILS TO LIMIT SI FLOW AND REFILL RWST - NO CD	20
50	IE-SA-129-U	4.61E-05	1.58E-02	TRAIN A SW FLOOD IN ROOM 129 EXCEEDS DRAIN CAPACITY	80
51	IE-SL-5B1-S	1.24E-03	1.53E-02	LOCALLY ISOL SW FLD IN ROOM 5B-1 WITHIN DRAIN CAPACITY	Spray shields were placed over piping in safeguards alley that could not be locally isolated to stop a flooding event. This is a new initiating event developed after completing this modification to evaluate the risk from breaks of locally-isolable piping. This event is important to core damage because of the potential for propagation to other rooms in safeguards alley. SAMA item 176 in LRA Appendix E, Attachment F, Table F-17 would address this issue.
52	IE-SB-130-U	4.39E-05	1.46E-02	TRAIN B SW FLOOD IN ROOM 130 EXCEEDS DRAIN CAPACITY	83

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
53	IE-S--4B--U	1.73E-03	1.44E-02	SERVICE WATER FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	A moderate fire protection pipe break in the Cardox room rapidly propagates to the B-train switchgear room and causes a loss of offsite power. The dominant accident sequences for this event involve failure of the A-train diesel generator thereby resulting in a station blackout. The Kewaunee PRA models assume that any internal flooding event that results in a station blackout results in core damage. However, detailed evaluation of station blackout events would likely show that some mitigation of flood-induced station blackouts could occur, thereby decreasing the importance of this event. Since this event is of low importance and more detailed modeling of existing procedures and equipment would lessen the importance, no SAMA items are developed from this event. Furthermore, preventing failure of the diesel generator would eliminate station blackout as a concern. Other means are available to mitigate station blackouts. Refer to SAMA items 55, 56, 58, 21, and 22.
54	IE-SB-22B2M	1.32E-05	1.41E-02	MAJOR FLOOD FROM SW TRAIN B IN ROOM 22B-2	This event is identified as item 82 from the CDF importance results. SAMA item 182 would address this event.
55	IE-SA-22B1M	1.31E-05	1.40E-02	MAJOR FLOOD FROM SW TRAIN A IN ROOM 22B-1	This event is identified as item 83 from the CDF importance results. SAMA item 182 would address this event.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
56	10-GE-DG1A---PS	6.12E-03	1.39E-02	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO START	75
57	47-RERKRBCCF1-8	1.37E-05	1.36E-02	GLOBAL FAILURE OF RX TRP RLYS (BOUND)	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and charging Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
58	IE-SA-2B--M	5.39E-06	1.33E-02	MAJOR FLOOD FROM SW TRAIN A IN ROOM 2B	72

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
59	49-CB-KFOCCF12	1.29E-05	1.30E-02	DOUBLE COMMON CAUSE FAILURE (CCF) CB-RTA/RTB FO	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and Chemical and Volume Control Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
60	IE-SOPORV	4.29E-02	1.28E-02	STUCK OPEN PORV OCCURS	56
61	27A-RMST-CST-HE	1.24E-03	1.27E-02	OPERATOR FAILS TO CROSS-TIE CSTS AND RMSTS	86
62	IE-W--14B-U	1.51E-04	1.23E-02	MODERATE BREAK FROM AFW PIPE IN ROOM 14B	40
63	33--ORI------HE	1.50E-02	1.21E-02	OPERATOR FAILS TO RESTORE RCS INVENTORY IN SBO	97
64	IE-SB-8B--U	3.30E-03	1.09E-02	MODERATE TRAIN B SW PIPE BREAKS IN ROOM 8B	18

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
65	05B-AFW-ISO-8-HE	3.59E-03	1.02E-02	OPERATOR FAILS TO ISOLATE A MODERATE AFW LEAK BEF 9"	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 61 of LRA Appendix E, Attachment F, Table F-8 is analogous to this event for the SAMA model. SAMA item 181 would similarly address this new basic event.
66	IE-TCC	3.65E+02	1.01E-02	MULTIPLIER FOR LOSS OF COMPONENT COOLING IE FREQ	10
67	02-SWHDRISOX7HE	1.00E+00	9.97E-03	OPERATOR FAILS TO ISOLATE A MAJOR SW BREAK IN DG A ROOM	73
68	IE-SA-301-U	2.73E-03	9.69E-03	TRAIN A SW FLOOD IN ROOM 301	102
69	IE-ST-5B--S	8.74E-04	9.00E-03	SW TURBINE HDR FLOOD IN ROOM 5B WITHIN DRAIN CAP	Spray shields were placed over piping in safeguards alley that could not be locally isolated to stop a flooding event. This is a new initiating event developed after completing this modification to evaluate the risk from breaks of locally-isolable piping. This event is important to core damage because of the potential for propagation to other rooms in safeguards alley. SAMA item 176 in LRA Appendix E, Attachment F, Table F-17 would address this issue.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
70	MULT-TAV	1.50E-02	8.65E-03	MULTIPLIER FOR TAV FRACTION OF YEAR SUBJECT TO HI TEMPS	This event indicates the fraction of time during the year when outside air temperatures are high enough that Screenhouse ventilation is required. A SAMA item to provide a high-temperature alarm for the Screenhouse and a procedure and equipment to provide temporary ventilation could potentially be cost beneficial.
71	02-SWHDRISOXGHE	1.30E-02	8.50E-03	OPERATOR FAILS TO ISOLATE A MAJOR SW BRK IN ROOM 156	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 31 of LRA Appendix E, Attachment F, Table F-3 is analogous to this event for the SAMA model. SAMA item 176 would similarly address this new basic event.
72	AC-0159	3.21E-01	8.44E-03	OFFSITE POWER NOT RECOVERED WITHIN 1 HOUR, 59 MINUTES	126
73	10-GE-KPSCCF12	2.75E-04	8.25E-03	DOUBLE COMMON CAUSE FAILURE (CCF) EDGS FAIL TO START	94
74	10-GE-TSC-DG-PR	3.06E-02	8.02E-03	TSC DIESEL GENERATOR FAILS TO RUN	108
75	05BMVI-MS102-FO	2.66E-03	7.97E-03	MOV MS-102 FAILS TO OPEN	112

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
76	27AXV-DW20---FO	4.80E-04	7.82E-03	MANUAL VALVE DW-20 FAILS TO CLOSE	This event is related to failure to provide an alternate source of water to the CSTs. Item 103 in LRA Appendix E, Attachment F, Table F-3 also is related to CST makeup. A SAMA item to ameliorate inadequate AFW suction is addressed under item 71 in LRA Appendix E, Attachment F, Table F-17.
77	IE-SLB	6.17E-03	7.80E-03	STEAM OR FEEDWATER LINE BREAK OCCURS	116
78	34-CVSI3034AVCO	1.01E-07	7.78E-03	CHECK VALVES RHR-5ASI-303A AND SI304A TRANS OPEN VAR TERM	129
79	34-CVSI3034BVCO	1.01E-07	7.78E-03	CHECK VALVES RHR-5BSI-303B AND SI304B TRANS OPEN VAR TERM	130

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
80	IE-S--4B--M	2.03E-07	7.46E-03	MAJOR FLOOD FROM SERVICE WATER IN ROOM 4B	A major service water pipe break in the Cardox room rapidly propagates to the B-train switchgear room and causes a loss of offsite power. The dominant accident sequences for this event involve failure of the A-train diesel generator thereby resulting in a station blackout. The Kewaunee PRA models assume that any internal flooding event that results in a station blackout results in core damage. However, detailed evaluation of station blackout events would likely show that some mitigation of flood-induced station blackouts could occur, thereby decreasing the importance of this event. Since this event is of low importance and more detailed modeling of existing procedures and equipment would lessen the importance, no SAMA items are developed from this event. Furthermore, preventing failure of the diesel generator would eliminate station blackout as a concern. Other means are available to mitigate station blackouts. Refer to SAMA items 55, 56, 58, 21, and 22.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
81	02-SWHDRISOXDHE	9.96E-01	7.46E-03	OPERATOR FAILS TO ISOLATE MAJOR SW BREAK IN CO2 ROOM	A major service water pipe break in the Cardox room rapidly propagates to the B-train switchgear room and causes a loss of offsite power. The dominant accident sequences for this event involve failure of the A-train diesel generator thereby resulting in a station blackout. The Kewaunee PRA models assume that any internal flooding event that results in a station blackout results in core damage. However, detailed evaluation of station blackout events would likely show that some mitigation of flood-induced station blackouts could occur, thereby decreasing the importance of this event. Since this event is of low importance and more detailed modeling of existing procedures and equipment would lessen the importance, no SAMA items are developed from this event. Furthermore, preventing failure of the diesel generator would eliminate station blackout as a concern. Other means are available to mitigate station blackouts. Refer to SAMA items 55, 56, 58, 21, and 22.
82	05BPMSKPSCCF123	2.50E-05	7.44E-03	TRIPLE COMMON CAUSE FAILURE (CCF) AFW-1A/1B/TD PS	45
83	10-GE-DG1B---FL	2.86E-03	7.44E-03	INDEPENDENT FAILURE DIESEL GENERATOR B FAILS TO LOAD	118

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
84	47-CNRKRCCCF1-8	7.41E-06	7.34E-03	GLOBAL FAILURE OF RX TRP RLYS (CNTCS)	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and Chemical and Volume Control Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
85	IE-SA-8B--U	2.17E-03	7.14E-03	MODERATE TRAIN A SW PIPE BREAKS IN ROOM 8B	74
86	IE-SB-3B--M	3.61E-06	6.85E-03	MAJOR FLOOD FROM SW TRAIN B IN ROOM 3B	45
87	02-SWHDRISOXAHE	1.00E+00	6.83E-03	OPERATOR FAILS TO ISOLATE MAJOR SW BREAK IN DG B ROOM	46
88	IE-SA-403-U	4.65E-03	6.74E-03	SW TRAIN A FLOOD IN ROOM 403	106
89	STBY-ABBFD	5.00E-01	6.68E-03	AUX BLDG BSMT FAN COIL UNIT D IS IN STANDBY	111
90	31-PM-KPRCCF12	6.96E-06	6.65E-03	DOUBLE COMMON CAUSE FAILURE (CCF) CCW-1A/-1B PR	23
91	IE-SB-14B-S	1.55E-03	6.65E-03	SPRAY EVENT FROM TRAIN B SW IN AUX BUILDING BASEMENT	122

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
92	08-FPHDRISOX9HE	4.14E-04	6.59E-03	OPERATOR FAILS TO ISOLATE A MAJOR FP BREAK IN SCRNHSE	This basic event represents an operator action to isolate a flooding event in safeguards alley. Because of plant changes made, additional time is available to perform this action. However, Item 87 of LRA Appendix E, Attachment F, Table F-3 is analogous to this event for the SAMA model. SAMA item 176 would similarly address this new basic event.
93	IE-SB-2B--U	2.62E-06	6.55E-03	TRAIN B SW FLOOD IN ROOM 2B EXCEEDS DRAIN CAPACITY	A moderate rupture of service water pipe in the A-train switchgear room causes a loss of the A-train switchgear and leads to a loss of offsite power. The dominant contributors to accident sequences following this event are failures of the B-train diesel. Providing a path for water to leave the room before level reaches 18 inches would preclude a loss of offsite power and minimize the need for the B-train diesel generator. Refer to SAMA item 181.
94	PORV-A	5.00E-01	6.41E-03	STUCK OPEN PORV IS PR-2A	91
95	PORV-B	5.00E-01	6.40E-03	STUCK OPEN PORV IS PR-2B	92
96	33-F925--CAL-AE	4.84E-03	6.39E-03	TECHNICIAN MISCALIBRATES SI FLOW CHANNEL F925	114
97	IE-SB-403-U	4.47E-03	6.38E-03	SW TRAIN B FLOOD IN ROOM 403	105
98	10-GE-DG1A---FL	2.86E-03	6.34E-03	INDEPENDENT FAILURE DIESEL GENERATOR A FAILS TO LOAD	109

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
99	49-ROD-MECH--FA	1.80E-06	6.11E-03	CONTROL RODS FAIL TO DROP INTO THE CORE	This event is important to core damage because of the conservative, simplifying assumption that an ATWS following an internal flooding initiating event leads directly to core damage. It is likely that an explicit evaluation of ATWS accident sequence progression after a flooding event would eliminate this event from significance. Dominant cutsets containing this event represent internal flooding sequences where AFW and Chemical and Volume Control Systems would be available for ATWS mitigation. Therefore, no new SAMA items would be generated as a result of this event.
100	PORV-CHALLENGE	2.08E-02	6.11E-03	PORV IS CHALLENGED BY THE INITIATOR	Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added.
101	IE-TDA	3.65E+02	5.93E-03	MULTIPLIER FOR LOSSOF 125 V DC BUS BRA-104 IE FREQ	110
102	IE-SB-22B2U	7.94E-04	5.79E-03	SW TRAIN B FLOOD < 2000 GPM IN ROOM 22B-2	104
103	IE-SA-22B1U	7.89E-04	5.68E-03	SW TRAIN A FLOOD < 2000 GPM IN ROOM 22B-1	113

Table 1.f.iii-2: Basic Event Importance with Respect to LERF

Item	Event Name	Probability	Fussell-Vesely Importance	Description	Corresponding Item from Table F-8 or Disposition
104	IE-W--8B5-U	6.38E-05	5.67E-03	MODERATE BREAK FROM AFW PIPE IN ROOM 8B5	This initiating event leads to core damage due to flood-induced failure of equipment needed to maintain RCP seal cooling, specifically, failure of MCCs 52E, 62E, and 62H. Loss of these MCCs leads to a loss of charging pumps and a loss of ventilation needed to ensure continued functioning of CCW pumps. Refer to SAMA item 169.
105	IE-SB-3B--U	3.11E-05	5.64E-03	TRAIN B SW FLOOD IN ROOM 3B EXCEEDS DRAIN CAPACITY	61
106	05B-DOOR-AFW-HE	6.09E-03	5.54E-03	OPERATOR FAILS TO OPEN DOORS TO AFW ROOM B FOR VNTLTN	This is the same event evaluated in item 14 of LRA Appendix E, Attachment F, Table F-3.
107	IE-F--22B1M	2.46E-04	5.53E-03	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 22B-1	This event is similar in effect to items 54 and 55 above. SAMA item 182 would address this event.
108	03-CVS-MU301-FO	4.23E-05	5.41E-03	CHECK VALVE MU-301 FAILS TO OPEN	This event is related to failure to provide water from the CSTs to AFW. A SAMA item to mitigate inadequate AFW suction is addressed under item 71 in LRA Appendix E, Attachment F, Table F-17.

Table 1.f.iii-2: Basic Event Importance with Respect to LERF					
Item	**Event Name**	**Probability**	**Fussell-Vesely Importance**	**Description**	**Corresponding Item from Table F-8 or Disposition**
109	IE-F--2B--U	4.62E-05	5.40E-03	FIRE PROTECTION FLOOD < 2000 GPM IN ROOM 2B	A moderate rupture of the fire protection water pipe in the A-train switchgear room causes a loss of the A-train switchgear and leads to a loss of offsite power. The dominant contributors to accident sequences following this event are failures of the B-train diesel. Providing a path for water to leave the room before level reaches 18 inches would preclude a loss of offsite power and minimize the need for the B-train diesel generator. Refer to SAMA item 181.
110	02-SWHDRISOX0HE	9.15E-02	5.37E-03	OPERATOR FAILS TO ISOLATE A MOD. SW BREAK IN DG B ROOM	64
111	IE-SA-156-M	1.67E-05	5.13E-03	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 156	This initiating event leads to core damage due to flood-induced failure of equipment needed to maintain RCP seal cooling, specifically, failure of MCCs 52E, 62E, and 62H. Loss of these MCCs leads to a loss of charging pumps and a loss of ventilation needed to ensure continued functioning of CCW pumps. Refer to SAMA item 169.
112	05BPT--AFW1C-PR	2.36E-03	5.04E-03	INDEPENDENT FAILURE TD AFW PUMP FAILS TO RUN	121
113	05BSV-KFOCCF123	1.69E-05	5.00E-03	TRIPLE COMMON CAUSE FAILURE (CCF) SV-AFW-111A/B/C FO	Given the low importance of this event, very little benefit would be obtained from efforts to reduce the importance further. Therefore, no SAMA items are added.

Response to 1.g

The six weaknesses identified in the IPE review have been addressed as indicated below:

Weakness 1: *Spray was not considered in internal flooding.*

The flooding model used for SAMA fails all equipment in the same room as the flood source unless an evaluation has been made to determine that the equipment is protected from spray. The PRA model used for the SAMA analysis has addressed this previously identified weakness.

Weakness 2: *Justification for not including certain phenomena in the containment event trees is absent.*

The Kewaunee Level 2 model used for SAMA addresses phenomena such as induced steam generator tube rupture that were not modeled in the IPE. The current model uses the ASME PRA Standard as a guide to determine which phenomena to address and which phenomena need not be considered. The PRA model used for the SAMA analysis has addressed this previously identified weakness.

Weakness 3: *The link between plant damage states and containment performance is lacking.*

The model used for SAMA has plant damage state trees to determine the characteristics of each core damage sequence that is important to Level 2. The containment event tree follows the accident sequence scenario and bins the sequence into one or several containment event tree endstates. The source term category tree bins all the containment event tree endstates into source term categories based on resulting dose, as determined by the Modular Accident Assessment Program (MAAP) thermal hydraulic code. The PRA model used for the SAMA analysis has addressed this previously identified weakness.

Weakness 4: *The definition of a vulnerability is vague.*

This weakness relates to identifying vulnerabilities in the IPE and does not pertain to the SAMA analysis.

Weakness 5: *The timing of human interactions (HIs) was not adequately addressed.*

The human reliability assessment was completely re-performed in 2003 and 2004 in response to the Westinghouse Owners Group (WOG) peer review. This new assessment used operator interviews and simulator observations to determine the time to perform an action and MAAP results to determine the time available. The PRA model used for the SAMA analysis has addressed this previously identified weakness.

Weakness 6: *Dependency between Human Interactions (HIs) may not be complete.*

This weakness was addressed subsequent to the staff evaluation report on the IPEEE and prior to the WOG peer review. Each combination of two or more HIs within a cutset is now analyzed. The WOG team evaluated this methodology and found it to be appropriate. The PRA model used for the SAMA analysis has addressed this previously identified weakness.

Response to 1.h

The referenced text in LRA Appendix E, Attachment F, Section F.2.5 is as follows:

> *"The KPS PRA model is updated frequently to maintain it consistent with the as-built, as-operated plant to incorporate improved thermal hydraulic results, and to incorporate PRA improvements. The updates have involved a cooperative effort including both licensee personnel and consultant support. As part of model change, the documentation affected by the incorporated changes is updated accordingly per Dominion procedures. Included in the documentation update is an independent review and approval of each revised document."*

The PRA model is subjected to a full revision every three years as required by Dominion procedures. The revision incorporates a full scope of required changes and optional improvements. High priority issues are incorporated immediately into the model; other changes are compiled for a full change at the three-year revision interval.

When a potential model change is identified, it is logged and prioritized in a tracking database. Potential model changes include plant hardware or procedure changes, potential model improvements or identified model errors. At the time of the model update, the tracking database is reviewed to identify all required changes. These changes are implemented in a test version of the model, tested, documented and subjected to independent review and approval. This process is controlled by procedure.

All model revision documents are independently reviewed by a qualified PRA engineer. The review scope addresses all technical and incidental (e.g., internal documentation) changes made to the model. The reviewer is completely independent, having not participated in the model revision process.

Due to the availability of electronic document updates, many reviewers' comments are incorporated into revisions of the documentation while it is still in its draft state. The review process may iterate between preparer and reviewer until comments are resolved to the satisfaction of both. Significant comments are documented in a reviewer's comments/resolution log.

After an update has been documented and independently reviewed, it must be approved by Dominion PRA management.

The model update, documentation, review and approval processes are controlled by internal procedure.

Response to 1.i

Table F-1 lists each initiating event that contributed, individually, to more than 1% of the CDF. Table 1.i-1 below shows the contribution for all initiating events. The information for the first 25 events has not changed from that given in LRA Appendix E, Attachment F, Table F-1, but is shown to four decimal places consistent with events later in the table.

The vast majority of events that contribute less than 1% of the CDF are internal flooding initiating events, generally from service water or fire protection water. Flooding events from service water and fire protection water as a group are significant to CDF because they are unlimited sources of flood water which, if not isolated in a timely manner, could propagate from the room where the flood initiates to other areas in the plant and damage additional equipment through submergence. Other initiating events such as medium LOCA or steam line break are not significant contributors to the overall CDF.

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event

Initiating Event ID	Initiating Event Description	Percent Contribution to CDF
IE-SA-8B--U	MODERATE TRAIN A SW PIPE BREAKS IN ROOM 8B	8.5750%
IE-TRA	TRANSIENT WITH MAIN FEEDWATER AVAILABLE OCCURS	8.4620%
IE-TCC	MULTIPLIER FOR LOSS OF COMPONENT COOLING IE FREQ	7.7520%
IE-SB-8B--U	MODERATE TRAIN B SWPIPE BREAKS IN ROOM 8B	7.6290%
IE-SGTR	STEAM GENERATOR TUBE RUPTURE OCCURS	6.1430%
IE-LOSP	LOSS OF OFFSITE POWER OCCURS	5.0100%
IE-SB-156-S	SMALL TRAIN B SW PIPE BREAKS IN ROOM 156	4.4000%
IE-SB-5B--U	TRAIN B SW FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	2.5800%
IE-SOPORV	STUCK OPEN PORV OCCURS	2.5560%
IE-TSW	MULTIPLIER FOR LOSS OF SERVICE WATER IE FREQUENCY	2.5240%
IE-SB-403-U	SW TRAIN B FLOOD IN ROOM 403	2.3810%
IE-W--14B-U	MODERATE BREAK FROM AFW PIPE IN ROOM 14B	2.1870%
IE-TMF	LOSS OF MAIN FEEDWATER OCCURS	2.0140%
IE-W-5B24-U	AFW PIPE FLOOD IN SAFEGUARDS ALLEY EXCEEDS DRAIN CAPAC	1.7660%
IE-SLO	SMALL BREAK LOSS OF COOLANT ACCIDENT OCCURS	1.5890%

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event		
Initiating Event ID	**Initiating Event Description**	**Percent Contribution to CDF**
IE-S-5B14-M	MAJOR FLOOD FROM SW HEADER IN SAFEGUARDS ALLEY	1.3580%
IE-VEF	VESSEL FAILURE OCCURS	1.2300%
IE-SB-14B-S	SPRAY EVENT FROM TRAIN B SW IN AUX BUILDING BASEMENT	1.2280%
IE-SB-3B--M	MAJOR FLOOD FROM SW TRAIN B IN ROOM 3B	1.2070%
IE-W-5B24-S	AFW PIPE FLOOD IN SAFEGUARDS ALLEY WITHIN DRAIN CAPAC.	1.1710%
IE-SB-5B1-S	TRAIN B SW FLOOD IN ROOM 5B-1 WITHIN DRAIN CAPACITY	1.1130%
IE-SA-129-U	TRAIN A SW FLOOD IN ROOM 129 EXCEEDS DRAIN CAPACITY	1.1120%
IE-SB-22B2U	SW TRAIN B FLOOD < 2000 GPM IN ROOM 22B-2	1.0540%
IE-TIA	MULTIPLIER FOR LOSSOF INSTRUMENT AIR IE FREQUENCY	1.0370%
IE-SB-130-U	TRAIN B SW FLOOD IN ROOM 130 EXCEEDS DRAIN CAPACITY	1.0340%
IE-SB-3B--U	TRAIN B SW FLOOD IN ROOM 3B EXCEEDS DRAIN CAPACITY	0.9770%
IE-SB-5B3-U	TRAIN B SW FLOOD IN ROOM 5B-3 EXCEEDS DRAIN CAPACITY	0.9085%
IE-SB-5B--S	TRAIN B SW FLOOD IN ROOM 5B WITHIN DRAIN CAPACITY	0.8904%
IE-F--2B--M	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 2B	0.8438%
IE-SB-5B3-S	TRAIN B SW FLOOD IN ROOM 5B-3 WITHIN DRAIN CAPACITY	0.8420%
IE-SA-2B--M	MAJOR FLOOD FROM SW TRAIN A IN ROOM 2B	0.8169%
IE-SA-14B-S	SPRAY EVENT FROM TRAIN A SW IN AUX BUILDING BASEMENT	0.7243%
IE-SB-156-U	MODERATE TRAIN B SW PIPE BREAKS IN ROOM 156	0.7039%
IE-SA-301-U	TRAIN A SW FLOOD IN ROOM 301	0.6456%
IE-SB-3B--S	TRAIN B SW FLOOD IN ROOM 3B WITHIN DRAIN CAPACITY	0.6204%
IE-SB-22B2M	MAJOR FLOOD FROM SW TRAIN B IN ROOM 22B-2	0.6192%
IE-TDA	MULTIPLIER FOR LOSSOF 125 V DC BUS BRA-104 IE FREQ	0.6077%
IE-SLB	STEAM OR FEEDWATER LINE BREAK OCCURS	0.5738%
IE-F--4B--M	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 4B	0.5502%

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event

Initiating Event ID	Initiating Event Description	Percent Contribution to CDF
IE-F--22B2M	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 22B-2	0.5474%
IE-SA-403-U	SW TRAIN A FLOOD IN ROOM 403	0.5051%
IE-SB-301-U	TRAIN B SW FLOOD IN ROOM 301	0.4675%
IE-SA-2B--S	TRAIN A SW FLOOD IN ROOM 2B WITHIN DRAIN CAPACITY	0.4375%
IE-SA-8B--M	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 8B	0.4357%
IE-W--8B5-U	MODERATE BREAK FROM AFW PIPE IN ROOM 8B5	0.4326%
IE-SA-5B--S	TRAIN A SW FLOOD IN ROOM 5B WITHIN DRAIN CAPACITY	0.4006%
IE-W--6B--M	FW LINE BREAK IN TURBINE BUILDING CAUSES FP ACTUATION	0.3883%
IE-F--22B1M	MAJOR FLOOD FROM FIRE PROTECTION IN ROOM 22B-1	0.3881%
IE-SA-22B1U	SW TRAIN A FLOOD < 2000 GPM IN ROOM 22B-1	0.3624%
IE-E------M	LARGE UNISOLABLE BREAK IN RWST PIPING	0.3604%
IE-ISL	INTERFACING SYSTEM LOSS OF COOLANT ACCIDENT OCCURS	0.3559%
IE-SB-14B1S	SPRAY EVENT FROM TRAIN B SW IN CHARGING ROOM	0.3183%
IE-SB-8B--M	MAJOR TRAIN B SW PIPE BREAKS IN ROOM 8B	0.3034%
IE-T--6B--M	STEAM LINE BREAK IN TURBINE BUILDING CAUSES FP ACTUATION	0.2941%
IE-SA-14B1S	SPRAY EVENT FROM TRAIN A SW IN CHARGING ROOM	0.2860%
IE-TDB	MULTIPLIER FOR LOSS OF 125 V DC BUS BRB-104 IE FREQ	0.2710%
IE-SA-156-S	SMALL TRAIN A SW PIPE BREAKS IN ROOM 156	0.2689%
IE-S--4B--U	SERVICE WATER FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	0.2558%
IE-SB-5B2-U	TRAIN B SW FLOOD IN ROOM 5B-2 EXCEEDS DRAIN CAPACITY	0.2550%
IE-SB-5B1-U	TRAIN B SW FLOOD IN ROOM 5B-1 EXCEEDS DRAIN CAPACITY	0.2541%
IE-SA-156-M	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 156	0.2354%
IE-ST-2B--S	SW TURBINE HDR FLOOD IN ROOM 2B WITHIN DRAIN CAP	0.2353%
IE-SA-14B-U	MODERATE BREAK FROM TRAIN A SW IN AUX BUILDING BASEMENT	0.2253%
IE-MLO	MEDIUM LOSS OF COOLANT ACCIDENT OCCURS	0.2168%

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event

Initiating Event ID	Initiating Event Description	Percent Contribution to CDF
IE-SA-5B--U	TRAIN A SW FLOOD IN ROOM 5B EXCEEDS DRAIN CAPACITY	0.2148%
IE-SB-14B-U	MODERATE BREAK FROM TRAIN B SW IN AUX BUILDING BASEMENT	0.2085%
IE-SA-22B1M	MAJOR FLOOD FROM SW TRAIN A IN ROOM 22B-1	0.2068%
IE-SA-2B--U	TRAIN A SW FLOOD IN ROOM 2B EXCEEDS DRAIN CAPACITY	0.2058%
IE-SA-14B2S	SPRAY EVENT FROM TRAIN A SW IN RHR ENVELOPE	0.1933%
IE-SB-8B5-S	SPRAY EVENT FROM TRAIN B SERVICE WATER IN ROOM 8B5	0.1872%
IE-M--8B--U	MODERATE BREAK FROM MISCELLANEOUS SYSTEMS IN ROOM 8B	0.1624%
IE-W--8B--U	MODERATE BREAK FROM AFW PIPE IN ROOM 8B	0.1598%
IE-SB-156-M	MAJOR TRAIN B SW PIPE BREAKS IN ROOM 156	0.1590%
IE-E--8B--U	MODERATE BREAK IN ECCS PIPE THAT DRAINS TO ROOM 8B	0.1546%
IE-F--5B--U	FAILURE OF FIRE PROTECTION PIPING IN ROOM 5B	0.1492%
IE-TB5	MULTIPLIER FOR LOSS OF 4160 V AC BUS 5 IE FREQUENCY	0.1395%
IE-SB-5B4-U	TRAIN B SW FLOOD IN ROOM 5B-4	0.1271%
IE-TB6	MULTIPLIER FOR LOSS OF 4160 V AC BUS 6 IE FREQUENCY	0.1220%
IE-LLO	LARGE BREAK LOSS OF COOLANT ACCIDENT OCCURS	0.1170%
IE-SA-14B2U	MODERATE BREAK FROM TRAIN A SW IN RHR ENVELOPE	0.1048%
IE-SA-14B1U	MODERATE BREAK FROM TRAIN A SW IN CHARGING ROOM	0.1031%
IE-SB-14B2S	SPRAY EVENT FROM TRAIN B SW IN RHR ENVELOPE	0.0934%
IE-M--231-U	PIPING FAILURES IN ROOM 231	0.0897%
IE-SA-5B1-S	TRAIN A SW FLOOD IN ROOM 5B-1 WITHIN DRAIN CAPACITY	0.0849%
IE-E--14B-U	MODERATE BREAK IN ECCS PIPE THAT DRAINS TO ROOM 14B	0.0811%
IE-SP-2B--S	SWPT FLOOD IN ROOM 2B WITHIN DRAIN CAPACITY	0.0630%
IE-SA-5B2-S	TRAIN A SW FLOOD IN ROOM 5B-2 WITHIN DRAIN CAPACITY	0.0618%
IE-SA-1A1BM	MAJOR FLOOD FROM SW TRAIN A IN SCREEN HOUSE BASEMENT	0.0606%

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event

Initiating Event ID	Initiating Event Description	Percent Contribution to CDF
IE-SB-1A1BM	MAJOR FLOOD FROM SW TRAIN B IN SCREEN HOUSE BASEMENT	0.0574%
IE-SA-156-U	MODERATE TRAIN A SWPIPE BREAKS IN ROOM 156	0.0557%
IE-SB-14B1U	MODERATE BREAK FROM TRAIN B SW IN CHARGING ROOM	0.0540%
IE-SB-14B2U	MODERATE BREAK FROM TRAIN B SW IN RHR ENVELOPE	0.0497%
IE-SB-8B5-U	MODERATE BREAK FROM TRAIN B SERVICE WATER IN ROOM 8B5	0.0395%
IE-F--6B--M	MAJOR FIRE WATER BREAK IN TURBINE BUILDING	0.0370%
IE-ST-2B--U	SW TURBINE HDR FLOOD IN ROOM 2B EXCEEDS DRAIN CAP	0.0366%
IE-SA-5B1-U	TRAIN A SW FLOOD IN ROOM 5B-1 EXCEEDS DRAIN CAPACITY	0.0341%
IE-SB-2B--U	TRAIN B SW FLOOD IN ROOM 2B EXCEEDS DRAIN CAPACITY	0.0325%
IE-F--2B--U	FIRE PROTECTION FLOOD < 2000 GPM IN ROOM 2B	0.0323%
IE-SA-5B2-U	TRAIN A SW FLOOD IN ROOM 5B-2 EXCEEDS DRAIN CAPACITY	0.0305%
IE-SA-5B4-U	TRAIN A SW FLOOD IN ROOM 5B-4	0.0296%
IE-SB-162-U	TRAIN B SW FLOOD IN ROOM 162	0.0293%
IE-SA-129-S	TRAIN A SW FLOOD IN ROOM 129 WITHIN DRAIN CAPACITY	0.0270%
IE-SB-130-S	TRAIN B SW FLOOD IN ROOM 130 WITHIN DRAIN CAPACITY	0.0267%
IE-SA-5B3-S	TRAIN A SW FLOOD IN ROOM 5B-3 WITHIN DRAIN CAPACITY	0.0253%
IE-SB-5B2-S	TRAIN B SW FLOOD IN ROOM 5B-2 WITHIN DRAIN CAPACITY	0.0235%
IE-SB-2B--M	MAJOR FLOOD FROM SW TRAIN B IN ROOM 2B	0.0226%
IE-S--4B--M	MAJOR FLOOD FROM SERVICE WATER IN ROOM 4B	0.0224%
IE-M--145-U	MISCELLANEOUS PIPE BREAKS IN ROOM 145	0.0184%
IE-B--TCC-U	FAILURE OF CCW PIPING	0.0119%
IE-E--14B-M	MAJOR BREAK IN ECCS PIPE THAT DRAINS TO ROOM 14B	0.0106%
IE-SA-14B2M	MAJOR TRAIN A SW PIPE BREAKS IN RHR ENVELOPE	0.0106%
IE-SA-14B-M	MAJOR TRAIN A SW PIPE BREAKS IN AUX BASEMENT	0.0103%
IE-SA-14B1M	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 14B-1	0.0093%
IE-SP-2B--U	SWPT FLOOD IN ROOM 2B EXCEEDS DRAIN CAPACITY	0.0089%

Table 1.i-1: Contribution to Core Damage Frequency By Initiating Event		
Initiating Event ID	Initiating Event Description	Percent Contribution to CDF
IE-SA-5B3-U	TRAIN A SW FLOOD IN ROOM 5B-3 EXCEEDS DRAIN CAPACITY	0.0080%
IE-SA-230-U	TRAIN A SW FLOOD IN ROOM 230 EXCEEDS DRAIN CAPACITY	0.0077%
IE-SB-14B-M	MAJOR TRAIN B SW PIPE BREAKS IN ROOM 14B	0.0075%
IE-SB-2B--S	TRAIN B SW FLOOD IN ROOM 2B WITHIN DRAIN CAPACITY	0.0074%
IE-C--6B--M	MAJOR CIRC WATER BREAK IN TURBINE BUILDING	0.0072%
IE-SA-8B5-S	SPRAY EVENT FROM TRAIN A SERVICE WATER IN ROOM 8B5	0.0066%
IE-SA-8B5-M	MAJOR TRAIN A SW PIPE BREAKS IN ROOM 8B5	0.0063%
IE-V-CVCS-U	RUPTURES OF CVCS SYSTEM PIPING	0.0057%
IE-S--6B--M	MAJOR SERVICE WATERBREAK IN TURBINE BUILDING	0.0044%
IE-F--1A1BM	MAJOR FLOOD FROM FIRE PROTECTION IN SCREENHOUSE BASEMEN	0.0023%
IE-F--4B--U	FIRE PROTECTION FLOOD < 2000 GPM IN ROOM 4B	0.0021%
IE-SB-14B1M	MAJOR TRAIN B SW PIPE BREAKS IN ROOM 14B-1	0.0019%
IE-P--243-S	SPRAY EVENTS FROM SFPC IN AREA 243	0.0013%
IE-SA-8B5-U	MODERATE BREAK FROM TRAIN A SERVICE WATER IN ROOM 8B5	0.0011%
IE-M--14B-U	BREAK FROM MISC. SYSTEM PIPE IN ROOM 14B	0.0010%
IE-E--8B--M	MAJOR BREAK IN ECCS PIPE THAT DRAINS TO ROOM 8B	0.0006%
IE-F--3B--U	FIRE PROTECTION FLOOD < 2000 GPM IN ROOM 3B	0.0004%
IE-P--243-U	BREAK GREATER THAN 100 GPM FROM SFPC IN AREA 243	0.0003%
IE-SB-14B2M	MAJOR TRAIN B SW PIPE BREAKS IN RHR ENVELOPE	0.0002%

NRC RAI 2

Provide the following information relative to the Level 2 PRA analysis:

a. ***Section F.2.4 states that the Level 2 model was developed for the Individual Plant Examination (IPE) and updated in 2004 and 2007, and describes the changes made in the 2007 update. Describe the nature of the changes made in the 2004 update beyond those described in Section F.2.4.1, if any.***

b. ***Section F.2.4 mentions the use of "bridge trees". Describe the bridge trees. Confirm whether they are separate event trees that link to the Level 1 trees or are bridge events incorporated directly into the Level 1 trees. Indicate whether they are quantified by direct linking or by binning.***

c. ***Describe any changes made to the definition and development of plant damage states subsequent to the IPE.***

d. ***Section F.2.4 states that, with one exception, the Modular Accident Analysis Program (MAAP) case selected to be representative for each release category was the same as for the IPE. The risk profile is much different now than in the IPE, for example, LOCCW - IPE < 1%, now 8%; SLOCAs – IPE 21%, now 2%; SBO – IPE 40%, now 14%. Provide further discussion and justification for the selection of the representative MAAP case for each release category.***

e. ***The release fractions for several nuclides for source term categories (STCs) 11 and 12 are reversed between Tables F-6 and F-10. Confirm which values are correct.***

f. ***Tables F-6 and F-10 indicate a zero release fraction for STCs 1 and 8. Even though these STCs may involve an intact containment, there will be some release to the environment due to normal leakage. Justify that omitting this contribution to total risk does not impact the results of the SAMA evaluation.***

Dominion Response to RAI 2

Response to 2.a

The 2004 update employed a different quantification tool from that of the IPE. The different quantification tool enabled graphical display of plant damage state, containment event, and source term category trees. The 2004 update also reflected a design change that ensured, in the event of a severe accident, water on the containment basement floor would spill into the reactor sump after reaching a level of 29 inches.

Response to 2.b

The term, "bridge tree", refers to event trees that include, as top events, plant systems and operator actions that impact the Level 2 accident sequence progression, but that do not change the frequency of core damage calculated by the event tree. The Kewaunee Level 1 event trees are defined in terms of not only the Level 1 top events, but also certain top events required for Level 2. The top events used for Level 2 are operation of containment fan coil units, containment spray, and low pressure injection onto a damaged core. The top events used for Level 2 are referred to as "bridge trees" in LRA Appendix E, Attachment F, Section F.2.4. These top events are an integral part of the Level 1 event trees. Including these systems in the overall quantification ensures that support system dependencies and other dependencies are considered properly in the overall sequence quantification results.

Response to 2.c

The plant damage states in the IPE were based on the following characteristics:

- Containment bypassed or not bypassed
- Early or late core damage
- High or low Reactor Coolant System pressure at the time of core damage
- Success or failure of low pressure injection
- Success or failure of containment spray
- Success or failure of containment fan coil units
- Success or failure of containment isolation

The current plant damage states include the following additional characteristics:

- Scrubbing of interfacing system LOCA release due to the presence of water.
- Scrubbing of steam generator tube rupture release due to the presence of water.
- Three different Reactor Coolant System pressure bins.
- Availability of power.
- Availability of feedwater.

The additional modeled characteristics enable a determination of the necessary parameters to estimate the probability of an induced steam generator tube rupture, which was not considered in the IPE and is a major LERF contributor in the current model.

Response to 2.d

The methodology of selecting MAAP runs in the Level 2 PRA Analysis was the same as that used for the IPE. However, the MAAP runs were rerun in 2004 using an updated version of the MAAP code and taking into account the power uprate implemented at Kewaunee. These MAAP runs were evaluated in 2007 to ensure that the sequence selected to represent each Source Term Category (STC) still reflected the expected accident progression for the associated source term category. For the source term categories that were not represented by existing MAAP runs, new cases were run.

The methodology for determining which MAAP case represents which source term was as follows. Once the Level 2 quantification was complete, a representative sequence was used to represent each source term category. The sequence with the highest frequency that bounded the source term category was selected as the representative sequence. When the Level 2 sequences were reanalyzed in 2007, the 2004 MAAP cases were examined. In most cases the existing MAAP runs represented the new source term categories. Although the frequencies of the source term categories have changed over the years, their physical characteristics remained the same.

Response to 2.e

The release fraction values in LRA Appendix E, Attachment F, Table F-6 are correct. The release fraction values in LRA Appendix E, Attachment F, Table F-10 are reversed.

Response to 2.f

The 2003 Integrated Leak Rate Testing Interval One-Time Extension Request for Information response in NMC letter NRC-03-121, dated December 12, 2003, contains a Level 2 PRA evaluation. In this evaluation, leakage rates from an intact containment were assumed to be at their maximum allowable value and the resultant dose for the intact containment source term categories was 120 person-REM. The frequencies for STCs 1 and 8 are 1.5E-6/yr and 2.6E-5/yr, respectively. The total dose risk for these STCs is (120 x (1.5E-6 + 2.6E-5)) or 3.3E-3 person-REM/yr. The total dose risk for all STCs is 30.2 person-REM/yr. If it is conservatively assumed that Kewaunee operates with the maximum leakage allowed, the effect of ignoring STCs 1 and 8 is a reduction of 3.3E-3 / 30.2 or 0.01% in the calculated dose risk. Therefore, neglecting the release rate from STCs 1 and 8 does not significantly impact the results of the SAMA evaluation.

NRC RAI 3

Provide the following information regarding the treatment of external events in the SAMA analysis:

a. ***Section F.2.3.1 summarizes several conservatisms in the fire PRA model. Indicate the fire zone(s) to which each conservatism is applicable.***

b. ***Section F.2.3.1 states that an assessment of the effects of plant procedure changes shows that the CDF would be reduced by a factor of 5 and that a more appropriate fire CDF would be 3.6 E-5. Discuss in more detail the assessment of procedure changes and the impact of the changes on the CDF for each of the fire zones listed in Table F-22.***

c. ***The individual plant examination of external events (IPEEE) safety evaluation report (SER) indicates that the protection of the underground diesel oil storage tank vents against tornado missiles is an open item. Confirm that this has been resolved, or address the implications for the SAMA analysis.***

d. ***Table 2.12 of NUREG-1742 indicates that Kewaunee had the potential for adverse seismic-fire interactions due to the presence of mercoid switches in the fire jockey pump and the Cardox system. Confirm that this has been resolved, or address the implications for the SAMA analysis.***

e. ***Although Table F-17 includes SAMAs for external events based on generic insights, the plant-specific fire and seismic risk results do not appear to have been systematically reviewed for the purpose of identifying potential external event SAMAs.***

   i. ***For each of the major fire risk contributors at KPS, provide an evaluation demonstrating that there are no viable SAMA candidates that would further reduce the fire risk. Address the impact of the weaknesses in the fire analysis (as identified in the IPEEE SER/technical evaluation report (TER)) on this evaluation.***

   ii. ***For each of the major seismic risk contributors at KPS, provide an evaluation demonstrating that there are no viable SAMA candidates that would further reduce the seismic risk. Address the impact of the weaknesses in the seismic analysis (as identified in the IPEEE SER/TER) on this evaluation.***

Dominion Response to RAI 3

Response to 3.a

Listed below are the conservatisms in the fire PRA model and the affected fire zone(s):

1. Initiating event frequencies are based on old data.
    - Applies to all fire zones
2. Model assumes isolation of opposite train and isolation of offsite power.
    - Applies to fires in the cable spreading area, the relay room, the A-train and B-train AFW pump rooms, the 480V bus 51 and 52 room and the A-train emergency diesel generator room.
3. Model assumes that if a cable tray is damaged, all cables within the tray are damaged.
    - Applies to all fire zones.
4. Fire damage results are based on conservative COMPBRN-IIIe results.
    - Applies to all fire zones except the B-train AFW pump room.
5. The most severe fire in a room is assumed to apply to the entire initiating frequency of the room.
    - Applies to all fire zones except the B-train AFW pump room.

Response to 3.b

In order to estimate the amount of conservatism in the Kewaunee IPEEE Fire Risk Analysis, the top 100 cutsets were examined. The initiators in these cutsets are fire events in one of the four locations described below.

Location 1: Control Room, Relay Room, or Safeguards Alley (Event IE-FIR5 in Table F-22)

Procedure OP-KW-AOP-FP-001, Abnormal Operating Procedure – Fire, indicates that, for a fire in the control room, relay room, or safeguards alley that results in the inability to monitor or control major plant parameters necessary for safe shutdown, operators perform the relevant actions in Appendices C and E to prevent inadvertent actuation/operation in the event of a fire in any other Alternate Zone (B-train). If the actions in those appendices do not work, procedure OP-KW-AOP-FP-002, Fire in Alternate Zone, is entered.

The IPEEE fire calculations assumed that the operators would immediately isolate offsite power, thus inducing a loss of offsite power event. However, based on the current procedure, OP-KW-AOP-FP-001, this is no longer the specified course of action. Thus, in cutsets that only involve failure of the A-train emergency diesel generator, failure of the offsite power supply to bus 5 would also have to occur. If it is conservatively assumed that all fire events in the relay room result in the offsite power supply breakers to bus 5 opening, the operators would have about 8 hours in which to close any of the above breakers (assuming the turbine driven AFW pump is available for the 8-hour battery life). A screening value of 0.1 can be used for failure to complete the action. Thus, these cutsets can be reduced by an order of magnitude.

Since shutdown is performed from the control room instead of the Dedicated Shutdown Panel (DSP) room, multiple trains of auxiliary feedwater (AFW) are available. Thus, additional independent failures are required, which will reduce cutsets involving a failure of the A-train AFW pump by at least an order of magnitude.

Some cutsets involve a failure of the check valve on a stopped AFW pump to close, resulting in backflow through the stopped pump. However, there is an additional parallel check valve that must fail for the short circuit to occur. Thus, an additional independent failure of a check valve is required, which will reduce any cutset with this type of check valve failure by several orders of magnitude.

Location 2: Dedicated Shutdown Panel (Event IE-FIR8 in Table F-22)

Procedure OP-KW-AOP-FP-001, Abnormal Operating Procedure – Fire, requires that, for a fire in the Dedicated Shutdown Panel (DSP) room that results in the inability to monitor or control major plant parameters necessary for safe shutdown, operators perform the relevant actions in Appendix D to prevent inadvertent actuation/operation in the event of a fire in any other Dedicated Zone (A-train). If the actions in those appendices do not work, procedure OP-KW-AOP-FP-003, Fire in Dedicated Zone, is entered.

The IPEEE fire calculations assumed that the operators would immediately isolate offsite power per procedure, thus inducing a loss of offsite power event. However, based on the current procedure, OP-KW-AOP-FP-001, this would not be the specified course of action. Thus, in cutsets that only involve failure of the B-train emergency diesel generator, failure of the offsite power supply to bus 6 would also have to occur. If it is conservatively assumed that all fire events in the DSP room result in the offsite power supply breakers to bus 6 opening, the operators would have about 8 hours in which to close any of the above breakers (assuming the turbine driven AFW pump is available for the 8-hour battery life). A screening value of 0.1 can be used for failure to complete the action. Thus, these cutsets can be reduced by an order of magnitude.

Service Water (SW) and Component Cooling Water (CCW) Systems are normally operating, and since operation of these systems is performed from the control room instead of from the DSP, at least one train of these systems is available. Thus, actions to manually start pumps at the DSP are not performed, and thus two more cutsets can be eliminated.

Since shutdown is performed from the control room instead of the DSP, multiple trains of CCW are available. Thus, additional independent failures are required, which will reduce the value of cutsets involving operator actions to restart SW and CCW Systems by at least an order of magnitude.

Location 3: EDG Rooms (Events IE-FIR4 and IE-FIR14 in Table F-22)

Procedure OP-KW-AOP-FP-001, Abnormal Operating Procedure – Fire, requires that, for a fire in the other relevant locations that results in the inability to monitor or control major plant parameters necessary for safe shutdown, operators perform the relevant actions in Appendices C, D, or E as appropriate to prevent inadvertent actuation/operation in the event of a fire.

The previous Kewaunee fire PRA assumed that the operators would immediately isolate offsite power per procedure, thus inducing a loss of offsite power event. However, based on the current procedure, OP-KW-AOP-FP-001, this is no longer the specified course of action. Thus, in cutsets involving failure of the emergency diesel generator in the unaffected room, failure of the offsite power supply to the unaffected emergency bus (i.e., the bus that is not in the room with the fire) would also have to occur. If a high energy arcing fault occurs in the breaker cubicle of the offsite power supply, it may propagate to the Tertiary (bus 5) or Reserve (bus 6) Auxiliary Transformer and cause damage that is irreparable in the near term. The frequency of these events is at least two orders of magnitudes less than the fire initiating event frequency assumed for the room, and it would not fail offsite power to the opposite train emergency bus. However, if it is conservatively assumed that all fire events in the EDG rooms (TU-90 or TU-92) result in the offsite power supply breakers to the opposite train emergency bus opening, the operators would have about 8 hours in which to close any of the above breakers (assuming the turbine driven AFW pump is available for the 8-hour battery life). A screening value of 0.1 can be used for failure of the action. Thus, these cutsets can be reduced by an order of magnitude.

SW and CCW Systems are normally operating, and since shutdown is performed from the control room instead of the DSP, at least one train of these systems is available. Thus, actions to manually start pumps at the DSP are not performed, and thus two more cutsets can be eliminated.

Since shutdown is performed from the control room instead of the DSP, multiple trains of CCW are available. Thus, additional independent failures are required, which will reduce the value of cutsets involving operator actions to restart SW and CCW Systems by at least an order of magnitude.

Location 4: AFW Pump Rooms (Events IE-FIR6 and IE-FIR7 in Table F-22)

If it is conservatively assumed that all fire events in the A-train AFW pump room or the B-train AFW pump section of safeguards alley result in the offsite power supply breakers to the opposite train emergency bus opening, the operators would have about 8 hours in which to close any of the above breakers (assuming the TDAFW pump is available for the 8-hour battery life). A screening value of 0.1 can be used for failure of the action. Thus, cutsets that only involve failure of the opposite train emergency diesel generator can be reduced by an order of magnitude.

SW and CCW Systems are normally operating, and since shutdown is performed from the control room instead of the DSP, at least one train of these systems is available. Thus, actions to manually start pumps at the DSP are not performed and cutsets involving operator actions to restart SW and CCW Systems can be eliminated.

Since shutdown is performed from the control room instead of the DSP, multiple trains of CCW are available. Thus, additional independent failures are required, which will eliminate cutsets involving failure of one train of CCW.

As stated above, the top 100 cutsets were examined in order to estimate the amount of conservatism in the latest Kewaunee Fire Risk Analysis. Of those 100 cutsets, 73 were determined to be conservative, including the top 13 cutsets. Table 3.b-1 summarizes the CDF contribution for the original cutsets and the CDF contribution for the recalculated cutsets. As indicated in Table 3.b-1, the overall fire event CDF contribution of the top 100 cutsets was reduced by about 80%. A similar decrease is expected in the rest of the cutsets. Thus, the latest Kewaunee Fire Risk Analysis is estimated to be conservative by a factor of about 5.

Table 3.b-1

Cutset Number	Initiating Event	CDF Contribution Of Top 100 Cutsets = 1.33E-04 /yr	Additional Failure Probability	Recalculated CDF Contribution Of Top 100 Cutsets = 2.59E-05 /yr
1	IE-FIR5	1.17E-05 /yr	0.1	1.17E-06 /yr
2	IE-FIR14	1.15E-05 /yr	0.1	1.15E-06 /yr
3	IE-FIR14	9.00E-06 /yr	0.1	9.00E-07 /yr
4	IE-FIR4	9.00E-06 /yr	0.1	9.00E-07 /yr
5	IE-FIR14	6.88E-06 /yr	0	0.00E+00 /yr
6	IE-FIR8	6.65E-06 /yr	0.1	6.65E-07 /yr
7	IE-FIR8	5.18E-06 /yr	0.1	5.18E-07 /yr
8	IE-FIR5	3.99E-06 /yr	0.1	3.99E-07 /yr
9	IE-FIR8	3.96E-06 /yr	0	0.00E+00 /yr
10	IE-FIR5	3.35E-06 /yr	0.1	3.35E-07 /yr
11	IE-FIR6	3.28E-06 /yr	0.1	3.28E-07 /yr
12	IE-FIR4	3.07E-06 /yr	0.1	3.07E-07 /yr
13	IE-FIR14	2.72E-06 /yr	0.1	2.72E-07 /yr

Table 3.b-1				
Cutset Number	**Initiating Event**	**CDF Contribution Of Top 100 Cutsets = 1.33E-04 /yr**	**Additional Failure Probability**	**Recalculated CDF Contribution Of Top 100 Cutsets = 2.59E-05 /yr**
14	IE-FIR10	2.66E-06 /yr	1 (no change)	2.66E-06 /yr
15	IE-FIR11	2.66E-06 /yr	1 (no change)	2.66E-06 /yr
16	IE-FIR6	2.55E-06 /yr	0.1	2.55E-07 /yr
17	IE-FIR6	1.95E-06 /yr	0	0.00E+00 /yr
18	IE-FIR14	1.87E-06 /yr	0	0.00E+00 /yr
19	IE-FIR5	1.69E-06 /yr	0.1	1.69E-07 /yr
20	IE-FIR8	1.57E-06 /yr	0.1	1.57E-07 /yr
21	IE-FIR5	1.39E-06 /yr	1 (no change)	1.39E-06 /yr
22	IE-FIR4	1.30E-06 /yr	0.1	1.30E-07 /yr
23	IE-FIR14	1.30E-06 /yr	0.1	1.30E-07 /yr
24	IE-FIR5	1.18E-06 /yr	0.1	1.18E-07 /yr
25	IE-FIR5	1.15E-06 /yr	1 (no change)	1.15E-06 /yr
26	IE-FIR8	1.08E-06 /yr	0	0.00E+00 /yr
27	IE-FIR14	1.03E-06 /yr	1 (no change)	1.03E-06 /yr
28	IE-FIR4	9.08E-07 /yr	0.1	9.08E-08 /yr
29	IE-FIR14	9.08E-07 /yr	0.1	9.08E-08 /yr
30	IE-FIR11	9.06E-07 /yr	1 (no change)	9.06E-07 /yr
31	IE-FIR5	9.03E-07 /yr	0.1	9.03E-08 /yr
32	IE-FIR5	9.00E-07 /yr	0.1	9.00E-08 /yr
33	IE-FIR5	9.00E-07 /yr	0.1	9.00E-08 /yr
34	IE-FIR14	8.19E-07 /yr	0.1 or lower	8.19E-08 /yr
35	IE-FIR10	8.03E-07 /yr	1 (no change)	8.03E-07 /yr
36	IE-FIR6	7.72E-07 /yr	0.1	7.72E-08 /yr
37	IE-FIR8	7.47E-07 /yr	0.1	7.47E-08 /yr
38	IE-FIR14	6.94E-07 /yr	0.1	6.94E-08 /yr
39	IE-FIR4	6.94E-07 /yr	0.1	6.94E-08 /yr
40	IE-FIR4	6.91E-07 /yr	0.1	6.91E-08 /yr
41	IE-FIR4	6.91E-07 /yr	0.1	6.91E-08 /yr
42	IE-FIR14	6.91E-07 /yr	0.1	6.91E-08 /yr
43	IE-FIR5	6.50E-07 /yr	0.1	6.50E-08 /yr
44	IE-FIR8	5.93E-07 /yr	1 (no change)	5.93E-07 /yr
45	IE-FIR5	5.72E-07 /yr	0.1 or lower	5.72E-08 /yr
46	IE-FIR6	5.30E-07 /yr	0	0.00E+00 /yr

Table 3.b-1				
Cutset Number	**Initiating Event**	**CDF Contribution Of Top 100 Cutsets = 1.33E-04 /yr**	**Additional Failure Probability**	**Recalculated CDF Contribution Of Top 100 Cutsets = 2.59E-05 /yr**
47	IE-FIR8	5.23E-07 /yr	0.1	5.23E-08 /yr
48	IE-FIR5	5.04E-07 /yr	0.1 or lower	5.04E-08 /yr
49	IE-FIR14	5.00E-07 /yr	0.1	5.00E-08 /yr
50	IE-FIR4	5.00E-07 /yr	0.1	5.00E-08 /yr
51	IE-FIR5	4.89E-07 /yr	0.1	4.89E-08 /yr
52	IE-FIR8	4.72E-07 /yr	0.1 or lower	4.72E-08 /yr
53	IE-FIR14	4.62E-07 /yr	0.1 or lower	4.62E-08 /yr
54	IE-FIR14	4.55E-07 /yr	1 (no change)	4.55E-07 /yr
55	IE-FIR8	4.00E-07 /yr	0.1	4.00E-08 /yr
56	IE-FIR8	3.98E-07 /yr	0.1	3.98E-08 /yr
57	IE-FIR11	3.83E-07 /yr	1 (no change)	3.83E-07 /yr
58	IE-FIR10	3.83E-07 /yr	1 (no change)	3.83E-07 /yr
59	IE-FIR14	3.75E-07 /yr	0.1	3.75E-08 /yr
60	IE-FIR4	3.75E-07 /yr	0.1	3.75E-08 /yr
61	IE-FIR6	3.68E-07 /yr	0.1	3.68E-08 /yr
62	IE-FIR5	3.33E-07 /yr	0.1 or lower	3.33E-08 /yr
63	IE-FIR14	3.20E-07 /yr	1 (no change)	3.20E-07 /yr
64	IE-FIR5	3.00E-07 /yr	1.00E-03 or lower	3.00E-10 /yr
65	IE-FIR5	3.00E-07 /yr	1.00E-03 or lower	3.00E-10 /yr
66	IE-FIR5	2.97E-07 /yr	0.1 or lower	2.97E-08 /yr
67	IE-FIR6	2.92E-07 /yr	1 (no change)	2.92E-07 /yr
68	IE-FIR8	2.88E-07 /yr	0.1	2.88E-08 /yr
69	IE-FIR10	2.68E-07 /yr	1 (no change)	2.68E-07 /yr
70	IE-FIR11	2.68E-07 /yr	1 (no change)	2.68E-07 /yr
71	IE-FIR8	2.66E-07 /yr	0.1 or lower	2.66E-08 /yr
72	IE-FIR8	2.62E-07 /yr	1 (no change)	2.62E-07 /yr
73	IE-FIR6	2.58E-07 /yr	0.1	2.58E-08 /yr
74	IE-FIR5	2.45E-07 /yr	0.1 or lower	2.45E-08 /yr
75	IE-FIR10	2.42E-07 /yr	1 (no change)	2.42E-07 /yr
76	IE-FIR5	2.41E-07 /yr	0.1 or lower	2.41E-08 /yr
77	IE-FIR6	2.32E-07 /yr	0.1 or lower	2.32E-08 /yr
78	IE-FIR14	2.30E-07 /yr	0.1 or lower	2.30E-08 /yr
79	IE-FIR8	2.16E-07 /yr	0.1	2.16E-08 /yr

Table 3.b-1				
Cutset Number	**Initiating Event**	**CDF Contribution Of Top 100 Cutsets = 1.33E-04 /yr**	**Additional Failure Probability**	**Recalculated CDF Contribution Of Top 100 Cutsets = 2.59E-05 /yr**
80	IE-FIR10	2.05E-07 /yr	1 (no change)	2.05E-07 /yr
81	IE-FIR11	2.05E-07 /yr	1 (no change)	2.05E-07 /yr
82	IE-FIR11	2.04E-07 /yr	1 (no change)	2.04E-07 /yr
83	IE-FIR11	2.04E-07 /yr	1 (no change)	2.04E-07 /yr
84	IE-FIR10	2.04E-07 /yr	1 (no change)	2.04E-07 /yr
85	IE-FIR6	1.97E-07 /yr	0.1	1.97E-08 /yr
86	IE-FIR6	1.96E-07 /yr	0.1	1.96E-08 /yr
87	IE-FIR8	1.85E-07 /yr	1 (no change)	1.85E-07 /yr
88	IE-FIR14	1.78E-07 /yr	0.1 or lower	1.78E-08 /yr
89	IE-FIR5	1.65E-07 /yr	0.1 or lower	1.65E-08 /yr
90	IE-FIR5	1.54E-07 /yr	0.1	1.54E-08 /yr
91	IE-FIR5	1.50E-07 /yr	0.1	1.50E-08 /yr
92	IE-FIR5	1.50E-07 /yr	0.1 or lower	1.50E-08 /yr
93	IE-FIR10	1.48E-07 /yr	1 (no change)	1.48E-07 /yr
94	IE-FIR11	1.48E-07 /yr	1 (no change)	1.48E-07 /yr
95	IE-FIR6	1.42E-07 /yr	0.1	1.42E-08 /yr
96	IE-FIR10	1.36E-07 /yr	1 (no change)	1.36E-07 /yr
97	IE-FIR8	1.33E-07 /yr	0.1 or lower	1.33E-08 /yr
98	IE-FIR6	1.31E-07 /yr	0.1 or lower	1.31E-08 /yr
99	IE-FIR6	1.29E-07 /yr	1 (no change)	1.29E-07 /yr
100	IE-FIR7	1.28E-07 /yr	0.1	1.28E-08 /yr

Table 3.b-2 shown below indicates the effect of the multipliers on each initiating event:

Table 3.b-2							
Rank	**Event ID**	**Description**	**Mult**	**CDF**	**CDF w/ Mlt**	**LERF**	**LERF w/ Mlt**
1	IE-FIR5	FIRE IN RELAY ROOM	0.170	3.26E-05	5.55E-06	1.15E-08	1.96E-09
2	IE-FIR10	FIRE IN BUS 5 SWITCHES IN ECCA	1.000	5.49E-06	5.49E-06	1.93E-09	1.93E-09
3	IE-FIR11	FIRE IN BUS 6 SWITCHES IN ECCA	1.000	5.23E-06	5.23E-06	1.85E-09	1.85E-09
4	IE-FIR14	FIRE IN DIESEL GENERATOR RM A	0.119	4.16E-05	4.94E-06	1.47E-08	1.75E-09
5	IE-FIR8	FIRE NEAR BUSES 51 AND 52	0.119	2.40E-05	2.85E-06	8.41E-09	9.99E-10
6	IE-FIR4	FIRE IN DIESEL GENERATOR RM B	0.100	1.77E-05	1.77E-06	6.32E-09	6.32E-10

7	IE-FIR6	AFW PUMP A OIL FIRE	0.112	1.18E-05	1.32E-06	4.11E-09	4.60E-10
8	IE-FIR2	FIRE IN CABLE SPREADING ROOM	1.000	2.34E-07	2.34E-07	4.94E-11	4.94E-11
9	IE-FIR7	AFW PUMP B OIL FIRE	0.100	3.52E-07	3.52E-08	8.11E-11	8.11E-12
10	IE-FIR9	FIRE NR GAS BTLS ON FAN FLOOR	1.000	1.13E-08	1.13E-08	0.00E+00	0.00E+00
11	IE-FIR13	FIRE IN PRZR PORV SWS IN MCCC	1.000	1.12E-08	1.12E-08	0.00E+00	0.00E+00
12	IE-FIR12	FIRE IN SG PORV SWS IN MCCA	1.000	1.04E-08	1.04E-08	1.25E-12	1.25E-12
13	IE-FIR3	FIRE IN BUS 1 AND 2 ROOM	1.000	9.66E-10	9.66E-10	0.00E+00	0.00E+00
14	IE-FIR1	FIRE NEAR MCC-62J	1.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		Total for all zones		1.39E-04	2.75E-05	4.90E-08	9.63E-09

Response to 3.c

Protection of the underground diesel oil storage tank vents against tornado missiles is no longer an open item with respect to the Individual Plant Examination of External Events (IPEEE). In 2005, these vents were lowered so they would not extend significantly above the top of the concrete Turbine Building foundation. Lowering the vents ensures that they would not be crimped by breakaway of the metal side panels of the Turbine Building, thus greatly reducing the tornado risk below the threshold for consideration in the IPEEE. Therefore, the issue identified in the IPEEE is considered resolved. Nevertheless, while resolved from an IPEEE standpoint, a future separation modification is planned which will further minimize the tornado risk.

Response to 3.d

As stated in the Kewaunee Individual Plant Examination of External Events (IPEEE), during a seismic event, the failure mode of the mercoid switches in the fire jockey pump and the Cardox System would be to prevent the jockey pump or Cardox System from operating. Therefore, the only case in which a seismic failure of the switches would be an issue would be in a concurrent fire and seismic event. As a result of a seismic walkdown, the IPEEE also concluded that there was no potential for fire-seismic interactions and that the probability of an independent fire concurrent with a seismic event was negligible. Therefore, the mercoid switches in the fire jockey pump and the Cardox System were not seen as a vulnerability and were not replaced. The staff evaluation report of the Kewaunee IPEEE specifically states that the fire-seismic interactions issue is closed. No changes have occurred since the IPEEE that would change this conclusion. Additionally, these switches were not credited in the seismic risk assessment, so there are no implications related to the SAMA analysis.

Response to 3.e.i

Both the Kewaunee Individual Plant Examination of External Events (IPEEE) and the IPEEE SER/technical evaluation report were reviewed as part of the initial identification of potential SAMA items. As stated in Section 4.0 of the IPEEE SER/technical evaluation report, no vulnerabilities to external events were identified through the IPEEE and no major plant changes were deemed necessary based on the IPEEE.

The response to RAI 3.b provided above details, for the risk-significant fire areas, the impact to fire CDF resulting from procedural changes and plant improvements completed since the IPEEE. As stated in that response, explicit modeling of these changes, as well as removing the known conservatisms described, would lower the internal fire-related CDF to less than 3.6E-05 per year, which is less than half the internal events-related CDF of 7.7E-05. The response provided to RAI 3.b describes the major fire risk contributors at Kewaunee.

Dominant Cutsets

The dominant cutsets from the analysis summarized in the response to RAI 3.b were reviewed to determine if any additional SAMA items not already identified could reduce fire risk. The results of this review are summarized below.

The dominant cutsets for fires in one of the two diesel rooms involve failure of the emergency diesel generator located in the opposite-train room. Failure of the other emergency diesel generator may be a result of either direct failure or failure of ventilation systems. Preventing failure of the emergency diesel generator is evaluated in SAMA items 55, 56, 58, 21, and 22. Ventilation-related emergency diesel generator failures are evaluated in SAMA items 80, 160, 166, 167, 170, and 171.

The dominant cutsets for relay room fires involve failure of at least one emergency diesel generator either directly or through failure of ventilation systems. Preventing failure of the emergency diesel generator is evaluated in SAMA items 55, 56, 58, 21, and 22. Ventilation-related emergency diesel generator failures are evaluated in SAMA items 80, 160, 166, 167, 170, and 171.

The dominant cutsets for fires near buses 51 or 52 involve failure of at least one emergency diesel generator either directly or through failure of ventilation systems. Preventing failure of the emergency diesel generator is evaluated in SAMA items 21, 22, 55, 56, and 58. Ventilation-related emergency diesel generator failures are evaluated in SAMA items 80, 160, 166, 167, 170, and 171.

The dominant cutsets for fires in one of the AFW pump rooms involve failure of the emergency diesel generator located in the opposite-train room. Failure of the opposite train emergency diesel generator may be either direct failure or through failure of ventilation systems. Preventing failure of the emergency diesel generator is evaluated in SAMA items 55, 56, 58, 21, and 22. Ventilation-related emergency diesel generator failures are evaluated in SAMA items 80, 160, 166, 167, 170, and 171.

Weaknesses

The IPEEE Technical Evaluation Report (TER) identified several weaknesses with the IPEEE internal fire evaluation. The first two weaknesses relate to documentation of how the COMPBRN code was used to evaluate initiating event locations and frequency values. Although addressing these weaknesses may provide a better understanding of the process used to evaluate internal fires, there is no indication that an improper or non-conservative analysis method was used. Therefore, the internal fire analysis results are considered valid and no new SAMA items are expected to be identified by addressing these weaknesses.

The third weakness relates to not considering fires that have occurred at Kewaunee in the initiating event frequency analysis. The first event cited involved an emergency diesel generator room fire that occurred in 1977 due to carbon buildup in the exhaust. At that time, testing of the emergency diesel generators involved performing a fast start of the engine without placing a load on the generator. Once the fast start was verified, the diesel was secured. These testing conditions were conducive to carbon build-up in the exhaust. Currently, emergency diesel generator testing involves running the engines under load for a minimum of one hour. This operating practice does not promote carbon buildup and, therefore, the cause of this fire would no longer be applicable to Kewaunee operation. The second event cited was a fire in the main auxiliary transformer, which is located outside and on grade level. The 4kV AC switchgear rooms are located below grade away from these transformers. Therefore, the cited event would not be applicable to fire frequency inside the plant. Resolution of the third weakness, therefore, would not result in the identification of any new SAMA items.

The fourth weakness involves the resolution of Generic Issue (GI) 57. The identified weakness is not with the internal fire analysis, but rather with the thoroughness of the actions taken to resolve GI-57. It should be noted that GI-57 was considered resolved by the IPEEE analysis. Since this weakness does not relate directly to the internal fire PRA, resolution of this weakness would not cause any change to fire risk and, therefore, no new SAMA items would be identified.

The fifth weakness is concerned with screening out large portions of the Auxiliary Building from consideration. These areas were not considered because they are large and open areas. The weakness states that radiant energy from fires near safety-related equipment could cause equipment damage. Although a fire very near a component located in a large open area could cause damage by radiant energy from a fire, this potential must be balanced with the lower probability that a fire will occur in a specific location in a large area as opposed to anywhere in the area. The large open areas cited in the weakness, AX-23A and AX-23B, do contain safety-related equipment, but the equipment is generally separated from other equipment by rooms consisting of concrete walls or fire barriers. However, the entrance to individual rooms is generally through open access ways configured to minimize radiation shine. Thus, while the areas are considered open, a fire is unlikely to radiate and damage equipment located in another area room. Therefore, it is concluded that this weakness would not identify any new SAMA items.

The sixth weakness cites that walkdowns did not verify that fire suppression system placement and sizing were correct. Although not verified in the IPEEE analyses, the weakness does not give indication that any fire suppression systems are inadequately designed. Kewaunee has an in-depth fire protection program which ensures that fire protection systems are designed and operated properly and in compliance with applicable codes and standards. Thus, this weakness is considered to reflect only on the completeness of the supporting documentation of the IPEEE and not on the overall results. Therefore, it is concluded that resolution of this weakness would not identify any new SAMA items.

The seventh weakness deals with the consideration of fire barriers that are impaired prior to the fire initiating event. As discussed above, Kewaunee has an in-depth fire protection program to ensure that fire barriers are maintained as designed. Barrier impairment procedures are in place to track, mitigate, and rectify any impaired fire barriers. Therefore, it is concluded that resolution of this weakness would not identify any new SAMA items.

The eighth weakness indicates that transient combustibles were not considered when screening out the emergency diesel generator fuel oil day tank room. Although transient combustibles may not have been considered, the overall impact is expected to result in only a small change in frequency. Therefore, it is concluded that resolution of this weakness would not identify any new SAMA items.

The ninth weakness relates to completeness of the submittal, indicating that specific component failures due to fire effects or suppression activities were not identified. Since this weakness is only related to thoroughness of documentation, it is concluded that resolution of this weakness would not identify any new SAMA items.

The last weakness relates to the assumption that blown fuses would protect control circuits from the effects of a control panel fire. As noted in the TER discussion of this weakness, operator action to remove fuses based on procedural guidance would have the same effect of protecting circuits. Current Kewaunee abnormal procedures for fire response direct that fuses for many circuits be pulled. Therefore, it is concluded that resolution of this weakness would not identify any new SAMA items.

Response to 3.e.ii

Both the Kewaunee Individual Plant Examination of External Events (IPEEE) and the IPEEE SER/technical evaluation report were reviewed as part of the initial identification of potential SAMA items. As stated in Section 4.0 of the IPEEE SER/technical evaluation report, no vulnerabilities to external events were identified through the IPEEE and no major plant changes were deemed necessary based on the IPEEE.

The results of the IPEEE analysis were reviewed to determine if any additional SAMA items not already identified could reduce seismic risk. The results of this review are summarized below.

Dominant Sequences

Six sequences dominate the seismic risk for Kewaunee. The first dominant sequence is a seismic event followed by failure of the containment structure or steam generators. This sequence is assumed to lead directly to core damage. The cost of strengthening these structures to withstand higher peak ground acceleration (PGA) levels is considered greater than the maximum available benefit.

The second dominant sequence is a seismic event followed by failure of the Screenhouse, Auxiliary Building, Turbine Building, or Reactor Containment Vessel. This sequence is assumed to lead directly to core damage. The cost of strengthening these structures to withstand higher PGA levels is considered greater than the maximum available benefit.

The third dominant sequence is a loss of off-site power and failure of the Auxiliary Feedwater (AFW) System. Failure of the AFW System is attributed to failure of the operator to shift the AFW pumps suction from the Condensate Storage Tank (CST) to the Service Water (SW) System. A sensitivity analysis performed as part of the IPEEE evaluated the effect of reducing the failure probability of operator action to switch AFW pump suction. That analysis showed a 2-percent reduction in seismic CDF. Such a small reduction in CDF would show little benefit. Furthermore, SAMA items to improve long-term AFW suction availability are evaluated with SAMA items 71 and 172 with an additional evaluation provided in the response to RAI 8.a. Therefore, it is concluded that no new SAMA items would be identified to reduce the risk presented by this sequence.

The fourth dominant sequence has a frequency of 1.0E-06 per year and is a failure of the emergency AC power system, including the emergency diesel generators, and supporting mechanical and electrical equipment. All components in the AC power system have median capacities of 1.86g PGA or greater which is quite robust. Since the components that contribute to this sequence are robust and the sequence has a low frequency, strengthening the components to withstand higher PGA would likely be expensive and produce little benefit. Therefore, it is concluded that no new SAMA items would be identified to reduce the risk presented by this sequence.

The fifth dominant sequence has a frequency of 9.0E-07 per year and is failure of the SW System. Failure of the SW System is dominated by failure of the Intake Structure, which is modeled using the surrogate component. The Intake Structure was screened based on a High Confidence Low Probability of Failure (HCLPF) level of 0.30g. All other components in the SW System have median seismic capacities of 0.66g PGA or greater. The cost of strengthening the Intake Structure to withstand higher PGA levels is considered greater than the maximum available benefit.

The sixth dominant sequence is failure of the DC power system, including failure of the station batteries, battery chargers, cable trays and electrical support equipment. This sequence has a frequency of 4E-07 per year. All components in the DC power system have median seismic capacities of 1.10g PGA or greater. As a result, failure of DC power is dominated by failure of the surrogate component. Given the low frequency of this sequence, very little benefit would be obtained from efforts to reduce the importance further. Therefore, it is concluded that no new SAMA items would be identified to reduce the risk presented by this sequence.

Weaknesses

The IPEEE TER identified five weaknesses with the IPEEE seismic evaluation. The first weakness relates to the use of the surrogate component to screen components. Use of the surrogate component in the seismic analysis results in risk values that overstate the risk that would be calculated if a more detailed evaluation of component seismic capacity was used. The seismic risk at Kewaunee is low relative to the risk from other events. Removing the conservatism from the analysis would result in a lower risk. Therefore, it is concluded that no new SAMA items are expected to be identified by resolving this weakness.

The second weakness relates to the use of a uniform hazard spectrum (UHS) curve other than recommended in NUREG-1407. Although use of a different UHS curve could produce a slightly different response, the frequency of seismic events at Kewaunee, particularly seismic events of a magnitude to threaten plant components, is very low. The seismic PRA documentation includes a sensitivity study using the Lawrence Livermore National Laboratory (LLNL) mean seismic hazard curves. The results of this sensitivity study show only a 15% increase in CDF versus the IPEEE base case. Therefore, it is concluded that no new SAMA items are expected to be identified by resolving this weakness.

The third weakness identified that calculations for the probability of operator actions required after a seismic event did not consider the locations or environment that could exist after the seismic event. A sensitivity evaluation presented in the IPEEE increased the failure probability of each operator action by one order of magnitude and showed insignificant changes in CDF. Another evaluation reduced operator failure probabilities by one order of magnitude and also showed insignificant changes in CDF. Since the overall seismic results are insensitive to changes in operator error probability values, it is concluded that no new SAMA items are expected to be identified by resolving this weakness.

The fourth weakness identified that certain specific procedural changes were not proposed as a result of the analysis. As discussed above, sensitivity analyses show that overall seismic risk is not sensitive to changes in the probability of operator errors. Therefore, it is concluded that no new SAMA items are expected to be identified by resolving this weakness.

The last weakness noted that changes to the Residual Hear Removal (RHR) heat exchangers to reduce seismic risk have not been considered. The dominant seismic results discussed above did not show the RHR heat exchangers to be a significant contributor. Since the seismic analysis from the IPEEE is conservative and low, and since the RHR heat exchangers are not significant contributors to seismic risk, it is concluded that resolution of this weakness would not identify any new SAMA items.

NRC RAI 4

Provide the following information relative to the Level 3 PRA analysis:

a. ***Provide additional information on how the population growth rates and the transient population data were developed, including the source of the county growth rates, how the growth rate estimates were applied, and how growth was estimated for the transient population.***

b. ***The base case analysis assumes all releases occur at the top of the containment with an ambient thermal content. Demonstrate that the resulting population doses bound those expected for a steam generator tube rupture (SGTR) with failure of secondary side isolation, which is the dominant contributor to population dose at KPS.***

c. ***The core radionuclide inventory is stated as being based on an end-of-cycle ORIGEN2 analysis for KPS. Confirm that this core inventory reflects the expected fuel management/burnup during the license renewal period.***

d. ***Describe the methodology and data sources used to fill in any gaps in the onsite meteorology data.***

Dominion Response to RAI 4

Response to 4.a

Population growth rates were based on Wisconsin county population projections for the years 2000-2030, provided by the Demographics Service Center of the Wisconsin Department of Administration in its "Final Population Projections for Wisconsin Counties by Components of Change: 2000-2030," available at:

http://www.doa.state.wi.us/docs_view2.asp?docid=2065

Both geometric and exponential annual county growth rates were calculated for the 2030-2033 population growth. The exponential rates were found to result in a larger projected 2033 population surrounding the site and were applied to the population in each of the 160 population wedges (10 distance rings x 16 directions). Individual county growth rates were applied to the fraction of area of each wedge in each county.

The transient population was taken from the site's evacuation time estimate study. The transient population was added to the residential population (taken from the 2000 census) and the growth rates described above were applied to the total.

Response to 4.b

LRA Appendix E, Attachment F, Section F.3.7 describes a sensitivity analysis of Level 3 input parameters, including release height and release heat. Total risk, with the contributions from all source term categories including number 13 (SGTR with failure of secondary side isolation), was calculated for ground-level release and for release heat content of 1 and 10 megawatts (MW). The total risk for an additional release height sensitivity case, release halfway up the containment, was performed for this response.

LRA Appendix E, Attachment F, Table F-14 shows the insensitivity of the total dose and cost risk to changes in release height and release heat. A ground-level release height is seen to result in 6% less risk (dose and cost) than the base case top of containment release. The mid-containment release risk is intermediate between the ground-level and top of containment release. Table F-14 also shows the insensitivity of the total risk to changes in release heat. Releases with 10 MW per release segment (each source term category is modeled with 4 release segments) indicate an increase of up to 5% in total risk (cost risk in this case) compared with the base case; the 1 MW per release segment case shows a result intermediate of the 0 (base case) and 10 MW per release segment cases.

Section F.3.7 also describes the conservative base case assumption of imposing perpetual rainfall in the 40-50 mile segment surrounding the Kewaunee site. Table F-14 shows that modeling the measured time-varying meteorology in this segment, as is done in all other segments, as opposed to the base case perpetual rainfall assumption, would result in a decrease in dose and cost risk of 61 and 66%, respectively. Section F.3.7 notes that this conservative base case assumption "is seen to more than balance any increases that might be due to alternative specification of release parameters." Therefore, the presented base case total risk bounds any possible perturbations in release height and release heat.

Response to 4.c

The core inventory used in the Level 3 PRA analysis reflects the current Kewaunee core inventory. Kewaunee has no current plans that would cause fuel management/burnup to change during the license renewal period.

Response to 4.d

Gaps in onsite meteorology data were filled in using the data substitution priority indicated in the Table 4.d-1.

Table 4.d-1

Measurement	Primary	Secondary	Tertiary	Quaternary	5th	6th	7th
Wind Direction	197-foot elevation	33-foot elevation	Backup 33-foot elevation	Point Beach 148-foot elevation	Point Beach 33-foot	Sheboygan, WI CMAN Station 63-foot	Austin Straubel Airport, Green

Table 4.d-1							
Measurement	**Primary**	**Secondary**	**Tertiary**	**Quaternary**	**5th**	**6th**	**7th**
					elevation	elevation	Bay, WI 33-foot elevation
Wind Speed	197-foot elevation	33-foot elevation	Backup 33-foot elevation	Point Beach 148-foot elevation	Point Beach 33-foot elevation	Sheboygan, WI CMAN Station 63-foot elevation	Austin Straubel Airport, Green Bay, WI 33-foot elevation
Stability	197-foot Delta T	33-foot Variance	Backup 33-foot Variance	Point Beach Delta T and 148-foot Variance			
Precipitation	Sturgeon Bay, WI Ground-level	Austin Straubel Airport, Green Bay, WI Ground-level					

The 33, 63, 148, and 197-foot wind speed data, if used, were extrapolated to the elevation of the top of containment.

Traditional default power law exponents for extrapolation of hourly wind speeds were used. These values for Pasquill Stability categories A through G are as follows:

A(1): -0.12
B(2): -0.16
C(3): -0.20
D(4): -0.25
E(5): -0.30
F(6): -0.40
G(7): -0.40

A professional meteorologist, using available hourly weather conditions present in the event of no other available stability data, interpolated the stability category.

NRC RAI 5

Provide the following information with regard to the selection and screening of Phase I SAMA candidates:

a. For Item 2 in Table F-3 (LOSP-24, Loss of all power from the grid during 24 hours), it is stated that the ability to isolate flooding events without requiring power "would greatly lower the importance of this event" and that SAMA 168 (Provide the ability to manually close electrically operated valves needed to isolate flooding events) is applicable. The Fussell-Vesely value for LOSP-24 is 0.1793. However, the evaluation of SAMA 168 in Section F.6.31 resulted in only a 1% reduction in CDF. Explain why the impact of this SAMA is so small. Identify and discuss alternative SAMAs that might be more effective in addressing this important risk contributor.

b. For items 22, 23 and 35 (and others) in Table F-3, adding a refueling water storage tank (RWST) low level alarm and/or an automatic refilling system for the RWST could potentially reduce dependency on prior action or eliminate the need for the operator to refill the RWST. Provide an evaluation of these alternative SAMAs.

c. In several places in Table F-17 (SAMAs 7 and 30, for example), the SAMA is stated to be already implemented, but the basis for this statement (e.g., citation of a specific procedure change) is not cited. Provide the basis for the statement that the SAMA is already implemented for all SAMAs where no citation is currently provided.

d. SAMA 10 (Revise procedure to allow bypass of diesel generator trips) is stated in Table F-17 to be of very low benefit based on review of only 8 months of EDG failure data (January 2001 through August 2001). Justify that this is enough data to exclude trip circuitry as a cause of EDG unavailability.

e. The potential enhancement for SAMA 64 involves either implementing procedure and hardware modifications to allow manual alignment of the fire water system to the component cooling water (CCW) system or installing a cooling water header cross-tie. Table F-17 indicates that this SAMA is already implemented, apparently on the basis that the system is normally cross-tied. Confirm that the CCW system can be manually cross-tied to the fire water system or, if this capability does not exist, evaluate its addition as a potential SAMA.

f. It is stated in Table F-17 that KPS does not have a diesel-driven fire pump. Discuss the potential benefits (in both internal events and fire events) of adding a diesel-driven fire pump at KPS.

g. ***For SAMA 144 (Install additional transfer and isolation switches), it is noted in Table F-17 that spurious actuations do not contribute to fire CDF since no credit is taken for equipment that is not specifically analyzed to survive a fire. It is not clear how not taking credit for this equipment reduces the importance of spurious actuations. Provide further justification for screening out this SAMA or consider appropriate plant improvements.***

h. ***SAMA 151 (Increase training and operating experience feedback to improve operator response) is dispositioned in Table F-17 as needing further evaluation. However, it is not included among the SAMAs that were further evaluated (as listed in Table F-19). Also, the comments in the column "Results of Potential Enhancement" for this item refer to Tables 5 and 6, but no such tables are provided in the ER. Clarify the disposition of SAMA 151.***

Dominion Response to RAI 5

Response to 5.a

A loss of offsite power from the grid within the 24 hours immediately following an initiating event (basic event LOSP-24) is important for several reasons. First, this event renders the Feedwater System unavailable. Additional reasons for the importance of this event are: (1) the need for power to isolate internal flooding sources and (2) the unavailability of equipment as a result of the various flooding events. The reason that the benefit of SAMA 168 is small is that the improvement addresses only isolation of flood sources and not loss of equipment availability.

SAMA 169 evaluated the benefits of protecting the MCCs from submergence and concluded that the SAMA could be cost beneficial. Equipment may be made unavailable either as a direct result of the flood, e.g., through spray or submergence, or indirectly by actions taken to isolate the flood. Numerous flooding events are analyzed for Kewaunee. Although each flooding event has unique effects, there are some common characteristics among the events. For example, some larger flooding events from the Auxiliary Feedwater (AFW) System in the Auxiliary Building are assumed to render the entire AFW System unavailable and to be unisolable in the time available to prevent subsequent equipment damage, particularly submergence of safety-related motor control centers (MCCs). For these larger AFW flooding events, all secondary cooling is lost because of the initiating event and the loss of offsite power, and ECCS injection and charging are lost because the safety-related MCCs are submerged as a result of the flooding. Protection of the safety-related MCCs in these events would ensure availability of power to components in the Chemical and Volume Control System and Safety Injection Systems to maintain RCP seal cooling and provide bleed and feed core cooling. With power available, the Chemical and Volume Control and Safety Injection Systems could still be available in a flooding event because their associated equipment is located well above the flood level that would fail the MCCs.

Provision of temporary cooling is evaluated by SAMA items 81, 82, 83, 166, 167, 170, and 171 and the results concluded that implementing these items could be cost beneficial. For larger flooding events from the Service Water System, particularly flooding events in the Auxiliary Building, one train of service water is lost because it is isolated to stop the flood. One train of ECCS equipment is also rendered unavailable through the isolation of cooling water (service water) from the failed service water header. Subsequently, a random failure of the emergency diesel generator on the unaffected service water train results in a loss of the associated ECCS equipment. For these larger Service Water System flooding events, the emergency diesel generator on the train of service water with the break would still be available because the diesel cooling supply is upstream of the isolation valve to the Auxiliary Building header. Although power would be available from one emergency diesel generator, the equipment that it supplies would be unavailable because cooling water has been isolated. Particularly, cooling to the safeguards alley room coolers would be lost, thereby rendering electrical equipment unavailable. Providing temporary cooling to the switchgear rooms, emergency diesel generator rooms, and safeguards alley during these flooding events would maintain availability of the AFW pump on the service water train affected by the flood, thereby maintaining secondary side decay heat removal.

Another reason that basic event LOSP-24 is important is related to the failure probability that is used. The failure probability for this event represents the chance for a loss of offsite power anytime within 24 hours of an initiating event and considers power losses that could occur immediately after a turbine trip. Many of the initiating events for which LOSP-24 is important are Auxiliary Building floods which would result in a manual, controlled shutdown thereby putting less stress on the grid and possibly resulting in a lower chance of losing offsite power. In some cases, the loss of power would not occur until many hours after the initiating event. However, the accident analysis treats any loss of offsite power as if it occurred concurrently with the internal flooding initiating event.

The PRA quantification uses a 24-hour mission time for the emergency diesel generators when a shorter time would be more appropriate for some events where the loss occurs hours after the initial shutdown. For these events, crediting any availability of offsite power would allow use of some of the ECCS equipment on the train with the service water flood. During this initial period of power availability, it is also likely that plant operators would initiate a plant cooldown and depressurization because of the extent of failed equipment. To define, develop and analyze such a time-phased accident progression would require a substantial effort, but would likely present a significant reduction in the importance for basic event LOSP-24.

Since the SAMA items described above were found to be cost beneficial, and since a more detailed time-phased accident analysis is expected to show that the importance of basic event LOSP-24 after implementing the SAMA items described above would be much less, it is concluded that no additional SAMA items would be effective in reducing the risk of this event.

Response to 5.b

The existing low level alarm at 37% Refueling Water Storage Tank (RWST) level and the existing low-low level alarm at 4% RWST were considered in the PRA model used for the SAMA analysis. Therefore, it is considered that adding another low level alarm to the RWST, as mentioned in the question, would have a negligible impact to plant risk.

The effect of adding an automatic RWST fill system was evaluated by assuming that manual operator action to refill the RWST would be successful. This is conservative because it does not include failure probability of the automated system and is modeled by setting to zero the failure probability values for the cognitive and execution portions of operator error to manually refill the RWST.

Utilizing this modeling resulted in a Source Term Category (STC) Frequency of 7.267E-5 with the following contributions from each STC:

1. 1.394E-6
2. 0.000E+0
3. 0.000E+0
4. 4.055E-5
5. 1.838E-7
6. 4.775E-9
7. 2.566E-8
8. 2.172E-5
9. 0.000E+0
10. 0.000E+0
11. 1.217E-7
12. 1.546E-7
13. 7.814E-6
14. 7.047E-7

The frequency of each STC above was multiplied by the associated conditional dose value from LRA Appendix E, Attachment F, Table F-15 to obtain the expected dose value for each STC. These expected dose values were then summed to obtain the total expected dose value of 26.15 person-REM per year that would result after implementation of the SAMA.

Similarly, the frequency of each STC above was multiplied by the associated conditional property damage value from LRA Appendix E, Attachment F, Table F-16 to obtain the expected property damage value for each STC. These expected property damage values were then summed to obtain the total expected damage value of $41,279 per year that would result after implementation of the SAMA.

The benefit of implementing this SAMA was then calculated as shown in LRA Appendix E, Attachment F, Section F.4 and the results are shown below along with the total averted costs.

CDF After Enhancements	7.267E-05
Total Expected Offsite Property Damage $/year Offsite ($F_AP_{DA}$)	$41,279
Total Expected Person-REM/year Offsite (F_AD_{PA})	26.15
Averted Public Exposure (APE)	$86,790
Averted Offsite Property Damage Costs (AOC)	$90,628
Averted Immediate Occupational Exposure Costs (W_{IO})	$584
Averted Long-Term Occupational Exposure Costs (W_{LTO})	$2,544
Total Averted Occupational Exposure Costs (AOE)	$3,128
Averted Cleanup and Decontamination Costs (U_{CD})	$95,409
Averted Replacement Power Costs (U_{RP})	$39,616
Averted Onsite Costs (AOSC)	$135,025
Total Averted Costs (APE + AOC + AOE +AOSC)	$315,571
Significant Costs Not Considered? (Yes/No)	Yes
Cost of Enhancement (COE)	$850,000
Double Calculated Benefit	$631,141
NPV of twice benefit	(-)$218,858

The present value of total averted costs for implementing this SAMA is $315,571. This amount has been doubled to account for the potential reduction in risk from external events, resulting in a total potential benefit of $631,141.

As described above, implementation of this SAMA would provide an automatic system to provide RWST refill on a low-low level. Automatic RWST refill would require that a source for boration be available. Existing procedures for manually refilling the RWST direct that the boric acid transfer pumps be used in conjunction with the reactor water makeup pumps. Implementation of this SAMA would require control circuitry to align flow from the reactor makeup water storage tanks through the boric acid transfer pumps to the RWST in order to ensure proper boration. In addition, control circuitry would be required to automatically align flow from the reactor makeup water storage tanks through the reactor water makeup pumps to the RWST. Consequently, the costs for control circuitry would be significantly more expensive than the cost for the changes that installed the Auxiliary Building flooding alarms, $149,700 from LRA Appendix E, Attachment F, Section F.6.33. Due to the complexity of the controls required to implement this SAMA, it is assumed that the control circuitry changes would be twice the cost of the Auxiliary Building flooding alarms, resulting in a total cost of $300,000 for the control circuitry changes.

At least two automatic valve operators would be required in the Reactor Makeup Water System. These would be located in the Turbine Building. Also, one automatic valve operator for the RWST piping would be required and located in the Auxiliary Building. Detailed cost estimates to procure and install these operators have not been developed; however, it is expected that procurement and installation of the valve operators would cost well in excess of the $100,000 minimum cost assumed for a modification in the

SAMA analysis. Therefore, the total costs for procurement and installation of valve operators are estimated to be at least $200,000.

In addition to the new control circuitry, existing manual valves would require that automatic operators be added. Because these valves would interface between seismically qualified and seismically unqualified piping, pipe stress analyses would be required to evaluate plant response, costing a minimum of $100,000.

Installation of an automatic RWST makeup system would likely require that control circuits be provided on control boards in the control room. Since changes to the control room would be required, changes to the Kewaunee training simulator would also be required along with changes to training plans. These changes are estimated to cost twice the minimum cost for a procedure change assumed in the SAMA analysis, or $50,000. Therefore, the total costs for simulator modifications and training plan changes are estimated to be at least $100,000.

In order to implement the new SAMA, changes to the Emergency Operating Procedures would be required along with new surveillance, test, and maintenance procedures. The changes to the EOPs alone would cost a minimum of $100,000, as assumed in the SAMA analysis.

Ongoing maintenance and surveillance costs for the equipment and controls are estimated to cost at least $50,000 over the license renewal period.

Even considering the conservative cost estimates described, the costs above total more than $850,000. Since this cost is significantly greater than the potential benefit, more detailed costs estimates have not been performed.

As quantified above, the total averted costs of this SAMA are $631,141. Implementation of this alternative would cost a minimum of $850,000. Therefore, the present worth can be calculated as:

$$NPV \leq \$631{,}141 - \$850{,}000.$$

$$NPV \leq -\$218{,}858$$

Consequently, since the calculated present worth is negative, implementation of this SAMA would not be cost beneficial.

Response to 5.c

Three SAMA items listed as already implemented were identified as lacking a basis. Each of these items is listed in Table 5.c-1 below with the basis for concluding that each has been implemented.

Table 5.c-1		
SAMA ID	Potential Enhancement (SAMA Title)	Result of Potential Enhancement and Basis for Conclusion That SAMA is Implemented
007	Add an automatic feature to transfer the 120V vital AC bus from normal to standby power.	Increased availability of the 120 V vital AC bus. The vendor technical manual provides a description of how the inverters automatically transfer to the standby source.
030	Improve ECCS suction strainers.	Enhanced reliability of ECCS suction. Modifications implemented in response to Generic Letter 2004-02.
185	Improve the reliability of turbine-driven AFW pump.	Improves the availability of secondary cooling. A comparison of Kewaunee-specific data with NUREG/CR-6928 shows that the TDAFP has a lower failure rate.

Response to 5.d

In addition to the emergency diesel generator (EDG) failure data collected during the period from January 2001 through August 2001, failures recorded in the Maintenance Rule tracking data from August 2001 through January 2009 have also been reviewed. During that period, a total of eleven failures associated with the EDGs occurred, none of which involved an automatic trip circuit failure that would be recoverable if a procedure existed to bypass the trip circuitry.

Response to 5.e

The Component Cooling Water (CCW) System at Kewaunee consists of two pumps and two heat exchangers. The two pumps take suction from a single, common pipe. The pump discharge lines then combine into a single line that leads to the two heat exchangers. The outlet lines from each of the two heat exchangers combine into a common pipe. One pump and one heat exchanger are associated with train A and the other pump and heat exchanger with train B. However, it is possible to use the pump powered from A-train to provide flow to a CCW heat exchanger that is cooled with B-train service water. Based on the above, SAMA 64 was considered implemented.

The CCW System cannot currently be crosstied to the fire water system. The risk impact of providing the ability to route fire protection water to be used as cooling for the CCW heat exchangers was evaluated. To represent the risk impact of this SAMA, it was assumed that the potential benefit could be represented by failure of a single operator action to align fire protection water. The failure probability of this operator action was 5.0E-02.

Utilizing this modeling resulted in a Source Term Category (STC) Frequency of 7.979E-5 with the following contributions from each STC:

1. 1.498E-6
2. 0.000E+0
3. 0.000E+0
4. 3.949E-5
5. 1.970E-7
6. 5.008E-9
7. 2.691E-8
8. 2.561E-5
9. 0.000E+0
10. 0.000E+0
11. 1.217E-7
12. 1.546E-7
13. 9.399E-6
14. 3.283E-6

The frequency of each STC above was multiplied by the associated conditional dose from LRA Appendix E, Attachment F, Table F-15 to obtain the expected dose for each STC. These expected dose values were then summed to obtain the total expected dose value of 29.95 person-REM per year that would result after implementation of the SAMA.

Similarly, the frequency of each STC above was multiplied by the associated conditional property damage value from LRA Appendix E, Attachment F, Table F-16 to obtain the expected property damage value for each STC. These expected property damage values were then summed to obtain the total expected damage value of $49,582 per year that would result after implementation of the SAMA.

The benefit of implementing this SAMA is then calculated as shown in LRA Appendix E, Attachment F, Section F.4 and the results are shown below along with the total averted costs.

CDF After Enhancements	7.979E-05
Total Expected Offsite Property Damage $/year Offsite ($F_AP_{DA}$)	$49,582
Total Expected Person-REM/year Offsite (F_AD_{PA})	29.95
Averted Public Exposure (APE)	$5,100
Averted Offsite Property Damage Costs (AOC)	$1,270
Averted Immediate Occupational Exposure Costs (W_{IO})	$79
Averted Long-Term Occupational Exposure Costs (W_{LTO})	$342
Total Averted Occupational Exposure Costs (AOE)	$421
Averted Cleanup and Decontamination Costs (U_{CD})	$12,836
Averted Replacement Power Costs (U_{RP})	$5,330
Averted Onsite Costs (AOSC)	$18,166

Total Averted Costs (APE + AOC + AOE +AOSC)	$24,956
Significant Costs Not Considered? (Yes/No)	Yes
Cost of Enhancement (COE)	$250,000
Double Calculated Benefit	$49,912
NPV of twice benefit	(-)$200,088

The present value of total averted costs for implementing this SAMA is $24,956. This amount has been doubled to account for the potential reduction in risk from external events, resulting in a total potential benefit of $49,912.

Implementation of this SAMA would require a plant modification to provide hose connections to one heat exchanger. Using the standard costs for a modification shown in LRA Appendix E, Attachment F, Section F.6, the minimum cost of this modification would be $100,000. The modification for this SAMA would also require a hardware change to weld several hose connections and valves to one of the CCW heat exchangers. Although detailed estimates were not performed, procurement and installation of these valves is estimated to cost at least $50,000. In addition to the modification, changes to the Emergency Operating Procedures (EOPs) would be required to direct use of the Fire Protection System to cool the heat exchangers. Changes to the EOPs are estimated to cost at least $100,000 because of the updates to operator requalification training. Because these costs exceed the potential benefits calculated above, more detailed costs estimates are not performed.

As quantified above, the total averted costs of this SAMA are $49,912. Implementation of this alternative would cost a minimum of $250,000. Therefore, the present worth can be calculated as:

NPV ≤ $49,912 – $250,000.

NPV ≤ -200,088

Since the present worth is negative, implementation of this SAMA would not be cost beneficial.

Response to 5.f

Risk reduction from installation of a diesel-driven fire pump (DDFP) potentially could be seen in the internal events as well as the external events analysis. For the internal events analysis, risk reduction could occur by using the DDFP as an alternative source for steam generator makeup or an alternate source to provide cooling fluid to plant components. For external events, a DDFP could provide additional fire suppression capability. These potential benefits could be provided either by a permanently-installed pump or through use of a portable pump. A permanently installed pump could provide a greater benefit than a portable pump because a permanent pump would be available immediately, while a portable pump would require time to position and connect. However, the costs of providing a portable pump could be significantly less than a permanently installed pump.

Kewaunee is provided with two motor-driven fire pumps that are powered from the safety-related 480 VAC buses. Although the fire pumps are automatically stopped if a safety injection signal is received; in the absence of a safety injection signal, the motor-driven fire pumps are automatically powered from the emergency diesel generators, should a loss of offsite power occur. A safety injection signal concurrent with a loss of power on both 480 VAC buses would be a low-probability event. Therefore, fire protection water would be available except for scenarios where all safety-related 480 VAC power is lost. 480 VAC power would generally be available except during station blackout (SBO) events, which are defined as a loss of power to both safety-related 4160 VAC buses, and during the low-probability event where power could be available to one safety-related 4160 VAC bus, but not available to either safety-related 480 VAC bus. For the latter situation to occur, either the supply breaker from the 4160 VAC bus to the 480 VAC bus must spuriously open, or the 4160-480 VAC transformer must fail. Both of these are low-probability occurrences. Since the benefit of a DDFP primarily occurs only for SBO scenarios, availability of fire protection water would show only a marginal improvement with the addition of a DDFP.

In the Kewaunee fire PRA analysis, suppression by fire protection water is only credited for fires in the B-train auxiliary feedwater (AFW) pump room. These scenarios contribute less than 0.3% to the CDF and less than 0.2% to the LERF for internal fire accident scenarios. Therefore, even if the addition of a DDFP would completely eliminate these scenarios, the effect on plant risk would be minimal.

Fire protection water could potentially be used to provide steam generator makeup in the event that all other means of steam generator makeup are unavailable. Although the Kewaunee PRA models do not take credit for such actions, the existing motor-driven pumps would be adequate for this purpose when 480 VAC power is available. For SBO scenarios, a DDFP could be used for steam generator makeup if the turbine-driven AFW pump fails however, since these are low frequency scenarios, a DDFP for steam generator makeup would provide a very small reduction in CDF and LERF.

Use of the Fire Protection System as a source of cooling fluid for plant components was evaluated under SAMAs 19 and 64 (refer to RAI 5.e). The results of these evaluations determined that use of a manually aligned alternate cooling water source would not be cost beneficial. The modeling in these evaluations was such that availability of AC power was not required. Therefore, any benefit of a DDFP for cooling water to plant components would be bounded by these evaluations and not be cost beneficial.

The addition of a DDFP at Kewaunee would likely require construction of a separate building to house the pump due to the limited space available inside the Screenhouse. As a result, the construction costs for the addition of a DDFP would be higher than if the DDFP could be placed within the existing structure. Regardless of the additional construction costs, even if a new DDFP could be placed inside the Screenhouse, the Fire Protection Systems and fire protection analysis and their associated programs would require extensive reevaluations. It is expected that the costs associated with the reevaluations would far outweigh any additional construction costs that would be incurred by locating the new pump in a separate building.

Costs to provide a DDFP would include the procurement costs for the pump and ancillary equipment and construction and installation costs. Although not explicitly evaluated, it is expected that these costs would exceed $2 million. In addition, ongoing maintenance and testing costs would be required over the life of the plant.

Given the low benefits expected for adding a permanently-installed DDFP and the high expected costs, it is concluded that installation of a DDFP would not be cost beneficial.

An existing portable pump at Kewaunee could be used to provide the benefits described above. However, because of the time delay needed to retrieve and connect a portable pump, it would provide very little, if any, benefit for fire suppression, other than for a large area fire. Furthermore, the time delays would also render a portable pump less effective for steam generator makeup.

Therefore, it is concluded that provision of a DDFP would not be cost beneficial for either a permanently-installed or portable pump.

Response to 5.g

SAMA 144 was identified from the list of generic items in NEI 05-01, Revision A. Although the installation of additional isolation switches could be of generic benefit, there were no fire scenarios identified in the Kewaunee IPEEE where isolation switches could provide such a benefit. Fire risk for Kewaunee is less than half of the risk from internal events. Therefore, since installation of additional isolation switches would impact only fire risk and since fire risk is significantly smaller than other risk contributors, installation of isolation switches would be expected to have a very small benefit.

Response to 5.h

In LRA Appendix E, Attachment F, Table F-17, under SAMA 151, the reference to "Table 5" in the column "Results of Potential Enhancement" should be replaced with "Table F-3." The reference to "Table 6" in the column "Results of Potential Enhancement" under SAMA 151, should be replaced with "Table F-18."

SAMA 151 was originally identified from a list of generic items and did not identify any specific action for improvement. Because of the non-specific nature of the generic SAMA, it initially could not be screened. The intention of indicating that SAMA 151 needed further analysis along with the items indicated in the "Result of Potential Enhancement" was to show that a structured evaluation of risk-significant operator actions was performed. The evaluation of SAMA 151 consisted of identifying risk-significant operator actions from the Kewaunee PRA models and then evaluating potential improvements that could reduce the failure probability of the actions. Basic events representing risk-significant operator actions are identified in LRA Appendix E, Attachment F, Tables F-3 and F-18. Each of the risk-significant actions considered is identified under SAMA 151. Disposition for each of the risk-significant operator actions with respect to the SAMA analysis is detailed in Tables F-3 and F-18.

NRC RAI 6

Provide the following information with regard to the Phase 2 cost-benefit evaluations:

a. ***Table F-19 indicates that implementation of SAMA 19 (Use fire water as a backup source for diesel cooling) would result in an increase in CDF. Explain why this occurs.***

b. ***The discussion in Section F.6.15 of SAMA 76 (Change failure position of condenser makeup valve so that the valve fails closed on loss of power or air) indicates that this SAMA was modeled by removing the power dependencies from the valve. Clarify whether this included removing its dependence on air. If not, incorporate the removal of this dependency or justify why it would not impact the results.***

c. ***As indicated in Sections F.6.17 (Diesel Room Cooling Improvements) and F.6.18 (Switchgear Room Ventilation Response), the evaluations of SAMA 81 and SAMA 82 assume implementation of a number of other SAMAs, including SAMAs 170 and 171. Based on Table F-17, the latter two SAMAs are plant-specific improvements that pertain to improving room cooling for the Safeguards Alley. Explain why SAMAs 170 and 171 have been combined with SAMAs 81 and 82 and why a SAMA involving implementation of SAMAs 170 and 171 for just the AFW rooms was not evaluated.***

d. ***Section F.6.30 indicates that the benefit of SAMA 150 (Improved maintenance procedures) was determined by setting maintenance unavailability of Maintenance Rule (a)(1) equipment to zero. This approach appears to reduce the risk due to maintenance unavailability rather than the risk due to any improvement in equipment reliability. Provide additional information supporting this evaluation.***

Dominion Response to RAI 6

Response to 6.a

The CDF increased in the SAMA 19 analysis presented in LRA Appendix E, Attachment F, Section F.6.2 because of assumptions used when making the modeling changes. Specifically, as analyzed for the LRA, SAMA 19 would have provided back-up cooling water flow to the emergency diesel generators only, not to other important service water loads, such as the 480 VAC switchgear room coolers. Loss of 480 VAC switchgear room cooling would have caused a loss of the 480 VAC busses and associated equipment, including charging and component cooling water pumps. As a result, RCP seals would have failed due to loss of seal cooling resulting in a LOCA and core damage. Thus, implementation of SAMA 19 would result in an increase in the CDF.

A revised analysis of SAMA 19 has been performed assuming that implementation of SAMA 19 would also change procedures to ensure that cooling for the 480 VAC switchgear rooms would be maintained if fire protection water was used to provide diesel-generator cooling.

Modeling of SAMA 19 represented the failure of all equipment and actions needed to provide cooling to the EDGs with a single event having a probability of 0.1. The analysis assumed that procedures would be changed to direct local alignment of fire protection water or another system to cool the diesel-generators if service water failed. The analysis also assumed that procedures would be changed to direct entry into SBO procedures if both trains of service water fail, if either emergency 4160 VAC buses fail, or if one train of service water and the opposite train 4160 VAC bus failed.

Utilizing this modeling resulted in a Source term category (STC) Frequency of 7.983E-5 with the following contributions from each STC:

1. 1.495E-6
2. 0.000E+0
3. 0.000E+0
4. 3.981E-5
5. 1.950E-7
6. 5.011E-9
7. 2.693E-8
8. 2.555E-5
9. 0.000E+0
10. 0.000E+0
11. 1.217E-7
12. 1.543E-7
13. 9.205E-6
14. 3.270E-6

The frequency of each STC above was multiplied by the associated conditional dose from LRA Appendix E, Attachment F, Table F-15 to obtain the expected dose for each STC. These expected dose values were then summed to obtain the total expected dose value of 29.61 person-REM per year that would result after implementation of the SAMA.

Similarly, the frequency of each STC above was multiplied by the associated conditional property damage value from LRA Appendix E, Attachment F, Table F-16 to obtain the expected property damage value for each STC. These expected property damage values were then summed to obtain the total expected damage value of $48,742 per year that would result after implementation of the SAMA.

The benefit of implementing this SAMA is then calculated as shown in LRA Appendix E, Attachment F, Section F.4 and the results are shown below along with the total averted costs.

CDF After Enhancements	7.983E-05
Total Expected Offsite Property Damage $/year Offsite (FAPDA)	$ 48,742
Total Expected Offsite Property Damage $/year Offsite (FAPDA)	29.61
Averted Public Exposure (APE)	$12,397
Averted Offsite Property Damage Costs (AOC)	$10,302
Averted Immediate Occupational Exposure Costs (WIO)	$75
Averted Long-Term Occupational Exposure Costs (WLTO)	$328
Total Averted Occupational Exposure Costs (AOE)	$404
Averted Cleanup and Decontamination Costs (UCD)	$12,316
Averted Replacement Power Costs (URP)	$5,114
Averted Onsite Costs (AOSC)	$17,430
Total Averted Costs (APE + AOC + AOE +AOSC)	$40,533
Significant Costs Not Considered? (Yes/No)	Yes
Cost of Enhancement (COE)	$100,000
Double Calculated Benefit	$81,066
NPV of twice benefit	(-)$18,934

The present value of total averted costs for implementing this SAMA is $40,533. This amount is then doubled to account for the potential reduction in risk from external events resulting in a total potential benefit of $81,066.

As described above, implementation of this SAMA would require a design change to provide hose connections for cooling. Using the standard costs for a modification shown in LRA Appendix E, Attachment F, Section F.6, implementation of this alternative would cost a minimum of $100,000. Since the benefit for this SAMA is less than this value, no further evaluation of costs is performed.

As quantified above, the total averted costs of this SAMA are $81,066. Implementation of this alternative would cost a minimum of $100,000. Therefore, the present worth can be calculated as:

NPV ≤ $81,066 – $100,000.

NPV ≤ -$18,934

Since the present worth is negative, implementation of this SAMA would not be cost beneficial.

Response to 6.b

For SAMAs 76 and 184, both the air dependence and the power dependence were removed from the condenser makeup valve.

Response to 6.c

At Kewaunee, the three auxiliary feedwater (AFW) pump rooms, two 480 VAC switchgear rooms, two 4160 VAC/emergency diesel generator rooms, and Cardox tank room are all located in an area known colloquially as "safeguards alley." The rooms are arranged in a backward "L" shape running from west to east with the base of the backward "L" running from north to south.

Located on the far west end of safeguards alley is the B-train AFW pump. The A-train AFW pump is located in a room adjacent to the eastern side of the B-train AFW pump. The A-train AFW pump room is accessed through a door from the hallway that provides normal access to the B-train AFW pump.

The turbine-driven AFW pump (TDAFP) is located just to the east of the A-train AFW pump. The TDAFP room is completely enclosed with one door on the east and one door on the west providing access. Normal access to the motor-driven AFW pump (MDAFP) rooms is through the TDAFP room.

To the east of the TDAFP room is the B-train 480 VAC switchgear room. Normal access to safeguards alley is via a door from the Turbine Building basement to the B-train 480 VAC switchgear room.

To the east of the B-train 480 VAC switchgear room is the A-train 480 VAC switchgear room. Access to the A-train 480 VAC switchgear room is through a door from the B-train 480 VAC switchgear room. The eastern wall of the 480 VAC room abuts the A-train diesel/4160 VAC room. The southern wall of the A-train 480 VAC room adjoins the Cardox room.

The A-train 4160 VAC room is the eastern-most end of safeguards alley. To the south of the A-train 4160 VAC room is the B-train diesel/4160 VAC room. The western wall of the A-train 4160 VAC room is the Cardox room. On the southeast corner of the A-train 4160 VAC room is the normal access door to the room. Normal access is from the service water tunnel which, in turn, is accessed from the B-train 4160 VAC room.

The B-train 4160 VAC room is on the southern-most end of safeguards alley. Normal access to this room is through a door on the eastern wall to the Cardox room. The B-train 4160 VAC room provides access to the service water tunnel via a door on the northeast side. The door from the B-train room to the service water tunnel is directly opposite the door from the A-train room to the service water tunnel.

For the operators to implement a SAMA to provide temporary ventilation, they must first be alerted to the need for the actions. None of the rooms described above are provided with a high temperature alarm. Without a clear, compelling indication for the loss of room cooling, operator action to mitigate such a loss would be unreliable. SAMA items 81, 83, and 171 each address providing a room high temperature alarm. SAMA 81 is taken from the list of generic items and refers to a diesel building. Kewaunee does not have a diesel building, but, as described above, the diesels are located in safeguards alley in the same room as the associated 4160 VAC electrical bus. SAMA item 83 is also taken from the list of generic items and refers to a switchgear room high temperature alarm. SAMA item 171 is a Kewaunee-specific item to provide high temperature alarms in safeguards alley. As described above, the rooms of safeguards alley are located in close proximity to one another and none are provided with a room high temperature alarm. Therefore, the SAMA evaluation assumed that the costs for providing a high temperature alarm to all the rooms in safeguards alley would not be appreciably greater than providing an alarm for a subset of the rooms.

To provide a flow path for temporary ventilation, an inlet and outlet flow path must be provided and separated sufficiently that the warm air from the outlet is not entrained in the inlet air. The description above provides a summary of physical layout of safeguards alley. One of two inlet pathways would likely be used when providing temporary ventilation. The first would be from the service water tunnel to the 4160 VAC rooms. The second would be from the Turbine Building basement to the Cardox room to the diesel rooms or 480 VAC room. The simpler of the two would be from the service water tunnel.

Temporary fans in the service water tunnel could provide flow to the B-train 4160 VAC room to the Cardox room and then to the Turbine Building basement, thereby cooling the B-train diesel and 4160 VAC switchgear. Temporary fans in the service water tunnel could simultaneously provide flow to the A-train 4160 VAC room. The only path out of the A-train 4160 VAC room is to the A-train 480 VAC switchgear room. From the 480 VAC switchgear room, flow can go to either the Cardox room or the B-train 480 VAC room.

Cooling for the B-train 480 VAC room would require an inlet from either the A-train 480 VAC room or the Turbine Building basement. The only outlet for either path, however, would be through the TDAFP room to the MDAFP areas and, from there to the Turbine Building basement. Temporary ventilation for the AFW pumps would require an inlet from either the 480 VAC switchgear room or the Auxiliary Building which is a radiologically controlled area, and, therefore, not a desirable option. As a result, any actions to provide temporary ventilation to the AFW pump areas would also provide, at a minimum, temporary ventilation to the 480 VAC switchgear rooms.

Providing inlet flow from the Turbine Building basement to 480 VAC room and discharging to the Turbine Building basement would result in the warm air from the discharge being near the inlet with the potential mixing of the two. This mixing could potentially limit the cooling benefit. As a result, inlet flow from the adjacent service water tunnel for temporary ventilation could provide the greatest cooling with the least amount of equipment and actions.

Although procedures could potentially be written to provide temporary ventilation flow to a subset of the rooms in safeguards alley, providing such flexibility would not appreciably affect the costs associated with the implementation. Furthermore, the equipment needed, and the resultant cost of the equipment, would not be significantly different for providing flow to a subset of the rooms as opposed to all of the rooms.

Response to 6.d

SAMA 150 was identified from the list of generic items in NEI 05-01, Revision A. The generic item did not identify any specific areas for improvement, but stated that implementing the SAMA could improve equipment reliability. While the reliability of any piece of equipment could theoretically be improved, evaluation of this SAMA was focused on equipment where unreliability could be a concern to plant risk. Implementation of the Maintenance Rule at Kewaunee tracks reliability and unavailability of important equipment against established goals with the intent of balancing an increase in equipment unavailability against a decrease in reliability. Evaluation of this SAMA made the implicit assumption that equipment that is performing within the goals established by the Maintenance Rule program would not show a significant benefit to risk by improving reliability.

For equipment that is not performing within the goals established by the Maintenance Rule program, the potential benefit of procedural changes was evaluated. As part of the evaluation, the maintenance unavailability term was set to zero to be used as a surrogate for potential improvement of all Maintenance Rule (a)(1) equipment. Although other changes could be used, such as a reduction in failure rates, any approach taken would involve an arbitrary change to the value selected.

The potential risk reduction for reducing the unavailability of all Maintenance Rule (a)(1) equipment is shown in the evaluation of SAMA 150 assuming that all components are improved simultaneously. It can be concluded from these results that improving any one component would show an even smaller risk reduction. Furthermore, because compliance with the Maintenance Rule already requires that actions be taken to improve the performance of the equipment evaluated by this SAMA, any steps taken to implement SAMA 150 would need to be in addition to the actions taken within the Maintenance Rule. No such steps to implement SAMA 150 were identified. Therefore, it is concluded that implementing SAMA 150 would not be cost beneficial.

<u>NRC RAI 7</u>

Provide the following information with regard to the sensitivity and uncertainty analyses:

a. ***On page F-93 it is stated that 12 additional analyses representing 5 SAMA items would show potentially positive cost-benefit if a discount rate of 3% was used. It appears that use of the 3% discount rate resulted in identification of 12 rather than 5 additional cost-beneficial SAMAs. Clarify this reference to "representing 5 SAMA items."***

b. ***The discussion in Section 7.1 of SAMA 58 (Replacement of existing reactor coolant pump (RCP) seals with seals that do not require any seal cooling) describes added costs for changing the seal cooling system for the new seals. This cost should be minimal since the new seals would not require cooling. The discussion of this SAMA in Section F.7.1 states that the added cost would be over $750,000 whereas the discussion in Section F.7.2 states that the added cost would be over $500,000. Clarify the cost estimates for this SAMA.***

c. ***The listing of SAMAs on page F-100 does not include SAMA 58, which had a negative net value in Table F-19 but a positive net value in Table F-20. Provide the results of the evaluation of this SAMA in the listing and in the subsequent discussion.***

d. ***Section F.7.7 discusses the simultaneous implementation of SAMAs 81, 82, 83, 166, 167, 170 and 171. SAMA 160 is not included in the Section F.7.7 discussion but is included in the individual discussion in Sections F.6.17. Clarify which changes in the diesel generator room and switchgear room are included in the combined package.***

<u>Dominion Response to RAI 7</u>

<u>Response to 7.a</u>

The words, "analyses representing five," should be deleted from the first sentence in the fifth paragraph on LRA Appendix E, Attachment F, page F-93. The resultant sentence would then correctly read, "The results of these analyses are shown in LRA Appendix E, Attachment F, Table F-20 and show that twelve additional SAMA items would show a potentially positive cost-benefit if a discount rate of three percent was used."

Response to 7.b

The base cost estimate used to evaluate SAMA 58 was taken from the actual project costs associated with the reactor coolant pump (RCP) seal replacement implemented at Kewaunee. This seal replacement was a like-for-like replacement where the new seals performed exactly like the old seals and only minimal cooling water piping replacement changes were required.

Replacing the RCP seals with a new design that does not require cooling would, at a minimum, necessitate cutting and capping of existing RCP seal injection lines. Changes to seal leakoff piping and coolers and potential changes to thermal barrier cooling could also be required. The alarm setpoints and annunciators related to RCP seal cooling and the existing control circuits and systems related to RCP seal cooling would also need to be disabled or modified. Even if all these systems and components could simply be disabled, substantial engineering costs would be required. Additionally, further costs would be required for training and updating of licensing-related documents such as the USAR and Technical Specifications.

Although detailed estimates of the above costs were not performed, a cost of $750,000 is considered conservatively low for a modification that changes the fundamental nature of how a critical plant component is designed and operated. The additional cost value of $750,000 should be used in LRA Appendix E, Attachment F, Section F.7.2 as well as in LRA Appendix E, Attachment F, Section F.7.1.

Response to 7.c

The potential benefit for SAMA 58 was calculated using the 95th percentile PRA results in the same manner that other items listed in LRA Appendix E, Attachment F, Section F.7.5 were evaluated. That is, the potential averted costs were increased by a factor of 1.8 while implementation costs were held constant. The results of this evaluation are shown below.

SAMA ID	Base Case Implementation Cost Estimates	Averted Cost-Risk (Base Case)	Net Value (Base Case)	Averted Cost-Risk (95th Percentile)	Net Value (95th Percentile)	Potential Change in Cost Effectiveness ?
58	$1,423,000	$1,251,926	(-)$171,074	$2,253,467	$830,466	Yes

The initial results of this evaluation showed that SAMA 58 could show a positive net benefit if the 95th percentile PRA results were used. However, as was noted in Sections F.7.1 and F.7.2, the cost estimates used did not include any engineering costs that would be required for a modification or any demolition or installation costs that would be associated with changing the seal systems for the new seals. Based on the standard costs for a modification shown in LRA Appendix E, Attachment F, Section F.6 and engineering judgment from review of other engineering costs reviewed as part of this analysis, additional costs of over $750,000 would be expected for such a modification. Using additional costs of $750,000 would show a small potential benefit of $80,466 for SAMA 58 using the 95th percentile value.

The additional costs of $750,000 are considered to be a lower-bound estimate for SAMA 58 and actual costs would likely be higher. Use of the 95th percentile upper limit for potential benefit calculations would clearly overstate the potential benefit of any change. Since the potential benefit of SAMA 58 is small even using the 95th percentile benefits and since the potential costs to implement SAMA 58 are considered to understate the actual costs, it is concluded that this item would not show a positive cost-benefit using the 95th percentile results.

Response to 7.d

SAMA 160 proposed installing additional insulation on the emergency diesel generator exhaust ducts to minimize heat input to the 4160 VAC rooms. This item was identified from a review of other recent SAMA analyses. Implementing SAMA 160 alone, however, would not eliminate the need for 4160 VAC room ventilation so it was included with other ventilation-related SAMA items during evaluation of the 4160 VAC rooms.

SAMA 160 is deliberately not included when considering potential synergies between the ventilation-related SAMAs, items 81, 82, 83, 166, 167, 170 and 171, for the 4160 VAC rooms and other rooms. Although synergies could be obtained by performing room heat-up calculations for multiple rooms simultaneously or by providing equipment and procedures for multiple rooms, no synergies between insulating diesel exhaust ducts and ventilation for other rooms were identified. Therefore, SAMA 160 was not included in the combined package.

NRC RAI 8

For certain SAMAs considered in the Environmental Report, there may be lower-cost alternatives that could achieve much of the risk reduction at a lower cost. In this regard, provide an evaluation of the following SAMAs:

a. Automate the cross-tie of the existing condensate storage tank (CST) to other water sources rather than installing a new CST.

b. Modify procedures to direct primary system cooldown to further reduce the probability of RCP seal failures.

c. Modify procedures and equipment for using a portable diesel-driven or AC-powered pump to provide feedwater to the steam generators with suction from the intake canal.

d. Develop a procedure to cross-connect the chemical and volume control system (CVCS) holdup tanks to the volume control tank (VCT) through the CVCS holdup transfer pump.

Dominion Response to RAI 8

Response to 8.a

An evaluation of the risk impact for automating the cross-tie of the condensate storage tanks (CSTs) was evaluated by setting the failure probability of the operator action to perform the cross-tie to zero.

Utilizing this modeling resulted in a Source Term Category (STC) Frequency of 6.666E-5 with the following contributions from each STC:

1. 1.036E-6
2. 0.000E+0
3. 0.000E+0
4. 3.924E-5
5. 1.443E-7
6. 4.148E-9
7. 2.229E-8
8. 1.559E-5
9. 0.000E+0
10. 0.000E+0
11. 1.217E-7
12. 1.546E-7
13. 7.143E-6

14. 3.209E-6

The frequency of each STC above was multiplied by the associated conditional dose value from LRA Appendix E, Attachment F, Table F-15 to obtain the expected dose for each STC. These expected dose values were then summed to obtain the total expected dose value of 25.20 person-REM per year that would result after implementation of the SAMA.

Similarly, the frequency of each STC above was multiplied by the associated conditional property damage value from LRA Appendix E, Attachment F, Table F-16 to obtain the expected property damage value for each STC. These expected property damage values were then summed to obtain the total expected damage value of $39,513 per year that would result after implementation of the SAMA.

The benefit of implementing this SAMA was then calculated as shown in LRA Appendix E, Attachment F, Section F.4 and the results are shown below along with the total averted costs:

CDF After Enhancements	6.666E-05
Total Expected Offsite Property Damage $/year Offsite ($F_AP_{DA}$)	$39,513
Total Expected Person-REM/year Offsite (F_AD_{PA})	25.20
Averted Public Exposure (APE)	$107,425
Averted Offsite Property Damage Costs (AOC)	$109,637
Averted Immediate Occupational Exposure Costs (W_{IO})	$1,011
Averted Long-Term Occupational Exposure Costs (W_{LTO})	$4,406
Total Averted Occupational Exposure Costs (AOE)	$5,417
Averted Cleanup and Decontamination Costs (U_{CD})	$165,226
Averted Replacement Power Costs (U_{RP})	$68,605
Averted Onsite Costs (AOSC)	$233,831
Total Averted Costs (APE + AOC + AOE +AOSC)	$456,309
Significant Costs Not Considered? (Yes/No)	Yes
Cost of Enhancement (COE)	$1,446,000
Double Calculated Benefit	$912,619
NPV of twice benefit	(-)$533,381

The present value of total averted costs for implementing this SAMA is $456,309. This amount has been doubled to account for the potential reduction in risk from external events resulting in a total potential benefit of $912,619.

As described above, implementation of this SAMA would provide an automatic system to provide CST refill on a low-low level or automatic alignment of AFW pump suction to an alternative source. To automate the cross-tie to another source, control circuitry would be required to automatically align flow from the reactor makeup water storage tanks to the CSTs.

At least two automatic valve operators would be required in the Reactor Makeup Water System. These would be located in the Turbine Building. In addition to the new control circuitry, existing manual valves would require that automatic operators be added. Because these valves would interface between seismically qualified and seismically unqualified piping, pipe stress analyses would be required to evaluate plant response.

Installation of an automatic CST makeup system would likely require that control circuits be provided on control boards in the control room. Since changes to the control room would be required, changes to the Kewaunee training simulator would also be required along with changes to training plans.

In order to implement the new SAMA, changes to the Emergency Operating Procedures would be required, along with new surveillance, test, and maintenance procedures.

A detailed cost estimate for this installation resulted in a total cost of $1,446,000, including:

- Engineering Costs of $430,000;
- Total Material Costs of $56,000;
- Total Implementation Costs of $960,000.
  - Note: Implementation costs include actual installation; training; EOP and other procedure changes; and simulator changes.

Additionally, ongoing maintenance and surveillance costs for the equipment and controls are estimated to cost at least $50,000 over the license renewal period.

The costs above total approximately $1,496,000. As quantified above, the total averted costs of this SAMA are $1,078,234. Therefore, the present worth can be calculated as:

NPV ≤ $912,619 – $1,496,000.

NPV ≤ -$533,381.

Consequently, since the calculated present worth is negative, implementation of this SAMA would not be cost beneficial.

Response to 8.b

The benefits of procedure modifications to direct primary system cooldown to further reduce the probability of reactor coolant pump seal failures were evaluated in LRA Appendix E, Attachment F, Section F.6.8 for SAMA items 50, 162, and 163. The analysis in Section F.6.8 shows a present worth of less than (-)$34,568 and concludes that these procedure changes would not be cost beneficial.

Response to 8.c

Following a reactor trip, the operators will follow emergency operating procedures, entering E-0, Reactor Trip or Safety Injection, and then, after determining that a safety injection was not required, transition to ES-0.1, reactor Trip Response, and begin monitoring the critical safety function status trees. At this point, the status of auxiliary feedwater (AFW) flow to the steam generators will be confirmed. If adequate flow is not available, the operators will enter FR-H.1, Response to Loss of Secondary Heat Sink, and will attempt to restore flow from AFW or main feedwater. If these efforts are not successful, attempts to depressurize the steam generators to use condensate pumps for makeup will occur. If all attempts to provide secondary makeup fail, the operators will then initiate bleed and feed cooling. Use of a portable pump to provide steam generator makeup would require that the steam generators be depressurized to less than 100 psi.

Furthermore, initiation of flow from the portable pump must occur before bleed and feed cooling is initiated. The conditions that direct initiation of bleed and feed cooling will be reached about 40 minutes after the initial reactor trip. Use of a portable pump requires about 700 feet of hose to be routed and then connected as needed to provide flow. It could take more time to perform these actions than would be available before bleed and feed initiation conditions would be reached. Once initiated, bleed and feed cooling would continue until a long-term assessment of recovery actions is performed.

For cases where no other plant impairments are indicated, i.e., plant buildings are intact and cooling systems are available, the operators would focus their attention on using existing and permanently installed equipment and systems to provide decay heat removal. Although use of a portable pump may be initiated immediately under conditions where operators know that plant buildings or equipment have been damaged, it is unlikely that a portable pump would be used under conditions where no obvious plant impairment has occurred. Therefore, it is concluded that modifying procedures to use a portable pump for steam generator makeup would provide a negligible reduction in risk and would not be cost beneficial.

Response to 8.d

Use of the Chemical and Volume Control System (CVCS) holdup tanks is proceduralized as a method to provide spent fuel pool makeup. Use of the CVCS holdup tanks to provide volume control tank (VCT) makeup, however, would be of minimal benefit under the vast majority of scenarios. Under most circumstances, Reactor Coolant System (RCS) letdown provides the source of water to the VCT. If VCT level drops to 5%, charging pump suction is automatically shifted to the refueling water storage tank (RWST). This switch ensures continued reactor coolant pump (RCP) seal injection and the integrity of the RCS boundary.

Should the automatic switch of charging suction from the VCT to the RWST fail, RCP seal cooling would still be maintained if component cooling water (CCW) to the RCP seals is available. If component cooling water (CCW) cooling is not available, then RCP seal injection must be restored within 13 minutes or a RCP seal LOCA would be expected. Provision of flow from the CVCS holdup tanks to the VCT within 13 minutes of a failure to transfer charging pump suction to the RWST is considered impractical.

If a RCP seal LOCA has occurred, then the Safety Injection System would be used to provide RCS makeup from the RWST. When RWST inventory is depleted, a switch to sump recirculation would ensure long-term RCS makeup and decay heat removal. Should the switch to containment recirculation fail, provision of flow from the CVCS holdup tanks to the charging pump suction could provide additional RCS makeup. Such operations would not provide long-term makeup and decay heat removal and would, at best, delay core damage. However, such actions would not prevent core damage. Therefore, it is concluded that modifying procedures to use CVCS holdup tank inventory for VCT makeup would provide a negligible reduction in risk and would not be cost beneficial.

NRC RAI 9

Section F.8.2, indicates that SAMAs 81,160,166 and 167 may also be cost beneficial if implemented concurrently with other SAMAs. This would bring the total number of SAMA candidates for further evaluation to 18. Confirm that these additional four SAMA candidates will be further reviewed as part of Dominion's ongoing performance improvement program.

Dominion Response to RAI 9

The concurrent implementation of these four SAMAs will be further reviewed as part of Dominion's ongoing performance improvement programs.