Dominion Nuclear Connecticut, Inc.
Millstone Power Station
Rope Ferry Road
Waterford, CT 06385

Dominion

August 13, 2004

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

Serial No.: 04-398
LR/RJG R0
Docket Nos.: 50-336
50-423
License Nos.: DPR-65
NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
LICENSE RENEWAL APPLICATIONS

By letter dated June 22, 2004, the NRC requested additional information regarding the license renewal applications (LRAs) for Millstone Power Station Units 2 and 3. The attachment to this letter contains the responses to the Request for Additional Information (RAI) associated with Appendix E, "Environmental Report, Severe Accident Mitigation Alternatives (SAMA) Analysis."

In response to questions asked as part of the RAI, two additional SAMAs were identified: one applicable to Millstone Unit 2 (see response to Unit 2 RAI 8e) and one applicable to Millstone Unit 3 (see response to Unit 3 RAI 7f). Dominion also evaluated high-cost SAMAs to determine if there were possible lower cost alternatives. These alternatives are detailed in the responses to Unit 2 RAI 9a and Unit 3 RAI 8a.

Should you have any questions regarding this submittal, please contact Mr. William D. Corbin, Director, Nuclear Projects, Dominion Resources Services, Inc., 5000 Dominion Blvd., Glen Allen, VA, 23060, (804) 273-2365.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

A106

Attachments:

1. Response to Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives (SAMA) for Millstone Power Station (MPS) Unit 2

2. Response to Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives (SAMA) for Millstone Power Station (MPS) Unit 3

Commitments made in this letter:

1. Millstone Unit 2 will complete its evaluation of this Severe Accident Mitigation Alternative (SAMA); and if it is cost beneficial, Millstone will develop a Severe Accident Management Guideline (SAMG) addressing the capability to flash the Diesel Generator field in the event of extended loss of DC power with a loss of offsite power, prior to the period of extended operation.

2. Millstone Unit 3 will complete its evaluation of this SAMA; and if it is cost beneficial, Millstone will develop a SAMG addressing manual control of the Turbine Driven Auxiliary Feedwater Pump, prior to the period of extended operation.

cc:

U.S. Nuclear Regulatory
Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Mr. V. Nerses
Senior Project Manager
U.S. Nuclear Regulatory
Commission
One White Flint North
11555 Rockville Pike
Mail Stop 8C2
Rockville, MD 20852-2738

Mr. S. M. Schneider
NRC Senior Resident Inspector
Millstone Power Station

Honorable Wayne L. Fraser
First Selectman
P.O. Box 519
Niantic, CT 06357-0519

Mr. Stephen Page
Central VT PSC
77 Grove Street
Rutland, VT 06701

Honorable Andrea Stillman
CT House of Representatives
5 Coolidge Court
Waterford, CT 06385

Mr. Denny Galloway
Supervising Radiation Control
Physicist
State of Connecticut – DEP
Division of Radiation
79 Elm Street
Hartford, CT 06106-5127

Honorable Chris Dodd
US Senate
100 Great Meadow Road
Wethersfield, CT 06109

Mr. Michael Doyle
Governor's Eastern Office
171 Salem Turnpike
Norwich, CT 06360

Mr. William Meinert
MMWEC
P.O. Box 426
Ludlow, MA 01056-0426

Honorable Melodie Peters
CT State Senate
25 Osceola Trail
Old Lyme, CT 06371

Honorable Gary Orefice
CT House of Representatives
47 Columbus Avenue
Niantic, CT 06357

Honorable Robert Simmons
US Congress
2 Courthouse Square
Norwich, CT 06360

Mr. Thomas Wagner
Town of Waterford
Town Planner
15 Rope Ferry Road
Waterford, CT 06385

Dr. Edward L. Wilds
Director, Division of Radiation
State of Connecticut – DEP
79 Elm Street
Hartford, CT 06106-5127

Chairman Donald Downes
DPUC
10 Franklin Square
New Britain, CT 06051

Honorable Dennis L. Popp
Chairman – Council of Governments
Municipal Building
295 Meridian Street
Groton, CT 06340

Chief Murray J. Pendleton
Director of Emergency Management
41 Avery Lane
Waterford, CT 06385-2806

Honorable Richard Blumenthal
Attorney General
55 Elm Street
Hartford, CT 06106-1774

Mr. John Markowicz
Co-Chairman – NEAC
9 Susan Terrace
Waterford, CT 06385

Mr. Evan Woolacott
Co-Chairman – NEAC
128 Terry's Plain Road
Simsbury, CT 06070

Honorable M. Jodi Rell
Governor
State Capitol
Hartford, CT 06106

Mr. Mark Powers
4 Round Rock Road
Niantic, CT 06357

Mr. Jay Levin
23 Worthington Road
New London, CT 06320

Mr. Jim Butler
Executive Director – Council of Governments
8 Connecticut Avenue
Norwich, CT 06360

Mr. Bill Palomba
Executive Director, DPUC
10 Franklin Square
New Britain, CT 06051

Honorable Wade Hyslop
State Representative, 39th District
32 Belden Street
New London, CT 06320

Honorable Terry Backer
CT State Representative
Legislative Office Building
Room 3902
Hartford, CT 06106

Honorable Kevin DelGobbo
CT State Representative
83 Meadow Street
Naugautuck, CT 06770

Honorable Thomas Herlihy
CT Senate
12 Riverwalk
Simsbury, CT 06089

Honorable Cathy Cook
CT Senate, 18th District
43 Pequot Avenue
Mystic, CT 06355

Mr. Edward Mann
Office of Senator Dodd
Putnam Park
100 Great Meadow Road
Wethersfield, CT 06109

Chairperson Pam Katz
CT Siting Council
10 Franklin Square
New Britain, CT 06051

Mr. Ken Decko
CBIA
350 Church Street
Hartford, CT 06103

Honorable Paul Eccard
First Selectman
Town of Waterford
15 Rope Ferry Road
Waterford, CT 06385

Mr. Richard Brown
City Manager
New London City Hall
181 State Street
New London, CT 06320

Honorable Gaylord Gaynor
Mayor, New London
New London City Hall
181 State Street
New London, CT 06320

SN: 04-398
Docket Nos.: 50-336/423
Subject: RAI – License Renewal Applications

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 Engineering, of Dominion Nuclear Connecticut, 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 13th day of August, 2004.

My Commission Expires: March 31, 2008.

Maggie McClure
Notary Public

(SEAL)

Attachment 1

Response to Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives (SAMA) for Millstone Power Station (MPS) Unit 2

RAI 1. The SAMA analysis is based on the "current" version of the Millstone Probabilistic Risk Analysis (PRA), which is a modification to the Individual Plant Examination (IPE) submittal. Please provide the following information regarding the PRA model used for the SAMA analysis:

a. Indicate which revision was used for the SAMA analysis (i.e., provide a date or revision number).

b. Provide a description of the internal and external peer review of the level 1, 2, and 3 portions of the PRA used for the SAMA analysis.

c. Provide a description of the overall findings of the Peer Review (by element) and discussion of any elements rated low (e.g., rated less than a 3 on a scale of 1 to 4 or rated a conditional 3) or any facts and observations (e.g., A and B Facts and Observations) that could potentially affect the SAMA identification and evaluation process, and how Dominion has addressed these findings for this application (including for example sensitivity studies).

d. For each model revision listed in Table F.2-1, provide the approximate CDF and large early release frequency (LERF), and a description of the major hardware and/or Level 1/Level 2 modeling changes from the prior version. Specifically, identify and discuss any changes made to address the weaknesses identified in the NRC staff SER on the MPS2 IPE. Include a description of the major differences between the PRA version peer reviewed in 2000 and the PRA used for the SAMA analysis.

e. Provide a breakdown of the internal event CDF by accident class, specifically include the contribution from station blackout, anticipated transient without scram (ATWS), and internal flooding.

f. Provide the plant damage states for each of the top 30 cutsets in Table F.2-2.

g. Describe any credit taken for equipment in either Units 1 or 3 and the assumptions concerning this equipment's availability as a result of conditions at the other unit.

h. Attachment E, Section F.1.2.2 indicates that source terms were generated for the dominant core damage sequences presented in the IPE. Since the dominant sequences probably have changed since the IPE, for each release category identify the dominant sequences and their frequencies, and the sequence on which the source terms are based. If the sequence used to generate the

current source terms is not the dominant sequence for each category, please discuss and justify.

l. Provide an explanation of why the containment isolation failure and basemat melt-through failures are zero for Unit 2.

Dominion Response to RAI 1

Response to 1a.

For Plant Specific SAMA Identification:
Model #M2010425, Calculation #PRA99YQA-02863S2, "MP2 Final Quantification", Rev. 2, April 2001.

For SAMA ΔCDF Quantification:
Model #M2020312, Calculation #PRA99YQA-02863S2, "MP2 Final Quantification", Rev. 3, October 2002.

Response to 1b.

The PRA external peer review process, performed in 1999, was a one-time evaluation of the then current PRA model and its maintenance and update methods. The review assessed the strengths and weaknesses of the various technical elements of the model. The overall objective of the peer review process was to provide a method for establishing the technical quality and adequacy of a PRA for a spectrum of potential risk-informed plant applications for which the model may be used. The table below describes the Peer Review Team and their positions within the nuclear industry.

Reviewer Affiliation	Reviewer Degree	Industry Experience	Years PRA Experience
Florida Power and Light	B.S. Electrical Engineering	28	10

Reviewer Affiliation	Reviewer Degree	Industry Experience	Years PRA Experience
ABB-Combustion Engineering Nuclear Operations	M.S. Fluids M.S. Mechanical Engineering	29	10
Baltimore Gas and Electric	B.S. Electrical Engineering	21	9
Baltimore Gas and Electric	B.S. Nuclear Engineering	9	9
Baltimore Gas and Electric	B.S. Mechanical Engineering	19	5
Arizona Public Service Company	M.S. & B.S. Nuclear Engineering	16	6
ABB-Combustion Engineering Nuclear Operations	M.S. Computer Science B.A. Physics	30	30

The general scope of the PSA Peer Review included review of eleven main technical elements for the at-power PRA. These were: initiating events, accident sequence analysis, thermal hydraulic and system analysis, data and dependency analysis, human reliability, structural analysis, quantification process, Level 2 (containment) analysis and PSA maintenance and update process. The review was guided by checklist tables. Internal peer reviews are performed routinely in accordance with Appendix B program whenever a model update is necessary.

Response to 1c.

Table 1 below provides the overview of the peer review comments for level A and B comments. Table 2 lists the individual level A and B peer review comments and evaluates their impact on the SAMA analysis. It is anticipated that the outstanding comments will be resolved in the next model upgrade.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Initiating Events (IE)	Update the steam generator tube rupture (SGTR) frequency.	Negligible impact on the SAMA analysis. An SGTR contributes less than 6 percent to the CDF.
Accident sequence evaluation (event trees) (AS)	Address the issues identified in the referenced Fact and Observation sheets.	Negligible impact on the SAMA analysis. The issues identified in the review of the AS element do not significantly undermine the quality of the event trees. Given that comments related to the event trees were resolved, the effect is considered insignificant.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Thermal Hydraulic Analysis (TH)	HS /CS injection is treated too conservatively when applied to small LOCAs. ATWS does not reference the CEOG standard and uses head lift failure criteria.	Negligible impact on the SAMA analysis. The injection model is recognized as overly conservative. This will be addressed in the next model update. The head lift failure criteria will be re-evaluated in the future model update. However, in the latest model the contribution from the ATWS has decreased significantly and is now 3.5% of the total CDF, compared to 12.1% in the version that was used for the SAMA analysis. The reduction is attributable to various manual means that the operators have available to trip the reactor, which had not been previously credited in the model.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Systems Analysis (SY)	• The AFW motor and turbine driven pumps appear similar enough to warrant common cause consideration of the pump itself. • Following a reactor trip, the operators take control of AFW. Consider the probability that the steam generators could overfill. • Model the common cause failure mode of the sequencers	Negligible impact on the SAMA analysis. There is a possibility of the shaft and impeller of the pumps having a common cause failure potential; however, this is relatively small when compared to the other portions of CCF, which are not comparable. The failure of the operator action to manually control the AFW would be low due to the familiarity of this action and the training. The CCF failure of the sequencers is considered a low frequency event.
Data Analysis (DA)	Update the loss of offsite power probabilities. Screen inadequate plant data when performing updates.	Negligible impact on the SAMA analysis. Most of these recommendations have been incorporated in the subsequent model updates. The remaining comments are considered low significance.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Human Reliability Analysis (HR)	• Locate and validate the current HRA methodology • Eliminate the use of screening values and the use of the simple estimator • Obtain and document operator input • Review HRA dependencies and address as appropriate	Negligible impact on the SAMA analysis. Several most risk-significant operator actions in the HR analysis were upgraded in the subsequent model updates since the peer review. The remaining issues are not considered to have a significant impact on the SAMA analysis.
Dependency Analysis (DE)	There is no updated flood evaluation; the original evaluation was based on a qualitative screening approach. Update human action dependencies. Improve system dependency traceability.	Negligible impact on the SAMA analysis. Flood model has no impact on the SAMA (internal flooding contributes less than one percent to the CDF). Some HRA dependencies related to the Service Water, steam generator depressurization and emergency boration have been accounted for through the Rule file applied after the model quantification. The remaining dependencies are judged to have insignificant impact on SAMA. System dependencies have insignificant impact on SAMA.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Structural Response (ST)	The old MP2 flood analysis apparently assumes that all flood barrier/flood doors will maintain their integrity under all conditions. There is no documentation of the flood door design bases that would support this implied assumption.	Negligible impact on the SAMA analysis. The internal flooding contribution to the CDF is less than one percent. The internal flooding analysis for Unit 2 is scheduled for the next model update.
Quantification (QU)	The recommended enhancements are essentially dominated by the need to complete the final quantification and perform the recommended evaluations: • Review dominant and non-dominant cutsets • Correct recovery event applications • Document asymmetries and logic cuts • Document bases for delete term and mutually exclusive events • Assess truncation limit • Perform uncertainty analyses • Perform sensitivity analyses • Perform importance analysis on systems and initiating event	Negligible impact on the SAMA analysis. Some of these comments have been resolved in recent model updates (recovery event applications, documentation issues, truncation limit, importance analysis). The remaining issues are judged to be non-impacting on the quality of the SAMA.

Table 1: Summary of Peer Review Comments By Category

Peer Review Comment	Recommended Enhancement	Impact of Not Incorporating Comments on SAMA Analysis
Containment Performance Analysis (L2)	Include a LERF analysis for the latest PRA update	Negligible impact on the SAMA analysis. The LERF analysis has been included in the latest update.
Maintenance and Update Process (MU)	• Establish a complete list of PRA inputs in addition to plant changes to review • Fully implement all processes needed to maintain the PRA • Define "High Priority Change" and "Low Priority Change" • Establish a process to address pending changes • Establish a process to address the update of PRA applications	Negligible impact on the SAMA analysis. These issues have been addressed in the guidance developed as part of the capital project for the PRA model updates within Dominion PRA.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.1) The significant combinations of inverter failures should be modeled. (AS-4)	Comment not yet incorporated. Individual inverter failures are modeled, however, combination of inverter failures may not be fully accounted for.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.
A.2) Incorporate the dependencies on AFW instrument air and indication power on the AFW flow control action. (AS-5)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The cumulative effect of a loss of instrument air or a station blackout event (i.e., events where the batteries would be necessary) plus the failure of the operator to manually control AFW flow after 2 hours (loss of instrument air), or after 8 hours (battery depletion) is considered insignificant.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.3) SMALL LOCA: The success criterion for containment cooling is PP OR 1 CAR FAN. Top branch shows no CD if CS OR FANS are successful. Bottom branch shows no CD if CS is successful and CD (SLFL1_15) if fans are successful. Should SLFL1_15 BE PD instead of CD? **(AS-7)**	Comment resolved. The small LOCA event tree has been changed through recent model updates, after the SAMA analysis was finished. The SLFL1 sequence in the new tree indicates that if the sump recirculation is not successful, core damage will eventually occur. The probability that the sump recirculation fails is very low however; the switchover sequence is automatically initiated, but it can also be performed manually if the automatic function fails, given that sufficient time is available. The operators are also trained to perform this procedure manually; the sump recirculation components are also tested regularly.	Negligible impact on the SAMA analysis.
A.4) Per the CEOG best estimate ATWS success criteria evaluation, a limit of 3700 psia is recommended to be used. In order to use 4300 psia as success, RV upper head lift issues must be considered in the analysis. If a lower pressure is used, confirm the impact on the assumption of 1 of 2 PORVs instead of 2 of 2 PORVs as recommended by the CEOG best estimate evaluation. **(AS-11)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The current contribution from an ATWS is only 3% of the total CDF.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.5) Credit was taken for the MP1 DG as a backup power supply to unit 2. fail to run and fail to start events (AC5DG15G11FN AC5DG15G11NN) were included in the fault tree. The failure rates for these are different than used for the unit 2 'A' AND 'B' DGs. The bases for the unit 1 DG failure rates do not appear to be documented in the data calculation. **(DA-03)**	Comment resolved. MP1 DG is no longer used as a back-up power supply. The updated PRA model credits the Unit 3 SBO diesel generator and the unit's station transformers. Unit 2 has now more backup power sources available from Unit 3 than had been credited in the old PRA model, which used Unit 1 as the backup source.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.6) Screening values are overused for operator actions. **(HR-01)**	Comment partially resolved. The subsequent model updates included the HRA analysis to provide a more detailed modeling of the more significant operator actions. Within the large LOCA tree there is one operator action, OABP (boron precipitation control - screening value acceptable because of a very long time – 8 to10 hrs.- involved); in the medium LOCA tree there are no operator actions; and within the small LOCA tree there is OABAF (failure to establish once-through cooling), OADEP (failure to depressurize the secondary side), and operator action associated with a consequential SBO or a loss of DC (OALTDAFW screening value is acceptable - very low frequency event).	Negligible impact on the SAMA analysis. Refining operator action error probability is not expected to have any significant impact on the CDF.
A.7) There does not exist any documented evidence in the Human Reliability analysis on the use of operator input for the calculation of human error probabilities. In addition, the Millstone PRA staff has stated that operator input was not used for the current HEP values. **(HR-03)**	Comment partially resolved. Operator input has been used in the model for the most significant operator actions. Interviewing the MP2 Simulator personnel provided this input. The results have been incorporated into Human Error Probabilities (HEP) such as OABAF.	Negligible impact on the SAMA analysis. The remaining HEPs have conservatisms to justify the uncertainties.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.8) Human Action OARDC1 is used to recover the Number 1 Sequence. The write-up for the description of this action is "Blank". It is unclear what action is taken for this recovery. This problem also exists for Actions OARDC1 and OASWALIGN. **(HR-05)**	Comment resolved. The AC power distribution fault tree has been updated to reflect the current alignment with the Unit 3 back-up power sources. These human action events are no longer credited in the new model. A different event accounts for operator error to align Unit 3 power sources (see response to A.11 below).	Comment resolved.
A.9) The HRA analysis in some cases discusses the total time to take the action after the initiating event for the action but does not account for the diagnosis time and time required to take the action. **(HR-09)**	Comment partially incorporated. Some changes have been made to provide a more detailed modeling to account for diagnosis time and required action time of some significant operator actions. It is planned that the next model revision will update success criteria for operator action based on diagnosis and response times obtained from operator interviews.	Negligible impact on the SAMA analysis. Refining operator action error probability is not expected to have any significant impact on the CDF.
A.10) Use of the simplified recovery action estimator found in Appendix B of the HRA calculation seems overly simplistic. **(HR-10)**	Comment not yet resolved.	Negligible impact on the SAMA analysis. These recoveries are not dominant.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.11) OPERATOR ACTION OAMP1XTIE (ALIGN POWER FROM UNIT 1): HRA calculation shows a 1.0 failure prob. Per the calculation discussion, the reason for the 1.0 probability is at least in part due to this being a stressful and complex task, and the entire procedure has never been accomplished. The quantification results show that the number 2 cutset contains this action with a 0.104 prob. The 0.104 must be justified in the HRA calculation or set to 1.0. **(HR-11)**	Comment resolved. Unit 1 is being decommissioned and is no longer the back-up power source to Unit 2.The new operator action modeled is OAM3SBODG and denotes the alignment of the Unit 3 SBO diesel generator to supply power to Unit 2 during station blackout. The HEP factor is documented in the Unit 2 HRA notebook.	Comment resolved.
A.12) The actions in the recovery rule file that are considered to be dependent are replaced with a new action with a higher probability. It should be confirmed that potentially important cutsets were not truncated due to quantification with the two dependent actions "ANDed" (i.e., the cutsets were truncated and not found by QRECOVER, thus the new action with the higher probability could not be added). **(HR-14)**	Comment resolved. This is typically considered as part of the overall review of the new PRA model update before its release into the production mode.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.13) OPERATOR ACTION OABAF: This bleed and feed action is in the model with a 0.1 probability. This action is not documented in the HRA calculation. **(HR-15)**	Comment resolved. The bleed-and-feed model has been modified as a result of new success criteria, determined analytically. The operator action is OAPBAF and is documented in Unit 2 notebooks.	Comment resolved.
A.14) HRA calculation identifies specific HRA dependencies that are not addressed by the recovery rules to preclude dependent recoveries, or make appropriate adjustments. **(DE-6)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Modeling HRA dependencies is not expected to have any significant impact on the CDF. The most significant HRA dependences have been addressed in the subsequent model updates.
A.15) Operator actions for ISLOCA are treated with screening values. Error rate seems high and should be conservative (0.01). Include statement with reference that opening of the relief has been judged to be sufficient to avoid downstream piping failure. **(IE-3)**	Comment not yet incorporated. Operator actions for ISLOCA refer mostly to the failures to diagnose such event in the charging line relief valves. The current value in the model is 0.1. It is planned that this factor will be evaluated again in the next model upgrade.	None, the error is in the conservative direction.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.16) All of the documents associated with the Millstone 2 PSA have a signoff block for independent review and independent review is required. None of the documents were signed, but this is because NU is in the process of finalizing the latest update of the PSA. **(IE-8)**	Comment resolved. Documentation issue. The documentation has been completed and signatures affixed.	Comment resolved.
A.17) The quantification report describes the basic quantification method, but the process is difficult to follow unless knowledgeable about the CAFTA code and the specific steps to follow. No basis was provided for the process of developing the delete term logic and the recovery patterns, although an explanation of the purpose of the mutually exclusive file (MP2MUT) and recovery rule file (MP2RULE). **(QU-01)**	Comment resolved. This is a documentation issue. The quantification method is being documented as part of the transition of the existing PRA calculations to the notebook format, based on the new ASME PRA standard.	Comment resolved.
A.18) The current status of the quantification was inadequate to perform a quality review of these PSA subelements. The PRA had been quantified with the top 500 cutsets provided, but final documentation of the results, analysis of the dominant cutsets, evaluation of the initiating event contributions, etc., were not complete at the time of the review. **(QU-03)**	Comment resolved. This is a documentation issue. The quantification method is being documented as part of the transition of the existing PRA calculations to the notebook format, based on the new ASME PRA standard.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.19) Many of the dominant sequences are a result of the loss of 125 VDC. Apparently, on January 1, 1981 the supply breaker (DO 103) to the 125V DC load center 201A was open during ground checks resulting in a reactor trip. NE personnel feel that this is readily recoverable. As a result, a recovery factor of 10% (OARDC1) is used for 125 VDC IEs %LDCA and %LDCB. The appropriateness of this factor is not documented in the HR report. All of the description fields are blank. Further, even if DC power is recovered this should cause a plant trip. Therefore, the plant trip frequency should be increased. **(QU-05)**	Comment resolved. The DC power fault tree has been updated. The OARDC1 recovery factor has been deleted, since the plant modification after the 1981 event precludes such operator error from occurring again.	Comment resolved.
A.20) In general, operators or someone knowledgeable in recovery possibilities should review the Millstone sequences. Many of the top sequences appear recoverable. For example, many of the top sequences relate to loss of 125 VDC. This fails MFW and disables breaker control for an AFW motor driven pump. No credit is taken for manually closing the breaker even though no other decay heat removal recoveries are credited. This leads to significant overestimation of the CDF contribution for these sequences. **(QU-06)**	Operators have been used to review selected fault trees. For model upgrades, top sequences are now being routinely reviewed for recoveries before the new model is released. Dominion believes that appropriate expertise exists among its PRA personnel to provide the meaningful review of the results.	None (see explanation in Comment Disposition section).

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.21) The MFW recovery factor, RECMFW, is being used to recover from LOCV and LMFW initiating events. Consider removing this recovery factor or significantly improve the documentation. **(QU-09)**	Comment not yet incorporated. This will be reviewed in the next model upgrade.	Negligible impact on the SAMA analysis. This is a documentation issue and will be corrected in the future update. In the current model this recovery factor is applied only to the LMFW initiating event (LOCV is no longer modeled).
A.22) The quantification report does not address (or appear to intend to address): • asymmetric modeling or evaluate the validity of cutset results due to asymmetric modeling or actual plant asymmetries • truncation limit validation • sensitivity analyses • uncertainty analysis dominant component importance analysis **(QU-11)**	Comment not yet incorporated. These comments will be resolved in future model updates, but do not impact the SAMA project. The SAMA analysis was performed using a truncation value of 1E-11 to ensure a sufficient number of cutsets would be obtained.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.
A.23) The quantification report and HRA report do not address the development of all the recovery actions. Examples: 'OACHGSWING' and the 'OA***' events. **(QU-13)**	Comment resolved. OACHGSWING is not in the current MP2 model. All other recovery actions have been addressed in the Final Quantification.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.24) F&B Methodology reflects new steam generator design (lower inventory at SG low level). No success credited under any circumstances without ADVs. No modified criteria for longer-term F&B scenarios. Analyses consider EOP only trip two, leave two. Table is confusing in that a 14.5 minute minimum time is provided. However table discusses 20 and 30-minute times only. 15 minute is used in actions. Longer times based on early generation analyses need to be redone. **(TH-10)**	Comment resolved. New success criteria for feed-and-bleed have been established, based on MAAP 4 analysis of various mitigating equipment alignments. The results show that it is possible to perform successful F&B without ADVs if at least one MSSV is available in each steam line.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.25) The following inadequacies were noted in the model update process: • The guideline on capturing PRA changes is limited to plant changes. Many changes to the PRA are the result of modeling issues, industry information and equipment performance issues. These issues do not appear to be captured. • The guideline has a table that lists various "PRA Model Inputs". In the "Conclusion" section of this table it indicates that many of the inputs do not have in-place processes to identify the potential changes. For example: Design changes - "Process in place is not working. Change to the DCM Procedure is necessary" and Tech. Spec. Changes - "SAB Manager is the formal link that needs to be linked to PRA". • The specification for what a "high priority change" and "low priority change" is not provided. • The time frame for incorporating changes appears to be aggressive, 60 days after change (high) and 90 days after refueling outage if low except that they can be extended indifferently. Therefore, changes could be pending for an extended period of time. • Other items were included, but are not listed here for spacing considerations. (MU-01)	Comment resolved. These guidelines have been developed and implemented since the peer review.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.1) SGTR frequency is based on the current version of the CEOG Standard. Revised values were provided by e-mail in 1998, but the report has not been updated yet. Report will be updated in 2000. (IE-1)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. An SGTR contributes less than 5 percent to the CDF.
B.2) Spurious opening of PSVs or PORVs is not modeled. (IE-2)	Comment resolved. Spurious opening of PORVs as a small LOCA initiator is not addressed in the small LOCA frequency because it is considered a consequential LOCA.	Comment resolved.
B.3) Many initiators are subsumed into the General Plant Transient (GPT) category and the Loss of Main Feedwater. There is no evidence that the progression of initiators, such as loss of condenser vacuum, were evaluated to ensure that they were consistent with the progression models for GPT or LMFW as appropriate. Note that for general transients, NU used only plant specific data and did show exactly where each trip was mapped. (IE-4)	Comment resolved. Initiators such as a loss of condenser vacuum are now part of the steam generator cooling node. The SGC model has been revamped to add credit for the Condenser pumps as an additional option for removing the decay heat.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.4) Perform Bayesian update of IE's using industry values. **(IE-5)**	Comment resolved The initiating event frequencies have been Bayesian updated with industry data in subsequent model updates after the peer review.	Comment resolved.
B.5) The total frequency for LNP at Millstone is given as 0.024. This is about 1/2 of the latest generic frequency for LNP. A review of PRA99YQA-02900-S2, shows that NU excluded a large number of Industry Loss of Power events, including 4 of the 5 events that occurred at Millstone, from the calculation of the LNP frequency. There is limited documentation on the basis for excluding specific events. The process did assume that all events that occurred when a plant was shutdown should be excluded. This is not necessarily a valid assumption. **(IE-6)**	Comment resolved. The LNP frequency in the model was modified to include the grid-related, weather-related and plant-centered initiating events. The data used to calculate the frequency of each category is based on the EPRI report TR-110398: "Losses of Offsite Power at US Nuclear Plants" and spans years 1984-1997.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.6) Section 6.2.10, General Plant Transient, states that many different initiators that cause a similar plant transient are included in the GPT event tree. On review of the initiating event analysis it appears that the initiating event of loss of condenser vacuum is included as one of the GPT initiating events. If this is the case, then when the questioning Event Tree Node "SGC", Steam Generator Cooling, Main Feedwater would need to be set to failure to make the event tree bounding or the loss of condenser vacuum needs to be addressed with a separate event tree. If loss of condenser vacuum is not included in the GPT, then this initiating event needs to be addressed. **(AS-1)**	Comment resolved. The SGC node has been modified. The total loss of MFW is one of the gates in the node, with the total failure probability of 0.288, combined with the probability of operator failure to recover the system.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.7) Section 6.2.10, General Plant Transient, does not appear to address secondary system steam removal. In Section 2, it states that the event tree node SGC addresses steam generator cooling. It identifies MFW and AFW as systems used to achieve this function. It does not include steam removal of ADVs, TBVs or main steam relief valves. (AS-3)	Comment not yet resolved. Because there is a multitude of steam relief paths available (i.e., steam dumps, atmospheric dump valves, steam supply to the steam-driven terry turbine, and steam generator safety valves), these paths were not explicitly modeled. Additionally, the ADVs can be locally manually operated on loss of air to the operating diaphragm. Therefore, the probability that these valves will all fail is extremely low. The resolution of this comment will be to describe in more detail the steam relief functions in the documentation of the next model upgrade.	No impact on the SAMA analysis.
B.8) SMALL-SMALL AND SMALL LOCA: why isn't B&F credited for heat removal if AFW fails? TH CALC STATES: ...Therefore, small breaks (as well as small-small breaks) require decay heat removal via main or auxiliary feedwater. For small break LOCA, opening a PORV would also be adequate. (AS-6)	Comment resolved. Small-small LOCA has been combined with the small LOCA tree. In the revised event tree the bleed and feed question is asked if the Steam Generator cooling is lost. This is now factored into the fault tree for small LOCA.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.9) The event tree analysis uses an RCP Seal failure probability of 8.91E-5 for four seal stages failing given that the affected RCP(s) have been tripped within 60 minutes. The reference for this value is stated as "CE NPSD-755, Reactor Coolant Pump Seal Failure Probability Given a Loss of Seal Injection." This reference is known to have calculated an optimistic number. (AS-8)	Comment resolved. The RCP seal failure methodology in the model has been modified. It is based on the CEOG report CE NPSD-1199-P. This model will be subject to another review in the next PRA model upgrade, however.	Comment resolved.
B.10) It is apparent that an undocumented assumption is made that AFW will succeed without reliance on ADVs, possibly due to the fact that AFW can feed against the MSSV lift setpoints. If this assumption is not valid, then loss of ADVs must be included in the failure mechanisms for AFW and SGC nodes in various event trees. The same assumption is made for the MFW pumps also. Ref. T/H Calculation MP2-PRA-89-014 pg 10. (AS-9)	Comment not yet resolved. Ample redundancy of steam relief is assumed. It is planned that this will be corrected in the next model upgrade.	Negligible impact on the SAMA analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.11) MFW Success Criteria do not require makeup to the condenser when steam dump valves fail. No documentation of the verification that adequate volume exists in the condenser was identified. Ref. T/H calculation MP2-PRA-89-014 pg 10. (AS-10)	Comment not yet incorporated. It is expected that if the steam dumps fail, the operators will switch to the AFW (and ADVs for steam release). The MFW is normally used to cool the plant down to near entry condition for the shutdown cooling. The AFW is then used until the SDC entry condition is reached. The capacity of the Condensate Storage Tank serving the AFW contains sufficient volume of water for 24 hours of decay heat removal.	Negligible impact on the SAMA analysis.
B.12) Boron precipitation control is assumed required for small and medium LOCAs. This assumption for small LOCAs is probably overly conservative. Some additional evaluation could likely justify that this requirement is conservative for medium LOCAs. Additional evaluation for large LOCAs could possibly demonstrate that the time for initiation could be extended beyond 24 hrs. (AS-12)	Comment resolved. The boron precipitation control model has been removed from the small and medium LOCA fault trees.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.13) In the old MP2 flood analysis, NU apparently assumes that all flood barrier/flood doors will maintain their integrity under all conditions. There is no documentation of the flood door design bases that would support this implied assumption. **(ST-03)**	Comment not yet resolved. Currently, the internal flooding analysis for Unit 2 is scheduled for 2005.	Negligible impact on the SAMA analysis. The internal flooding contribution to the CDF is less than one percent. Therefore there is no significant impact on SAMA.
B.14) HS /CS Injection treated conservatively and applied. to small LOCAs. Use of HS/CS injection for large and medium LOCAs is in accordance with conservative design basis assumptions. HS/CS for small LOCAs is not necessary for small LOCAs even with DB assumptions. A more realistic treatment of the issue should reduce risk contribution, and simplify modeling. **(TH-5)**	Comment not yet resolved. The injection model is recognized as overly conservative. It is expected that this will be addressed in the next model update.	The model is overly conservative; thus, the impact on the SAMA analysis is an artificially high benefit.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.15) ATWS does not reference the CEOG standard and uses head lift failure criteria. The general approach used appears conservative since it relies on early generation CESEC calculations in early CE documents. Modified calculations show reduced ATWS pressure threat. This is offset by a more aggressive approach to utilize the 4300 psia failure limit. Using this approach will require consideration of failure to reseat issues (hot side LOCA). (TH-7)	Comment not yet resolved. See Response to A.4 above.	Negligible impact on the SAMA analysis.
B.16) Plant specific analyses used for many scenarios. Generally this is a strength. However, some calculations used for event timings were referenced to CY. Unclear how this information is used in MP2 PSA. RELAP 5-Mod 2 used for F&B (strength) however many analyses use early plant conditions and less sophisticated codes. Timings for these analyses will be distorted. For RELAP calculations, this issue appears to be met. (TH-8)	Comment resolved. The thermo-hydraulic analysis has been updated using the MAAP and RELAP codes. The references to CY event timings are not used anymore. The success criteria were updated based on the new analysis.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.17) Sump recirculation time calculation does not include CS injection. Underestimate of operator time available. **(TH-11)**	Comment resolved. The operator action for sump recirculation was not modeled because the switchover to sump recirculation (SRAS) is automatic. Even if the automatic action fails, there is sufficient time for the operators to perform the switchover manually. This manual backup is proceduralized and trained on.	Comment resolved.
B.18) Do not use IREP for Calvert Cliffs as Calvert Cliffs doesn't support its general conclusions. CR item conclusion is generally consistent with current Calvert Cliffs PSA. **(TH-12)**	Comment resolved. The reference to IREP for Calvert Cliffs is believed to refer to the upper boundary of the medium LOCA breaks. The primary reference for these break size classification is the Combustion Engineering report CEN-114-P. The Calvert Cliffs IREP is mentioned only as a secondary reference.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.19) Timing results for actions following LOCAs appear conservative. CY results may not be applicable to MP2. **(TH-14)**	Comment partially resolved. The subsequent model updates included the HRA analysis to provide a more detailed modeling of the more significant operator actions. Within the large LOCA tree there is one operator action, OABP (boron precipitation control - screening value acceptable because of a very long time – 8 to10 hrs.- involved); in the medium LOCA tree there are no operator actions; and within the small LOCA tree there is OABAF (failure to establish once-through cooling), OADEP (failure to depressurize the secondary side), and operator action associated with a consequential SBO or a loss of DC (OALTDAFW screening value is acceptable - very low frequency event).	Negligible impact on the SAMA analysis. Refining operator action error probability is not expected to have any significant impact on the CDF.
B.20) Need to evaluate the need for ventilation for critical rooms including the AFW rooms and Control Room. **(TH-15)**	Comment resolved. The AFW room does not require a ventilation system. The control room is manned and any loss of ventilation would be noticed quickly. HVAC does need to be further addressed but it has been modeled to a certain extent already.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.21) It appears that the AFW motor and turbine driven pumps are both Ingersoll Rand. The pumps appear similar enough to warrant common cause consideration of the pump itself. **(SY-02)**	Comment not yet incorporated. There is a possibility of the shaft and impeller of the pumps having a common cause failure potential; however, this is relatively small when compared to the other portions of CCF, which are not comparable.	Negligible impact on the SAMA analysis.
B.22) Document basis for excluding the HVAC dependency to the AFW model. **(SY-03)**	Comment resolved. The AFW rooms do not require an HVAC system.	Comment resolved.
B.23) Following a reactor trip, the operators take control of AFW. Without this, the steam generators could overfill. This is not modeled or documented in the AFW analysis. **(SY-04)**	Comment not yet incorporated. The failure of the operator action to control AFW would be low due to the familiarity of this action and the training. Other failures of the AFW system would probably dominate.	Negligible impact on the SAMA analysis.
B.24) The failure probability of a component should be related to the surveillance interval. **(SY-05)**	This contradicts the WOG peer review comment for Unit 3, which resulted in Millstone removing the impact on surveillance intervals. It is planned that this will be addressed in the future update.	Negligible impact on the SAMA analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.25) In AFW, the common cause factors noted in 98YQA-02394-S2 Section 6.2.4 do not match the basic event factors in 98YQA-02394-S2, Attachment B, pg. 2 (SY-16)	Comment resolved. The data in Section 6.2.4 is correct. The data in Appendix B (the U-Factor) is incorrect. The SAMA analysis used the correct data.	Comment resolved.
B.26) In the ESAS fault tree, the failures of isolators and power supplies are not considered. The analysis states that isolators are passive and therefore do not need to be considered. Isolators are no more passive than transformers, which are typical considered. Power supplies, especially those associated with ESAS actuation, can be a significant contributor. ESAS power supplies often cross safety signals. (SY-08)	Comment not yet incorporated. The treatment of isolators and power supplies should be appropriately addressed but these elements are not dominant contributors to risk.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.27) PSA Guideline #4 "System Modeling", Section 4.8.2, application of modeling assumption to neglect passive components may be too general. Example - Failure of 2-MS-202/201 to remain open is likely not to be two decades less than the failure of 2-MS-4B/4A to open. The basis for screening the passive components is that the failure likelihood of the passive component is two decades less than the next most dominant contributor. In certain cases, this is not met. Model may provide a reasonable estimate of plant risk, but component risk may be obscured. **(SY-09)**	Comment not yet incorporated. Adding passive components is not assumed to contribute significantly to the CDF. This will be addressed in the future.	Negligible impact on the SAMA analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.28) PSA Guideline #4 "System Modeling", Section 4.8.2, assumption to neglect modeling passive components may hide their importance when performing analyses with equipment OOS. Given an application of the model in which the component is configured as running, but must continue operation then this modeling technique could indicate that essential will not fail, since passive failures are neglected and fail to start/transfer would be false. Model may provide reasonable estimate of plant risk as long as the limitations are recognized and addressed when evaluating the risk insights. **(SY-10)**	Comment resolved. For this SAMA application, equipment out of service was not assumed in the analysis.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.29) Common cause failure of the sequencers not modeled. (SY-11)	Although the common cause failure of the sequencers has not been modeled, the undervoltage (UV) actuation modules CCF has been modeled. These modules provide one of the inputs to the sequencers (the SIAS being the other). The CCF of the sequencers is estimated to be on the order of two magnitudes less than the CCF of the UV modules. This includes a combination of an LNP and SIAS (the sequencers perform identically after an LNP with or without a SIAS). Not modeling this failure therefore does not have a significant impact on the SAMA. The CCF methodology for the sequencers will be reviewed however in the future model update.	Negligible impact on the SAMA analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.30) In the RWST and Containment Sump recirculation analysis, PRA97YQA-02032-S2 Section 6.2.1, page 20 states that containment sump screens will not become plugged during recirculation. This is not a standard assumption and would need strong justification. It is recommended that this failure mode be included in the model. The industry currently has several ongoing programs to look at the issues associated with Sump blockage for PWRs , which may provide resolution to this issue. **(SY-13)**	Comment not yet incorporated. The industry failure rates are on the order of 1.0E-5 to 1.0E-06/hr. This would result in sump screen clogging contributing a 1-10% increase in the overall sump recirculation unavailability. However, recovery actions such as refilling the RWST and switching back to the injection mode could be credited to reduce this contribution. Los Alamos National Lab (LA-UR-02-7562) performed a study entitled "The Impact of Recovery From Debris-Induced Loss of ECCS Recirculation on PWR Core Damage Frequency" which concluded that recovery actions will substantially reduce the CDF with debris effects for all plants.	Negligible impact on the SAMA analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.31) Provide justification for PSA Guideline #12 Section 5.3 method to screen inadequate plant data to perform updates. Assuming plant data indicates a high failure rate (although the number of demands appears inadequate by the criteria stated) failure to incorporate this plant specific data and apply the generic mean failure rate to the component fails to properly assign a valid failure rate. **(DA-01)**	Comment resolved. The PSA guidelines are no longer used. The failure rate data uses both plant-specific and generic data. The model database is scheduled for another review in the upcoming 2004 model update.	Comment resolved.
B.32) Calculation PRA98YQA-02610-S2, "MP2 Data Analysis," page 7, Assumption 4. The assumed value of .33 when no failures have been experienced is rather unusual. There are several processes for dealing with the "zero failure" condition, one of these is discussed on page 17 of PRA99YQA-02900-S2. The equation used is E(n,t) = (2n+1)/2t. For the "zero failures", this essentially assumes .5 failures in time t. **(DA-02)**	Comment not yet incorporated. The 0.33 value was developed by SAIC and dates back to the 1980s. The early PRA models used this number, in absence of a better reference. The current practice is to use a value closer to 0.5 failures. It comes from the Bayesian updating using a Jeffreys non-informative prior (0.5 + N)/(0.5 + 0.5 + D) where N is the number of plant-specific failures, and D is the plant-specific demands. If D is large, the denominator goes to D, and for N=0, it obviously approaches 0.5/D. It is planned that the next model update will incorporate this approach.	Negligible impact. The difference between the 0.33 and 0.5 failure values will not have a significant impact on the CDF.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.33) Electrical power fault tree does not appear to include an event to account for a LNP induces by grid instability caused by the plant trip. One plant trip induced LNP has occurred in the industry. Model the probability of a plant trip induced loss of offsite power in the electrical system fault tree. **(DA-05)**	Comment resolved. See the response to B.5 above. The LNP frequency in the model has been modified to distinguish among the grid-related, weather-related and plant-centered initiating events.	Comment resolved.
B.34) The LNP initiating event frequency is given as 3.7E-02 in MP2 data Analysis (PRA98YQA-02610-S2) Table 6.4.1, Initiating Event Frequencies. This is based on Reference 16 (NUSCO Calculation PRA98YQA-01013-SG "LOP Frequency Calculation" Rev. 0). However, the quantification uses a lower LNP value of 2.4E-02. (As shown in the "Cutsets with Descriptions Report"). The 3.7E-02 is closer to the industry value. **(DA-06)**	Comment resolved. See the response to comment B.2 above. The grid-centered LNP frequency is 3.1E-3; the weather-related LNP frequency is 5.2E-3; and the plant-centered LNP is 2.25E-2.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.35) PORV Unavailability: A statement from the plant PSA staff indicated that one reason for using a 1 of 2 instead of 2 of 2 PORV success for ATWS pressure relief was due to high PORV unavailability. The data calculation states that there was no unavailability for the 3 yrs of MR data used and thus a 1E-04 value was used. It should be confirmed that this low value is appropriate. For Feed and Bleed: PORV unavailability is "ANDed" with the block valve to open. This assumes that all PORV unavailability would be recoverable. If the PORV is determined to be inoperable (e.g. other than just some leakage), the block valve would likely be closed with it's breaker open and thus the PORV would not be recoverable. PORV Unavailability Basic Events: There are different PORV unavailability basic events used in the fault tree (one for failure of auto pressure relief and one for failure of F&B). (DA-08)	Comment not yet incorporated. This assumption will be verified in the next model update. However, the plant data indicates the PORV availability remains high (currently 100% availability for the rolling 24-month period). Therefore the 1.0E-4 value remains applicable. For feed and bleed cooling, not all PORVs that are out-of-service due to maintenance (1.0E-04) can be recovered by opening the PORV. However, by not crediting the block valve opening, this maintenance unavailability contributes about 1% to the overall feed and bleed unavailability, assuming no recovery. A value of 2E-03 is used for both the auto pressure relief and feed and bleed.	None.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.36) There is no operator error for miscalibration of RWST level sensors leading to an early SRAS. An early SRAS would result in the LPSI pumps being tripped and the HPSI and CS pump suction being switched to the sump. If there is limited inventory in the sump, there is potential for the pumps to failure on low NPSH in the sump. **(HR-02)**	Comment resolved. This was addressed in an earlier MP2 LPSI Fault Tree analysis, which stated that a gross miscalibration of 2 of the 4 RWST level transmitters would have to occur. This was not considered a credible event. The combined allowable error between the bistables and level transmitters is approx. 39%, with most error allowed in bistable calibration. Additionally, a channel check of the level transmitter as it relates to the low level bistable trip is done by each shift; a channel functional check is done on a monthly basis; and calibration is performed every refueling outage.	Comment resolved.
B.37) Document the basis for the calculator used in HRA analysis **(HR-07)**	Comment not yet incorporated. The method to calculate the HRA probabilities uses the HRA Toolbox program. This comment is one of documentation.	None. Documentation issue. There is no impact on the CDF.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.38) The time available to perform a human action, the time required to perform the action and the bases for both are not always provided for the applicable actions. This lack of information makes it impossible to verify the appropriateness of the HEP values used for each action. **(HR-08)**	Comment not yet incorporated. Within the LOCA trees, large LOCA contains one operator action - OABP (screening value acceptable - long time 8-10hrs.), medium LOCA contains none and small LOCA contains OABAF, OADEP (=1.0) and operator action associated with a consequential SBO or Loss of DC (OALTDAFW screening value acceptable, very low frequency event).	None. Documentation issue. Improving the documentation is not expected to have an impact on the CDF.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.39) OAADV1 (potentially not used) is an action "Local Manual Operation of an ADV" that is used for feed and bleed. In the dependency section of the action description, it states that OABYPASS and OATDAFW, operator fails to start the terry turbine, appear in cutsets with OAADV1. It appears that if the Terry Turbine action fails, due to other than hardware, then the OAAVD1 should fail. OACST (operator fails to provide makeup to the CST) is redundant to the initiation of SDC. This dependency is addressed by increasing the combined failure rate by a factor of 10 (OACSTSDC). Although it appears that the OACST action is very conservative, it appears that there two actions have complete dependency. If a failure to makeup to the CST occurs due to human error not hardware, a relative easy action then it is hard to fathom the operators pursuing initiation of SDC. However, if CST makeup fails due to hardware then initiation of SDC as a recovery would be reasonable. The factor of 10 increase in failure probability for dependent actions which is used for several dependent actions has no identified bases (example: OACSTSDC, OARWSTSDC, OASWSYS) (HR-12)	Comment partially incorporated. OASWSYS is no longer in the model. The small small LOCA event tree has been merged with the small LOCA tree and is no longer modeled separately.	None. This is a conservative approach, in lieu of a detailed dependency analysis.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.40) Action OARDC1 (0.1) is used in the recovery rule file to replace actions OADCALTCHG and OARDC1. The apparent dependency between OADCALTCHG and OARDC1 is not discussed in the HRA calculation discussion for these actions. OARDC1 is not discussed in HRA or QU calculations, it only appears in the rule file. Confirm other dependencies between actions listed in rule file are discussed in HRA calculation. Also, OARWST, OATDAFW, OALTDAFW, and OATRIPRCP are only addressed in the rule, i.e., no discussion in the HRA or QU calculation. **(HR-13)**	Comment resolved. OARDC1 and OADCALTCHG have been deleted from the model. OATRPRCP has been deleted and OAPRCPTRIP is now modeled in more detail. OARWST (only modeled after SGTR), OATDAFW (modeled after SBO) and OALTDAFW (modeled after total loss of DC) are discussed in the updated HRA analysis, which was used for the SAMA analysis.	Comment resolved.
B.41) References in EOPs and AOPs used to support various human actions are weak and when stated do not include the revision number. This makes configuration control difficult. **(HR-16)**	Comment not yet incorporated. Revisions have been made to the HRA documentation, as discussed in previous responses. The documentation references the EOP or AOP and the revision number. This will continue to be done for the future HRA updates.	None.
B.42) The description of operator should clearly identify the bounding conditions for which the HEP was calculated. **(HR-17)**	Comment not yet resolved.	None. Although this is a good practice to follow, it has no effect on SAMA.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.43) Detailed guidance on the development of dependencies is not available. Support system dependencies on Initiating Events are not fully identified. LOSSDC top logic is not identified in the flag file to document the system dependencies. **(DE-02, DE-05)**	Comment not yet incorporated. As part of the Dominion capital project on PRA model improvement, this guidance is being addressed. Dependencies have been accounted for in the model.	Negligible impact on the SAMA analysis.
B.44) There is no current flood evaluation. The old flood evaluation is largely qualitative approach. **(DE-08)**	Comment not yet incorporated. An updated internal flooding analysis for Unit 2 is scheduled for 2005.	Negligible impact on the SAMA analysis. The internal flooding contribution to the CDF is less than one percent. Therefore there is no significant impact on SAMA.
B.45) Directly link references to dependencies and provide a summary for the scope of the dependency evaluation for each system. **(DE-09)**	Comment not yet incorporated. As part of the Dominion capital project on PRA model improvement, this guidance is being addressed. Dependencies have been accounted for in the model.	None.
B.46) In the old MP2 Flood analysis, NU apparently assumes that all flood barrier/flood doors will maintain their integrity under all conditions. There is no documentation of the flood door design bases that would support this implied assumption. **(ST-03)**	Comment not yet incorporated. An updated internal flooding analysis for Unit 2 is scheduled for 2005.	Negligible impact on the SAMA analysis. The internal flooding contribution to the CDF is less than one percent. Therefore there is no significant impact on SAMA.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.47) The quantification report does not describe the actual process undertaken to perform the quantification including the development of the sequence failure and success cutsets, mutually exclusive and recovery files and delete term for the purpose of performing the validation of the event trees prior to the conversion of the master fault tree. **(QU-02)**	Comment resolved. Although the quantification documentation is not detailed, this does not mean it was done incorrectly. It is planned that the documentation will be upgraded as part of the capital project.	Comment resolved.
B.48) Millstone uses the CAFTA R&R Workstation with the RELMCS solution engine. This tool is one of the industry standards. However, Millstone does not have a formal software control process in place to ensure that the version being used is producing consistent and correct results. **(QU-04)**	Comment resolved. The RELMCS solution engine has been replaced with the FORTE solution engine. There is now a formal software control process in place.	Comment resolved.
B.49) It is overly conservative to always assume a 24- hr. mission for the EDGs. **(QU-07)**	Comment resolved. The 24-hour EDG mission time assumption has been deleted and replaced with the probability of recovering AC power as a function of time. The analysis is part of the documentation basis for the updated PRA model.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.50) In cutset 12, the OARDC recovery is being used to recover from a hardware failure, DCBKD0103NF. **(QU-08)**	Comment resolved. OARDC is no longer modeled.	Comment resolved.
B.51) Millstone did not perform any uncertainty analyses for this quantification of the PSA and they did not document any sensitivity studies on the impact of key assumptions as part of this PSA update. Although the data calculation included error factors and their code has the capability to easily perform numerical uncertainty analyses, Millstone did not populate the database with the error factors. **(QU-16)**	Comment not yet incorporated. This will be considered for the next model update.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.
B.52) As part of the planned update, prepare a table listing the CET fault tree basic event values for each of the PDSs, which are propagated through the CETs. **(L2-02)**	Comment not yet incorporated. Documentation issue.	None.
B.53) T-I SGTR sequences based on 50% degraded tubes and WOG 1/7-scale results. This assumption may under-estimate SG releases that may be included in early releases. **(L2-04)**	Comment not yet incorporated. Early releases due to an SGTR are a very small fraction of the total LERF (less than one percent).	Negligible impact on the SAMA analysis.
B.54) NU does not have a LERF analysis for the latest PRA update. **(L2-05)**	Comment resolved. The LERF analysis has been included in the latest update.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.55) During the initial presentations several pending changes or open items were identified including: • updating the flood analysis • addressing the induced steam generator tube rupture • updating the success criteria to reflect changes such as the new steam generators • updating Level 2 analysis from MAAP 3B to version 4.0 • improving the human action analysis that currently is heavily dependent on screening values These and potentially other open items are not being formally captured thus allowing the PRA results to viewed in light of the identified weaknesses. This process of identifying and capturing PRA weaknesses is critical to achieving an as-built, as-operated PRA. (MU-02)	Comment resolved. The Dominion PRA group has implemented a PRA configuration control database, which captures all proposed PRA changes.	Comment resolved.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.56) Millstone uses the CAFTA R&R workstation with the RELMCS solution engine. This tool is one of the industry standards. Millstone does not have a formal software control process in place to ensure that the version being used is producing consistent and correct results. **(QU-04)**	Comment resolved. The RELMCS solution engine has been replaced with the FORTE solution engine. There is now a formal software control process in place.	Comment resolved.
B.57) It is overly conservative to always assume 24 hour mission time for the EDGs. **(QU-07)**	Comment resolved. The 24-hour EDG mission time assumption has been deleted and replaced with the probability of recovering AC power as a function of time. The analysis is part of the documentation basis for the updated PRA model.	Comment resolved.
B.58) In cutset 12, the OARDC recovery is being used to recover from a hardware failure, DCBKD0103NF. **(QU-08)**	Comment resolved. OARDC is no longer modeled.	Comment resolved.
B.59) It is recommended that Millstone perform at least a simple numerical uncertainty analysis and sensitivity on key assumptions as part of their next quantification. **(QU-16)**	Comment not yet incorporated.	None. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 2: Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.60) Develop and maintain an active list of pending PRA changes. Evaluate the impact of these changes on each application of the PRA to ensure that these weaknesses are included. (MU-02)	Comment resolved. The Dominion PRA group has implemented a PRA Configuration Control database, which captures all proposed PRA changes.	Comment resolved.

Response to 1d.

The table below provides the overview of the NRC staff SER comments, when they were incorporated and the impact of not incorporating them on the SAMA analysis.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
Using data that predated the 1992 analysis cutoff represented a weakness in the IPE.	In May 1999 the MP2 model database was updated with the then current plant specific data and initiating event frequencies.	Comment resolved.
Consideration of pre-initiator human errors appears to be limited. Specifically, we did not provide adequate justification for dismissing calibration errors. Additionally, restoration errors should have been more inclusive than just considering the misalignment errors of valves. All pre-initiator human error assumptions should be revisited and a relook made of potential pre-initiator human errors.	In January 2000 the MP2 model revision 0 update included revised pre-initiator human error probabilities along with more calibration and restoration errors.	Comment resolved.
For post-initiator HRA, screening values were too small and truncation limits too large (which may have eliminated important cutsets). Also, the dependencies between multiple operator actions were not considered because operator actions were modeled within event and fault trees. Prefer adding operator actions to sequences so that they are sequence-specific and any dependencies on individual sequences can be accounted for.	In October 2002 the MP2 model revision 3 update included utilizing the PRAQUANT code, which has capability for a sequence specific recovery rule file. This allowed for applying dependencies between operator actions as well.	Comment resolved.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
The NRC noted our commitment to significantly reduce the potential of an RCP thermal barrier failure to result in an overpressurization of RBCCW piping outside Containment.	In response to NRC Information Notice 89-54 dealing with the potential for intersystem LOCA in the Combustion Engineering RCP integral heat exchanger tubes used to cool the RCP seals, four QA Category 1 relief valves were added to the supply lines to the RCP heat exchangers. The modification was made to the model in 1998. The modification also verified that the RBCCW motor-operated containment isolation valves in those lines could be manually closed after a SBO.	Comment resolved.
The exclusion of LNPs with durations of less than one-half of an hour was thought to be a weakness. Note that R. Labreque has used an updated frequency of approximately 0.04/yr that does include short-term events. Presently, our initiating event frequency is 0.09/yr. (NRC believes that based on NSAC 147, the LOSP frequency should be approximately 0.06 per year).	According to the EPRI report TR-110398 issued April 1998 a frequency of LNP of 0.0308/yr was determined from the data. We believe that over the last ten years since the NRC's position there has been sufficient evidence to justify this frequency of LNP.	Comment resolved.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
The NRC would like to see an analysis of the loss-of-Intake-Structure ventilation to see if it results in a trip of Service Water and a resultant plant trip. Note, if the Circulating Water pumps trip before the Service Water pumps, then the event is bounded by GPTs. If the Service Water pumps trip before the Circulating pumps, then the initiating event of Loss of Service Water needs to be reevaluated.	In June 2000 a reexamination of the Intake Structure loss of HVAC revealed that passive recirculation through induced ventilation out the wall louvers was sufficient to prevent trip of the Service Water pumps.	Comment resolved.
The loss of DC frequency is approximately an order of magnitude high when compared with other IPEs.	In May 1999 the MP2 model database was updated with the then current plant specific data and initiating event frequencies.	Comment resolved.
The loss of HVAC in the EDG Rooms should be reexamined (comment is related to taking undue credit for operator actions to mitigate loss of HVAC).	The PRA model used for the SAMA analysis did not take credit for the operator actions to mitigate the loss of ventilation in the EDG rooms. Recovery by the operators of the EDG ventilation when the emergency diesels are running was not modeled since the measures are deemed ineffective and are not in the procedures. Therefore, the loss of ventilation probability is related only to the failure probabilities of the individual components within the system.	Comment resolved.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
The NRC believes that the plant-specific failure data for the AFW start-and-run basic events is smaller than the NUREG/CR-4550 mean-value estimates by more than an order of magnitude. Note, the same was the case for the RBCCW and SW pumps, battery charger and 480V circuit breaker transfer failures. These values should be reevaluated.	In May 1999 the MP2 model database was updated with the then current plant specific data and initiating event frequencies.	Comment resolved.
The human error probability for an operator starting the steam-driven AFW pump should be reevaluated.	In January 2000 the MP2 model revision 0 update included revised human error probabilities along with more calibration and restoration errors.	Comment resolved.
The NRC believes NU paid incomplete attention to understanding the results of the containment performance analysis in terms of front end initiator drivers.	In January 2000 the MP2 model revision 0 update included reevaluation of the plant damage state (PDS) designations together with a more intuitive naming scheme.	Comment resolved.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
The IPE team did not include the frequency of "high" releases of Te accompanied by medium releases of CsI in comparing with the NRC safety goal for "large" releases. This appears to be a weakness.	As part of the MP2 SAMA analysis new source term release fractions were generated using the MAAP 3.0b computer code. The release fractions were generated for 13 release categories consistent with the MP3 SAMA analysis. The release fractions included the following 12 radionuclide species: Noble Gases, CsI, TeO2, SrO, MoO2, CsOH, BaO, La2O3, CeO2, Sb, Te, and UO2-ACT. These 12 species were collapsed down to 9 species in order to be suitable for the MACCS2 computer code. The 9 species input to the MACCS2 code included the following: Noble Gases, I, Cs, Te, Sr, Ru, La, Ce, and Ba. These 9 species were used for calculating the risk for all 13 release categories.	Comment resolved.

Revision 0 (01/2000); Model used in peer review

CDF = 9.26E-05/yr.
LERF = (Not developed)

Revision 0 included work performed in some important areas. One was the incorporation of more timely plant-specific data into the failure rate determination of specific components. Another was an improvement in the determination of human error probabilities (HEPs). Calibration and restoration HEPs were placed in the model. In addition, some initiating event frequencies were revised to be more in line with other IPEs. The event tree plant damage state (PDS) designations were reevaluated and a new naming scheme was implemented. There were no major hardware or Level 1/2 model changes made (NRC SER comment resolution).

Revision 1 (06/2000)

CDF = 8.12E-05/yr.
LERF = (Not developed)

The revision included incorporating some comments from the Peer Review Report, updating the LNP event frequency, and correcting errors found in Revision 0. A reexamination of the Intake Structure loss of HVAC revealed that passive recirculation through induced ventilation out the wall louvers was sufficient to prevent Service Water Trip. There were no major hardware or Level 1/2 model changes made (NRC SER comment resolution).

Revision 2 (04/2001); Model #M2010425

CDF = 7.25E-05/yr.
LERF = 7.92E-07/yr.

Revision 2 updated the model as a result of physical modifications to Unit 2 arising from the decommissioning of Millstone Unit 1. These included the new 4160V cross-tie from Unit 3 and the availability of the MP3 station blackout diesel generator as an alternate AC power source to mitigate SBO conditions at Unit 2. The changes required modifications to the AC power fault tree, event trees and recovery rule file. The specific changes to the model are listed below:

1. The AC Power Fault Tree was modified as follows:

    - The MP1/MP2 4160V connection from bus 14H to 24E was replaced by a 4160V cross-tie from Unit 3 bus 34B to Unit 2 bus 24E. Since bus 24E can now be powered by a number of AC power sources from Unit 3, including the MP3 SBO DG, RSST/NSST and offsite lines, a new logic was added to account for all the failure possibilities of these components to power bus 24E. A new top node ACUNIT3_24E in the AC power fault tree represents this logic.

    - Loss of offsite power logic was further subdivided to differentiate between grid-related and weather-related SBO events. The plant-centered LNP events can be mitigated by obtaining AC power from the Unit 3 offsite transformer (Unit 3 NSST). The site-wide LNP events can be mitigated by obtaining AC power from the Unit 3 SBO diesel generator (NRC SER comment resolution).

    - The operator actions for recovery of offsite AC power were reduced to two values that were independent of time, and only apply to events in which the operators have at least one hour in which to recover offsite AC power. The two operators actions added were:

        1. OAM3XFORMER: obtaining AC power from the Unit 3 offsite transformer (Unit 3 NSST) and

        2. OASBODG: obtaining AC power from the Unit 3 SBO diesel generator.

    - Equipment unavailabilities were added to account for scheduled maintenance activities.

2. The Station Blackout event tree was modified by adding additional top events to the tree that better model the logic of the event itself. The logic for mitigating an SBO event by recovering offsite AC power included new operator coping times, determined by MAAP analysis and verified on the MP2 simulator. As a result of these changes, the SBO CDF contribution was significantly reduced.

3. The Total Loss of Cooling Water event tree was modified by updating nodes OATRIPRCP and TRCPSF. A failure of operator action to trip the reactor coolant pumps, OATRIPRCP, results in a small-small LOCA, instead of a small LOCA. This resulted in the small LOCA CDF being reduced to 2.22E-05/yr., from 2.349E-05/yr. Node TRCPSF was updated to include revised probabilities of an RCP seal LOCA

and the resultant leak rate. Since the value of TRCPSF increased, this resulted in an increase in the SSLOCA (which includes RCP seal LOCAs) CDF contribution.

4. Consequential RCP Seal LOCA event tree was changed to eliminate the consequential SLOCA node SRCPLOCA, since that consequence is no longer in the loss-of-cooling-water event tree.

5. Minor revisions were made to the HPSI and LPSI fault trees.

<u>Revision 3 (10/2002); Model #M2020312</u>

CDF = 5.31E-05/yr.	Truncation = 2.00E-09
LERF = 3.28E-07/yr.	Truncation = 2.00E-09

The summary of the major changes to the PRA model, comprising Revision 3, is provided below:

1. The AC Power Distribution logic has been revamped. The new logic added the MP2 Normal Station Service Transformer as the power source that had not been modeled explicitly before; corrected the modeling of a partial loss of power; and corrected alignments when spare pumps on the swing bus 24E are used.

2. Modified the RBCCW and Service Water fault trees as a result of changes to the AC Power logic.

3. Revised the HPSI and LPSI trees to include containment heat removal functions as the support system for the sump recirculation. The containment heat removal nodes that led to core damage in the event trees were deleted as well.

4. Reduced the number of event trees from 18 to 16, by combining some of the transients as discussed below:

   - Combined the Loss of Cooling Water event trees (COOLING and COOLINGAB) into one overall total-loss-of-cooling-water event tree LOCCW. The COOLINGAB event tree, Loss of Cooling Train A or B, was deleted.

   - Deleted the Small-Small LOCA (SSLOCA) event tree; all small LOCAs are now represented by a single Small LOCA (SLOCA) tree. This was done because the results showed an unrealistic small LOCA contribution to the CDF being calculated in the current model. The structure of the new Small LOCA tree, SLOCA, has been changed: it considers first whether the emergency power is available, and, if so, whether steam generator cooling is feasible, followed by the question of HPSI availability. If the emergency diesel generators are not available but the emergency DC buses are, the logic transfers to the SBO event tree. If neither is available, then the logic transfers to the Loss of DC (LOSSDC) tree.

- Modified the Station Blackout event tree by adding a loss of DC Bus A and B event as the first event to be considered. The SSLOCA node has been deleted.
- Simplified the Steam Generator Tube Rupture (SGTR) event tree. The mitigating actions considered in the beginning are limited to only three: whether steam generator cooling is available; if not, whether HPSI is available; and, if not, whether bleed-and-feed can be initiated.
- If containment spray and containment air recirculation fans are not available during the break that dumps energy into the containment, but the HPSI is available, then the plant damage states starting with PD2 and core damage are not expected to occur. Therefore these branches have been removed from all of the event trees.

5. Modified the PRAQUANT top gate logic to account for the changes made in the model update (NRC SER comment resolution).

6. Modified the event trees to match the success paths modeled in the PRAQUANT top gates (NRC SER comment resolution).

7. Revised the 4160 V AC fault trees by changing the DC support gate to the initiating event gate (i.e., LDCA, LDCB) vs. the overall DC power gates (i.e., DC1201A, DC2201B). The overall gates model DC ventilation, which is not required by the 4160V AC buses. The DC support needed by the AC buses is immediate (i.e., transfer power) and therefore, long term failures resulting from loss of ventilation should not be modeled.

8. Changed the power success path to just include failure of both EDGs given an LNP. The AC Power tree includes bus failures, which are significant failures that should not be deleted since they are not recoverable within the SBO scenario.

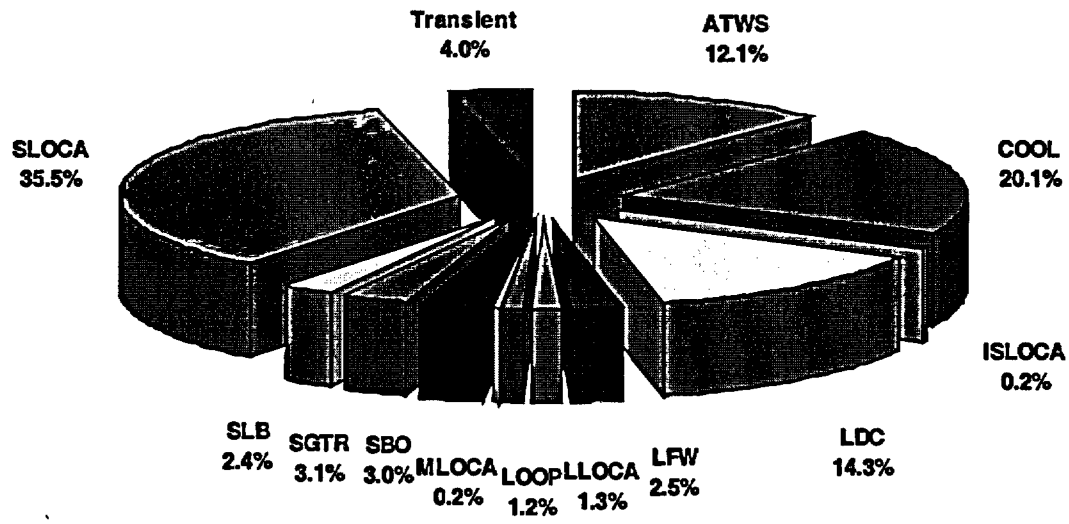
9. Modified the Human Error Probability for operator failure to trip the RCPs given a loss of cooling. This had a Fussell-Vesely value of 0.20, which is extraordinarily high for such a simple action.

Response to 1e.

The following table was generated using model #M2020312 at a truncation value of 1.0E-11.

Accident Class	CDF (yr^{-1})	% Contribution
Small LOCA	2.55E-05	35.5
COOL (SW+Seal LOCA+RBCCW)	1.44E-05	20.1
Loss of DC Power	1.03E-05	14.3
ATWS	8.68E-06	12.1
Transient	2.87E-06	4.0
Steam Generator Tube Rupture	2.22E-06	3.1
Station Blackout	2.15E-06	3.0
Loss of Main Feedwater	1.79E-06	2.5
Steamline Break	1.72E-06	2.4
Large Break LOCA	9.32E-07	1.3
Loss of Offsite Power	8.60E-07	1.2
Medium LOCA	1.43E-07	0.2
Interfacing Systems LOCA	1.43E-07	0.2
Main Feedline Break	1.28E-09	0.0
Internal Flooding (not included in TOTAL below)	2.04E-07	0.3
TOTAL	**7.17E-05**	**100%**

The following figure replaces Figure F.2-1 of the Environmental Report. LOOP should have been 1.17% instead of 11.7%.



Response to 1f.

The correct top 30 cutsets are shown below with their respective plant damage states. No other aspects of the analysis are affected by this correction to Table F.2-2. These plant damage states are defined in Table F.2-3 of the Environmental Report.

Table F.2-2
Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
1	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	1.75E-06
		MTC	PROBABILITY OF AN ADVERSE MTC WITH TURBINE TRIP		5.00E-02	5.00E-02	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
2	SLFH	%SLOCA1A	SMALL LOCA INITIATOR IN LOOP 1A		5.06E-04	6.75E-04	5.09E-07
		CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	1.11E-02	6.80E-02	7.55E-04	
3	SLFH	%SLOCA1B	SMALL LOCA INITIATOR IN LOOP 1B		5.06E-04	6.75E-04	5.09E-07
		CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	1.11E-02	6.80E-02	7.55E-04	
4	SLFH	%SLOCA2A	SMALL LOCA INITIATOR IN LOOP 2A		5.06E-04	6.75E-04	5.09E-07
		CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	1.11E-02	6.80E-02	7.55E-04	
5	SLFH	%SLOCA2B	SMALL LOCA INITIATOR IN LOOP 2B		5.06E-04	6.75E-04	5.09E-07
		CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	1.11E-02	6.80E-02	7.55E-04	
6	SLCH	%SLOCA1A	SMALL LOCA INITIATOR IN LOOP 1A		5.06E-04	6.75E-04	5.05E-07
		SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	7.80E-03	9.60E-02	7.49E-04	
7	SLCH	%SLOCA1B	SMALL LOCA INITIATOR IN LOOP 1B		5.06E-04	6.75E-04	5.05E-07
		SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	7.80E-03	9.60E-02	7.49E-04	
8	SLCH	%SLOCA2A	SMALL LOCA INITIATOR IN LOOP 2A		5.06E-04	6.75E-04	5.05E-07
		SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	7.80E-03	9.60E-02	7.49E-04	
9	SLCH	%SLOCA2B	SMALL LOCA INITIATOR IN LOOP 2B		5.06E-04	6.75E-04	5.05E-07
		SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	7.80E-03	9.60E-02	7.49E-04	
10	SECL	%SLOCA1A	SMALL LOCA INITIATOR IN LOOP 1A		5.06E-04	6.75E-04	4.68E-07
		SWCAVV32ABFF	CCF OF AIR OPERATED VALVES 2-SW-3.2A AND B TO CLOSE ON DEMAND	1.02E-02	6.80E-02	6.94E-04	
11	SECL	%SLOCA1B	SMALL LOCA INITIATOR IN LOOP 1B		5.06E-04	6.75E-04	4.68E-07

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
		SWCAVV32ABFF	CCF OF AIR OPERATED VALVES 2-SW-3.2A AND B TO CLOSE ON DEMAND	1.02E-02	6.80E-02	6.94E-04	
12	SECL	%SLOCA2A	SMALL LOCA INITIATOR IN LOOP 2A		5.06E-04	6.75E-04	4.68E-07
		SWCAVV32ABFF	CCF OF AIR OPERATED VALVES 2-SW-3.2A AND B TO CLOSE ON DEMAND	1.02E-02	6.80E-02	6.94E-04	
13	SECL	%SLOCA2B	SMALL LOCA INITIATOR IN LOOP 2B		5.06E-04	6.75E-04	4.68E-07
		SWCAVV32ABFF	CCF OF AIR OPERATED VALVES 2-SW-3.2A AND B TO CLOSE ON DEMAND	1.02E-02	6.80E-02	6.94E-04	
14	V2	%SGTR	STEAM GENERATOR TUBE RUPTURE		3.86E-03	3.86E-03	4.60E-07
		HPCP2P4133NN	CCF OF 3/3 HPSI PUMPS P-41 A/B/C TO START	3.36E-03	3.55E-02	1.19E-04	
15	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	4.55E-07
		OAEMBOR	OPERATOR FAILS TO INITIATE EMERGENCY BORATION		1.30E-02	1.30E-02	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
16	V2	%SGTR	STEAM GENERATOR TUBE RUPTURE		3.86E-03	3.86E-03	3.86E-07
		CSXCVCS26XNN	CHECK VALVE 2-CS-26 FAILS TO OPEN ON DEMAND	1.00E-04	1.00	1.00E-04	
17	SLFH	%RBP4RP11CFN	RBCCW PUMP P-11C FAILS TO RUN (INITIATOR)	3.31E-05	8760	2.90E-01	3.81E-07
		ACSWING24C	BUS 24C ALIGNED TO POWER SWING BUS 24E		0.64	6.40E-01	
		CS1MVCS16ANN	MOTOR OPERATED VALVE 2-CS-16.1A FAILS TO OPEN ON DEMAND	1.11E-02	1.00	1.11E-02	
		OAPRCPTRIP	OPERATORS FAIL TO TRIP RCPs GIVEN LOSS OF THERMAL BARRIER COOLING		8.40E-04	2.10E-04	
		RB2P11CX18C	P-11C AND X-18C IN OPERATION		0.88	8.80E-01	
18	SLCH	%RBP4RP11CFN	RBCCW PUMP P-11C FAILS TO RUN (INITIATOR)	3.31E-05	8760	2.90E-01	3.50E-07
		ACSWING24C	BUS 24C ALIGNED TO POWER SWING BUS 24E		0.64	6.40E-01	
		OAPRCPTRIP	OPERATORS FAIL TO TRIP RCPs GIVEN LOSS OF THERMAL BARRIER COOLING		8.40E-04	2.10E-04	
		RB2P11CX18C	P-11C AND X-18C IN OPERATION		0.88	8.80E-01	
		SW1AVSW32BFF	AIR OPERATED VALVE 2-SW-3.2B FAILS TO CLOSE ON DEMAND	1.02E-02	1.00	1.02E-02	
19	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	3.11E-07
		CH1MVCH501FF	MOV CH-501 FAILS TO CLOSE ON DEMAND	8.89E-03	1.00	8.89E-03	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
20	TL	%DCBKD0103NF	BUS FEED BREAKER D0103 FAILS TO REMAIN CLOSED (SUPPLY TO 201A)	1.00E-06	8760	8.76E-03	2.96E-07
		CH18BZ1	SWING CHARGING PUMP P-18B ALIGNED TO FACILITY 1		0.50	5.00E-01	
		CH2P7CP18CCQ	CHARGING PUMP P-18C OOS FOR MAINTENANCE	7.54E-03	1.00	7.54E-03	

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
		RB1P11AX18A	P-11A AND HX X-18A IN OPERATION		0.88	8.80E-01	
		SW2AVSW32AFF	AIR OPERATED VALVE 2-SW-3.2A FAILS TO CLOSE ON DEMAND	1.02E-02	1.00	1.02E-02	
21	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	2.73E-07
		CHXAVCH192NN	RWST ISOLATION VALVE 2-CH-192 FAILS TO OPEN ON DEMAND	7.80E-03	1.00	7.80E-03	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
22	TL	%DCBKD0103NF	BUS FEED BRKR D0103 FAILS TO REMAIN CLOSED (SUPPLY TO 201A)	1.00E-06	8760	8.76E-03	2.72E-07
		CH2P7TRAINXQ	CHARGING TRAIN B OOS FOR MAINTENANCE	3.46E-03	1.00	3.46E-03	
		RB1P11AX18A	P-11A AND HX X-18A IN OPERATION		0.88	8.80E-01	
		SW2AVSW32AFF	AIR OPERATED VALVE 2-SW-3.2A FAILS TO CLOSE ON DEMAND	1.02E-02	1.00	1.02E-02	
23	TL	%DCBKD0203NF	BUS FEED BREAKER D0203 FAILS TO REMAIN CLOSED (SUPPLY TO 201B)	1.00E-06	8760	8.76E-03	2.72E-07
		CH1P7TRAINXQ	CHARGING TRAIN A OOS FOR MAINTENANCE	3.46E-03	1.00	3.46E-03	
		RB2P11CX18C	P-11C AND X-18C IN OPERATION		0.88	8.80E-01	
		SW1AVSW32BFF	AIR OPERATED VALVE 2-SW-3.2B FAILS TO CLOSE ON DEMAND	1.02E-02	1.00	1.02E-02	
24	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	2.55E-07
		MTC	PROBABILITY OF AN ADVERSE MTC WITH TURBINE TRIP		5.00E-02	5.00E-02	
		RTMECH	REACTOR TRIP FAILS DUE TO MECHANICAL ROD BINDING		2.10E-06	2.10E-06	
25	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	2.27E-07
		PRXRVRC200FF	SAFETY RELIEF VALVE RC-200 FAILS TO CLOSE DUE TO MECHANICAL FAILURE	6.50E-03	1.00	6.50E-03	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
26	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	2.27E-07
		PRXRVRC201FF	SAFETY RELIEF VALVE RC-201 FAILS TO CLOSE DUE TO MECHANICAL FAILURE	6.50E-03	1.00	6.50E-03	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	
27	SLFH	%SLOCA	SMALL LOCA INITIATOR		2.25E-04	3.00E-04	2.26E-07
		CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	1.11E-02	6.80E-02	7.55E-04	
28	SLFH	%SLOCA	SMALL LOCA INITIATOR		2.25E-04	3.00E-04	2.25E-07
		SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	7.80E-03	9.60E-02	7.49E-04	
29	SLFH	%RBP4RP11AFN	RBCCW PUMP P-11A FAILS TO RUN (INITIATOR)	3.31E-05	8760	2.90E-01	2.14E-07

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
		ACSWING24D	AC BUS 24E ALIGNED TO BUS 24D		0.36	3.60E-01	
		CS2MVCS16BNN	MOTOR OPERATED VALVE 2-CS-16.1B FAILS TO OPEN ON DEMAND	1.11E-02	1.00	1.11E-02	
		OAPRCPTRIP	OPERATORS FAIL TO TRIP RCPs GIVEN LOSS OF THERMAL BARRIER COOLING		8.40E-04	2.10E-04	
		RB1P11AX18A	P-11A AND HX X-18A IN OPERATION		0.88	8.80E-01	
30	TEH	%GPT	GENERAL PLANT TRANSIENT		2.43	2.43E+00	2.10E-07
		PRXRVRC200NN	SAFETY RELIEF VALVE RC-200 FAILS TO OPEN DUE TO MECHANICAL FAILURE	6.00E-03	1.00	6.00E-03	
		RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)		1.44E-05	1.44E-05	

Response to 1g.

Unit 1 is being decommissioned. There is no equipment available at Unit 1 that is credited for Unit 2 SAMA.

Unit 3 AC power sources provide a back-up power to Unit 2 through a 4160V AC cross-tie line between the two units. These sources consist of:

a.) The SBO diesel generator at Unit 3, which serves as the power source for mitigation of the station blackout scenario at Unit 2; however, Unit 3 has priority for an SBO at both units, and this priority is factored into the model.

b.) Unit 3 station transformers (NSST or RSST), which can provide the necessary power for mitigation of a loss of offsite power at Unit 2 or provide LOCA loads if the Unit 2 emergency diesel generators fail to start.

Response to 1h.

The Millstone Unit 2 Level 1 PRA model has been updated four times since the original MP2 IPE was issued in December 1993. The latest PRA model revision was completed in December of 2003. As a result of a decade of PRA model revisions, it is likely that the dominant sequences have changed from the original IPE model. Although some dominant sequences may not exactly be matched to the original model, the current model is still considered valid. This is explained further below.

The sequences are binned into plant damage states defined to group sequences together with similar characteristics such that their subsequent behavior in the accident progression past core damage onset can be expected to be similar. Once they are so binned, they are treated as a class. The Level 2 portion of the IPE PRA for Millstone Unit 2 has not been updated but there have been some modifications of the individual bin definitions for consistency between the Unit 2 and Unit 3 PRAs.

To calculate the complete accident progression and the subsequent fission product releases, a sequence selected from a plant damage state bin is used as characteristic of the Level 1 portion and is combined with a particular path through the containment event tree. The dominant Level 1 sequence in a plant damage state bin is not always chosen as the characteristic, the reason being most often to achieve some diversity in the calculated progressions. With properly defined plant damage state bins, any of the sequences in the bin can be in principal selected for the characteristic Level 1 portion of the sequence. It is true that the results will differ somewhat depending on which particular Level 1 sequence is coupled with which particular containment event tree trajectory, but this is considered an acceptable result of using binning at the Level 1 and Level 2 end stages. For a given release category (or source term bin), the binning at the end of the Level 2 stage usually contains contributions from several plant damage state bins and several different containment event tree trajectories.

There are uncertainties in the source terms resulting from the binning-related averaging process and uncertainties due to the actual progression. The phenomenological containment event tree itself is an expression of the uncertainty of the severe accident modeling and quantification, i.e., it is not a stochastic model as the Level 1 accident tree is and there is not a dominant sequence in the Level 1 sense. The use of the dominant Level 1 sequence may reduce the stochastic portion of the uncertainty, but only within the band of that particular plant damage state and that particular source term bin. The Level 2 uncertainty contribution normally outweighs because of the unknowns of the phenomenology.

Taking into account the following variables; the continuity of the dominant sequences in the updating, the objectives of the plant damage state binning, the uncertainties of the containment event tree, and the level of discrimination in the SAMA cost/benefit comparisons, it is concluded that the possible variations in the end result from using alternate sequences in a given plant damage state bin as characteristic of that bin are considered to be within acceptable bounds for the purposes of the SAMA evaluations.

Since the original Level 1 IPE sequence data files could not be located, a comparison of the PDS and the STC frequencies was made for the IPE and SAMA analysis. Table 1h-1 below shows the PDS comparison between the IPE and the revised values used for the SAMA analysis in alphabetical order. The nomenclature for the SAMA PDS was modified slightly (from the IPE) for some of the PDS as shown below. The matching of IPE PDS against the SAMA PDS are shown in Table 1h-1 and this matching process resulted in some IPE PDS to be used more than once as shown below. A complete list of the IPE and SAMA PDS are shown on Table 1h-2.

Table 1h-1

No.	IPE PDS	FREQ	SAMA PDS	Base/Freq	Description
1	AECL	6.66E-07	AEC	2.25E-07	Large or medium LOCA, early core damage, no containment heat removal
2	AEFL	2.93E-07	AEF	1.26E-07	Large or medium LOCA, early core damage, CAR fans available
3	AEH	2.31E-07	AEH	1.19E-08	Large or medium LOCA, early core damage, high RCS pressure
4	AEL	6.91E-07	AEL	1.82E-07	Large or medium LOCA, early core

Table 1h-1

No.	IPE PDS	FREQ	SAMA PDS	Base/Freq	Description
					damage, low RCS pressure
5	ALH	1.68E-07	AL	3.02E-08	Large or medium LOCA, late core damage, containment spray available
6	ALCH	5.34E-07	ALC	2.67E-08	Large or medium LOCA, late core damage, no containment heat removal
7	ALFH	3.22E-07	ALFH	3.21E-09	Large or medium LOCA, late core damage, CAR fans available, high RCS pressure
8	ALFH	3.22E-07	ALFL	3.37E-07	Large or medium LOCA, late core damage, CAR fans available, low RCS pressure
9	SECL	6.76E-07	SECH	3.89E-06	Small or small small LOCA, early core damage, no containment heat removal, high RCS pressure
10	SECL	6.76E-07	SECL	3.29E-06	Small or small small LOCA, early core damage, no containment heat removal, low RCS pressure
11	SEFL	5.17E-07	SEF	2.76E-07	Small or small small LOCA, early core damage, CAR fans available
12	SECL	6.76E-07	SEGH	1.28E-10	Small or small small LOCA, early core damage, containment spray available after AC recovery, high RCS pressure
13	SEH	2.54E-07	SEH	3.76E-06	Small or small small LOCA, early core damage, high RCS pressure
14	SEL	2.37E-07	SEL	8.84E-07	Small or small small LOCA, early core damage, low RCS pressure
15	SLCH	1.00E-06	SLCH	9.70E-06	Small or small small LOCA, late core damage, no containment heat removal, high RCS pressure
16	SLCH	1.00E-06	SLCL	1.65E-07	Small or small small LOCA, late core damage, no containment heat removal, low RCS pressure
17	SLFH	1.71E-06	SLFH	8.56E-06	Small or small small LOCA, late core damage, CAR fans available, high RCS pressure
18	SLFH	1.71E-06	SLFL	2.46E-08	Small or small small LOCA, late core damage, CAR fans available, low RCS pressure
19	SLH	6.84E-07	SLH	6.85E-06	Small or small small LOCA, late core damage, high RCS pressure
20	SLH	6.84E-07	SLL	2.31E-08	Small or small small LOCA, late core damage, low RCS pressure

Table 1h-1

No.	IPE PDS	FREQ	SAMA PDS	Base/Freq	Description
21	TECH	1.29E-06	TECH	1.53E-06	Transient, early core damage, no containment heat removal, high RCS pressure
22	TEFH	8.36E-07	TEFH	3.94E-07	Transient, early core damage, CAR fans available, high RCS pressure
23	TEGH	3.60E-07	TEGH	3.79E-07	Transient, early core damage, containment spray available after AC recovery, high RCS pressure
24	TEHD	6.66E-07	TEH	1.36E-05	Transient, early core damage, high RCS pressure
25	TLCH	1.07E-07	TL	1.51E-05	Transient, late core damage
26	ISLOCA	6.70E-07	V	1.07E-07	Interfacing System LOCA
27	SGTR	6.60E-08	V2	2.24E-06	Steam Generator Tube Rupture bypassing containment

A comparison was made between the IPE and SAMA PDS on Table 1h-2 to determine the dominant sequences as determined by the percent frequency contribution to total CDF for each PDS. It is to be noted that the IPE reported a total of 28 PDS versus 27 used for the SAMA analysis. The PDS frequencies were sorted in descending order as shown below. The most dominant IPE PDS is TEHB as compared to the most dominant SAMA PDS as TL. Although PDS TEHB and TL are not an exact match, they are both transients. Similarly, the second dominant PDS comparison is between IPE PDS TEHA and SAMA PDS TEH, which are also both transients. As can be seen, for the most part the ranked IPE/SAMA plant damage sequences are in general agreement with each other. The ranking of the IPE SGTR and the SAMA V2 are not exact but relatively close to each other. The IPE ISLOCA CMF contribution is ranked No. 27 at 0.19% contribution versus the SAMA V sequence, which is ranked No. 20 at 0.15% contribution, a relatively close match. The differences in the ranking that are noted between the IPE and SAMA PDS are attributed to plant modifications and PRA model updates that were made over the past 10 years.

Table 1h-2

No.	IPE PDS	FREQ	%CMF	SAMA PDS	Base/Freq	%CMF
1	TEHB	9.77E-06	28.74%	TL	1.51E-05	21.06%
2	TEHA	6.66E-06	19.59%	TEH	1.36E-05	18.97%
3	TEHC	5.11E-06	15.03%	SLCH	9.70E-06	13.53%
4	SLFH	1.71E-06	5.03%	SLFH	8.56E-06	11.94%
5	TECH	1.29E-06	3.80%	SLH	6.85E-06	9.55%

Table 1h-2

No.	IPE PDS	FREQ	%CMF	SAMA PDS	Base/Freq	%CMF
6	SLCH	1.00E-06	2.94%	SECH	3.89E-06	5.43%
7	TEFH	8.36E-07	2.46%	SEH	3.76E-06	5.24%
8	AEL	6.91E-07	2.03%	SECL	3.29E-06	4.59%
9	SLH	6.84E-07	2.01%	V2	2.24E-06	3.12%
10	SECL	6.76E-07	1.99%	TECH	1.53E-06	2.13%
11	SGTR	6.70E-07	1.97%	SEL	8.84E-07	1.23%
12	AECL	6.66E-07	1.96%	TEFH	3.94E-07	0.55%
13	TEHD	6.66E-07	1.96%	TEGH	3.79E-07	0.53%
14	ALCH	5.34E-07	1.57%	ALFL	3.37E-07	0.47%
15	SEFL	5.17E-07	1.52%	SEF	2.76E-07	0.38%
16	TEGH	3.60E-07	1.06%	AEC	2.25E-07	0.31%
17	ALFH	3.22E-07	0.95%	AEL	1.82E-07	0.25%
18	AEFL	2.93E-07	0.86%	SLCL	1.65E-07	0.23%
19	SEH	2.54E-07	0.75%	AEF	1.26E-07	0.18%
20	SEL	2.37E-07	0.70%	V	1.07E-07	0.15%
21	AEH	2.31E-07	0.68%	AL	3.02E-08	0.04%
22	TEH (MFLB)	1.92E-07	0.56%	ALC	2.67E-08	0.04%
23	ALH	1.68E-07	0.49%	SLFL	2.46E-08	0.03%
24	TEH (MSLBO)	1.60E-07	0.47%	SLL	2.31E-08	0.03%
25	TLCH	1.07E-07	0.31%	AEH	1.19E-08	0.02%
26	SEH (MSLB+SGTR)	1.04E-07	0.31%	ALFH	3.21E-09	0.00%
27	ISLOCA	6.60E-08	0.19%	SEGH	1.28E-10	0.00%
28	TEFH (MSLBO)	1.51E-08	0.04%			
	Total		100%			100%

Table 1h-3 below shows the release category matching between the IPE and the revised nomenclature used for the SAMA analysis. It is seen that the IPE reported 24 release categories that were reduced to 13 categories for the SAMA evaluation. There was no frequency assigned to the SAMA release categories M2, M4, M9, M10, and M11. Instead, the contributions were assigned to other related categories. A complete list of the IPE and SAMA release categories are shown on Table 1h-4.

Table 1h-3

No	IPE RC	IPE Freq	ASSIGN RC	SAMA Freq	Description
1	E-HL-V	5.96E-08	M1A	1.00E-07	Containment Bypass, V-Sequence
2	E-HH-I	1.06E-09	M1B	2.36E-06	Containment Bypass, SGTR
3	E-HL-I	1.55E-08	M1B	2.36E-06	Containment Bypass, SGTR
4	E-HM-I	9.27E-09	M1B	2.36E-06	Containment Bypass, SGTR
5	E-LL-I	0.00E+00	M1B	2.36E-06	Containment Bypass, SGTR
6	E-ML-I	3.32E-09	M1B	2.36E-06	Containment Bypass, SGTR
7	E-MM-I	1.01E-09	M1B	2.36E-06	Containment Bypass, SGTR
8	L-ML-S	6.19E-07	M1B	2.36E-06	Containment Bypass, SGTR
9	E-HH-R	1.53E-07	M3	6.86E-07	Early Failure/Late Melt, No Sprays
10	E-HM-R	7.63E-10	M3	6.86E-07	Early Failure/Late Melt, No Sprays
11	E-ML-R	2.88E-08	M3	6.86E-07	Early Failure/Late Melt, No Sprays
12	E-LL-R	6.39E-09	M5	5.48E-06	Intermediate Failure/Late Melt, No Sprays
13	E-MM-R	1.64E-06	M5	5.48E-06	Intermediate Failure/Late Melt, No Sprays
14	E-LM-R	2.04E-07	M6	1.37E-05	Intermediate Failure/Early Melt, No Sprays
15	E-MH-R	1.08E-06	M6	1.37E-05	Intermediate Failure/Early Melt, No Sprays
16	L-LL-L	3.84E-06	M7	2.14E-05	Late Failure, No Sprays
17	L-LL-R	1.18E-06	M7	2.14E-05	Late Failure, No Sprays
18	L-HH-L	2.23E-07	M8	1.71E-05	Intermediate Failure With Sprays
19	L-HH-R	2.13E-07	M8	1.71E-05	Intermediate Failure With Sprays
20	L-HL-L	2.77E-09	M8	1.71E-05	Intermediate Failure With Sprays
21	L-HL-R	2.49E-08	M8	1.71E-05	Intermediate Failure With Sprays
22	L-LH-L	5.07E-06	M8	1.71E-05	Intermediate Failure With Sprays
23	L-LH-R	5.08E-07	M8	1.71E-05	Intermediate Failure With Sprays
24	NCF	1.91E-05	M12	1.08E-05	No Containment Failure

Note1: 22 IPE RC Frequencies were taken from MP2 IPE Table 4.9-5
Note2: SGTR L-ML-S Frequency was taken from MP2 IPE Table 4.9-6
Note3: ISLOCA E-HL-V Frequency was taken from MP2 IPE Table 4.9-7

The sorted release categories reported for the IPE and the SAMA analysis are listed in Table 1h-4 below. These release category frequencies were sorted in descending order based on percent of CDF. The largest contribution to CDF for the IPE release category is no containment failure (NCF), versus the M7 category for the SAMA analysis. The NCF release category M12 is ranked No. 4 for the SAMA analysis. In reality the NCF release category would be expected to release the minimum source term, as allowed by normal plant operation leakage, even though it contributed 56.2% to CDF. The second largest contributor to CDF for the IPE release category is L-LH-L with 14.92% contribution to CDF versus the SAMA category M8 with 23.87% contribution. The same type of accident sequence were ranked No.2 on this list for both the IPE and SAMA analysis. The No.3 ranking was assigned to IPE category L-LL-L versus the SAMA category M6. As noted on Table 1h-3 above the IPE category L-LL-L was assigned to M7 instead of M6. Based on inspection of the ranking, these are not exactly matched release categories. The differences in the ranking as noted between the IPE and SAMA RCs are attributed to plant modifications and PRA model updates that were made over the past 10 years.

Table 1h-4

No.	IPE RC	FREQ	%CDF	SAMA RC	Base Freq	%CDF
1	NCF	1.91E-05	56.20%	M7	2.14E-05	29.88%
2	L-LH-L	5.07E-06	14.92%	M8	1.71E-05	23.87%
3	L-LL-L	3.84E-06	11.30%	M6	1.37E-05	19.13%
4	E-MM-R	1.64E-06	4.83%	M12	1.08E-05	15.08%
5	L-LL-R	1.18E-06	3.47%	M5	5.48E-06	7.65%
6	E-MH-R	1.08E-06	3.18%	M1B	2.36E-06	3.29%
7	L-ML-S	6.19E-07	1.82%	M3	6.86E-07	0.96%
8	L-LH-R	5.08E-07	1.49%	M1A	1.00E-07	0.14%
9	L-HH-L	2.23E-07	0.66%	M2	0.00E+00	0.00%
10	L-HH-R	2.13E-07	0.63%	M4	0.00E+00	0.00%
11	E-LM-R	2.04E-07	0.60%	M9	0.00E+00	0.00%
12	E-HH-R	1.53E-07	0.45%	M10	0.00E+00	0.00%
13	E-HL-V	5.96E-08	0.18%	M11	0.00E+00	0.00%
14	E-ML-R	2.88E-08	0.08%			
15	L-HL-R	2.49E-08	0.07%			
16	E-HL-I	1.55E-08	0.05%			
17	E-HM-I	9.27E-09	0.03%			
18	E-LL-R	6.39E-09	0.02%			
19	E-ML-I	3.32E-09	0.01%			
20	L-HL-L	2.77E-09	0.01%			
21	E-HH-I	1.06E-09	0.00%			
22	E-MM-I	1.01E-09	0.00%			
23	E-HM-R	7.63E-10	0.00%			
24	E-LL-I	0.00E+00	0.00%			
	Total		**100%**			**100%**

Response to 1i.

The source term bin structure for the Unit 2 Level 2 PRA was changed from the original IPE arrangement for consistency with the Unit 3 PRA methodology and terminology. The Unit 2 calculated source terms were binned into the Level 3 source term structure according to similarities in the physical qualities of timing, level of volatile and non-volatile releases and size or type of the release path, rather than by the text title assigned to the bin. The isolation failure related sequences were a better fit into other bins than M4. No sequences were discarded. Further description follows.

Isolation Failures:

MP2 IPE Section 4.7 (Containment Event Tree "CET" Description) states that *"Sequences with containment isolation failure can be adequately covered by simply regarding them as cases with guaranteed early containment failures in Class 1 CETs."*
(note: Class 1 CETs are for all non-bypass core melt sequences. Class 2 CETs are for SGTRs and Class 3 CETs are for other bypass sequences.)

This means that isolation failure sequences are treated as an early containment rupture failure with the level of radiation release being determined by other factors (debris in cavity, spray operation) as for other early failures.

Thus isolation failures are indistinguishable as a class for source term purposes and are distributed among the early failure terms as governed by the release level.

Basemat Failures:

In IPE Section 4.9 ("Radioactive Release Characterization and Quantification Results"), it notes *that MAAP does not model basemat melt-through releases and so for simplicity these cases are treated the same as Late Leak-type (rupture) failures.*

Thus basemat failures are indistinguishable as a class for source term purposes and are included in the late leak failure terms. Though not explicitly modeled using MAAP, basemat failures were included in the source terms as M10 and M11 through the assumption of the type of release noted above.

RAI 2. Please provide the following information concerning important cutsets, basic events, and risk contributors:

a. The data in the cutset list in Table F.2-2 indicates that the RBCCW pumps have a 29% chance of failing to run over a year. Indicate whether this is based on historical data. Identify any improvement programs that have been instituted to reduce this failure rate.

b. In comparing the importance list in Table F.3-4 with the top 30 cutset list in Table F.2-2, it is apparent that basic event OAPRCPTRIP is an important failure yet it is not in the importance list. Based only on the top cutsets, this basic event should have a FV importance of something greater than 0.08. Please explain.

c. Please provide additional information concerning: the CDF sequences involving RCP seal LOCAs, the MPS2 RCP seal design and cooling systems, dependencies of these systems on other support systems, and how the RCP seal failure is modeled in the MPS2 PRA.

d. Confirm that the modification to eliminate the vulnerability identified in the MPS2 IPE (RCP thermal barrier tube rupture interfacing LOCA) has been implemented.

Dominion Response to RAI 2

Response to 2a.

The failure rate is based both on the plant-specific data on the pump performance (collected between 1989 and 1998) and generic data. The resultant rate was calculated using the plant-specific data, (Bayesian) updated with the generic failure rate from NUREG/CR-4550. The plant-specific failure rate of 3.33E-5/hr. is roughly consistent with the generic failure rate of 3.00E-5/hr. The current preventive maintenance and surveillance programs for these pumps are considered effective.

Response to 2b.

As shown in RAI 1a, the latest version of the MP2 model available at the time was used to determine the plant specific SAMAs, which was subsequently updated for the quantification. In addition, there was an error in Table F.2-2, which is discussed and corrected in the response to RAI 1f. The correct Fussell-Vesely for OAPRCPTRIP is 0.06, as shown in the response to RAI 6a.

Response to 2c.

Millstone Unit 2 RCP seal cooling is provided by the Reactor Building Closed Cooling Water System. Part of the water from the RBCCW is circulated through an oil cooler mounted on the motor casing to cool the bearing lubricating oil. The remainder of the water flows through the pump integral heat exchanger, where it cools the RCP seal controlled bleed-off flow, and through the thermal barrier and seal casing, where it serves to keep the seal cavity at approximately 130°F.

The bounding case for RCP seal LOCA was determined to be the station blackout (SBO) scenario. The SBO coping time analysis was performed with the Modular Accident Analysis Program, version 4.0.3 (MAAP 4). Several MAAP 4 cases were run to determine the effect of reactor coolant pump seal failure, combined with the availability of the Turbine-Driven AFW pump to maintain steam generator cooling.

If the TDAFW pump is available throughout the transient, the possibility of a seal LOCA must also be examined. The seal LOCA logic tree considers the following questions: whether a seal LOCA has occurred; if so, then at what time; does the seal LOCA occur in one or more pumps; and what is the resultant leakage per pump.

The Combustion Engineering Owners Group has performed an extensive study of failure of RCP seals given a loss of seal cooling. The study is documented in report CE NPSD-1199-P. The modeling of the seal LOCA in the Millstone Unit 2 model is based on this methodology.

The probability of having a seal LOCA and the timing of the seal LOCA are very much dependent on the type of seals that the pumps have. Millstone Unit 2 pumps originally included the Byron Jackson (BJ) SU seal design, but since then have been upgraded with the improved seal design BJ N-9000.

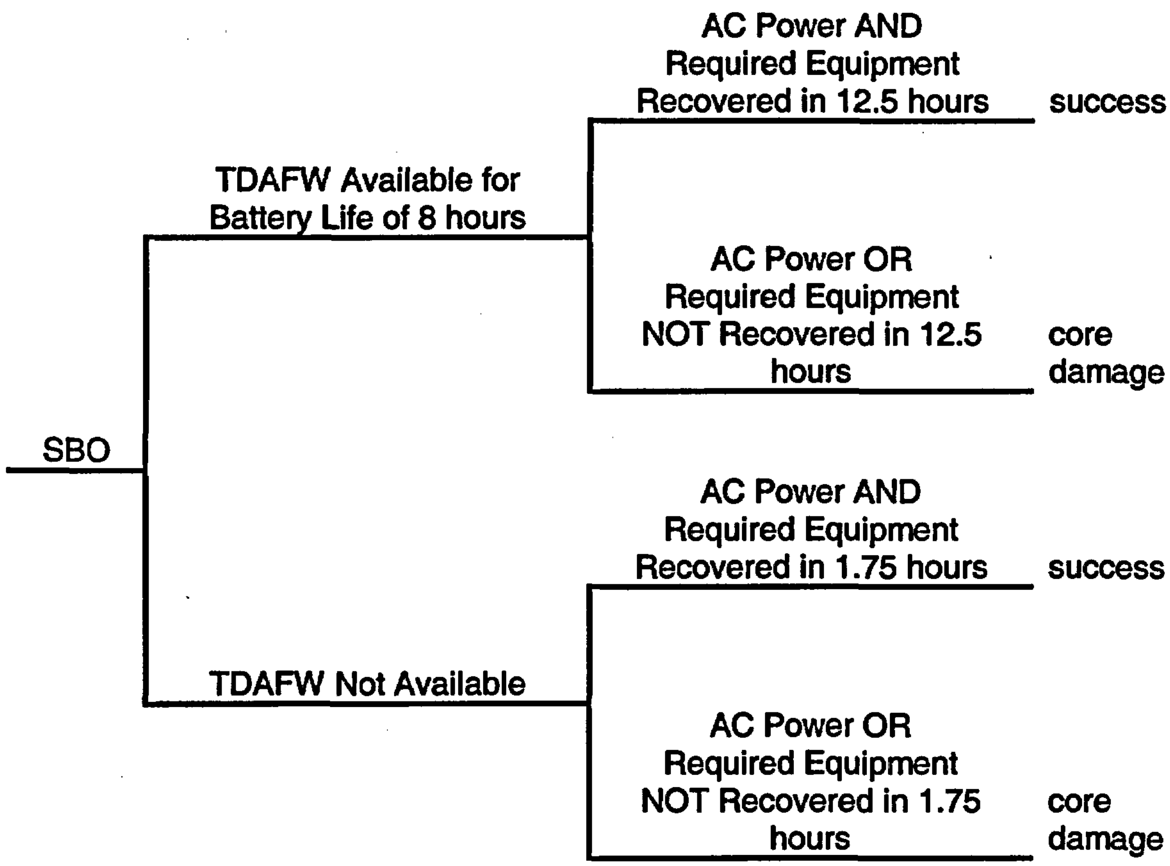
Based on the improved seal design, the conditional seal failure probabilities calculated with MAAP are as follows.

CEOG Report CE NPSD-1199-P Case No.	**RCPF-13**	**RCPF-14**	**RCPF-15**	**RCPF-16**
Probability of RCP Seal Failure	4.07E-07	1.19E-06	3.87E-06	3.42E-05
Time of RCP Seal Failure (hr.)	0.5	1.5	3.0	6.0
Time of Core Uncovery (hr.)	4.5	5.5	7.0	10.0
Probability of Not Recovering Power	8.66E-02	7.01E-02	5.60E-02	4.06E-02
Probability of Core Damage	**3.52E-08**	**8.34E-08**	**2.17E-07**	**1.39E-06**

The minimum equipment required to mitigate the SBO is:

- 1 functional ADV per steam generator (SG safety valves are also acceptable, but less reliable);
- 1 of 2 MDAFW pumps providing flow to both steam generators after coping time;
- 1 of 2 HPSI pumps injecting to cold legs (once the RCS pressure allows) after coping time.

Based on the results obtained with MAAP, the following event tree summarizes the SBO coping times.



Response to 2d.

The Reactor Building Closed Cooling Water System (RBCCW), which supplies cooling to the RCP seals in Unit 2, was modified in 1998 in response to the NRC Information Notice 89-54 dealing with the potential for intersystem LOCA in the Combustion Engineering RCP integral heat exchanger tubes. The modification added four QA Category 1 relief valves in the supply lines to the RCP heat exchangers. These valves were installed inside the containment, thus significantly reducing the possibility of an ISLOCA. The modification also verified that the RBCCW motor-operated containment isolation valves in those lines could be manually closed after the SBO.

RAI 3. Please provide the following information concerning the MACCS2 analyses:

a. The MACCS2 analysis for both units uses a core inventory scaled by power level from a reference PWR core inventory at end-of-cycle calculated using ORIGIN. The ORIGIN calculations were based on a 3-year fuel cycle (12 month reload), 3.3% enrichment, and three region burnup of 11000, 22000 and 33000 MWD/MTU. Current PWR fuel management practices use higher enrichments and significantly higher fuel burnup (>45000 MWD/MTU discharge burnup). The use of the reference PWR core instead of a plant specific cycle could significantly underestimate the inventory of long-lived radionuclides important to population dose (such as Sr-90, Cs-134 and Cs-137), and thus impact the SAMA evaluation. Evaluate the impact on population dose and on the SAMA screening and dispositioning if the SAMA analysis were based on the fission product inventory for the highest burnup and fuel enrichment expected at MPS during the renewal period.

b. Please provide the release time and duration, warning time, release height and release energy used in the MACCS2 analysis for each of the release categories.

c. The assumption of 100% evacuation in the baseline case is overly optimistic. Sensitivity case 3 (95% evacuation) would be a more reasonable baseline. However, the estimated SAMA benefits under case 3 are even lower than the baseline case, which is counterintuitive. Please explain this apparent anomaly.

d. The population is based on projected values for year 2030 for Unit 2, which is 5 years prior to the end of the renewal period. Explain why this date was selected rather than the date for the end of the renewal period.

e. The population distribution and economic data are based on SECPOP90; SECPOP2000 was not considered. State what the impact would be if SECPOP2000 were used. In addition, please explain how resort areas are addressed in the economic model.

Dominion Response to RAI 3:

Response to 3a.

The design basis source terms for Millstone Unit 2 represent worst case source term core inventories. Calculated using ORIGEN, each source term was determined by varying critical input variables to yield bounding core inventory values which would encompass plant operating histories and design. Fuel assemblies with three different burnups, representing one, two, and three cycles, were assumed to determine an equilibrium core source term at the end of a fuel cycle. Different combinations of fuel enrichment (up to the maximum licensed enrichment of 5.0%) and low and high region burnups (up to a core-average burnup of 50,000 MWD/MTU) were used in the source term determination. Core inventories for individual nuclides vary differently with fuel enrichment and burnup. Specifically, for a fixed enrichment, some nuclide inventories increase with burnup, while others decrease; for a fixed burnup, some nuclide inventories increase with enrichment while others decrease. For bounding source term calculations, the worst-case core inventory for each nuclide was selected between all the ORIGEN runs to represent a core maximum value over all expected operating conditions.

Even using this very conservative approach, the benefit calculations are still not significantly impacted. Using the offsite dose and dollar results from MACCS, the baseline offsite annual dose increases from 17.4 person-rem/year to 26.7 person-rem/year (compared to more than 35,000 person-rem per year from natural background radiation for the population within 10 miles of the plant, and more than 900,000 person-rem per year from natural background radiation for the population within 50 miles). Counting all contributors to benefit, the Unit 2 baseline benefit (if 100% of the CDF is eliminated, including all external events CDF) increases from $2.50M to $3.04M, or 22%. A best-estimate calculation with mid-cycle burnup and actual expected (instead of worst-case) inventories of each nuclide would yield an even smaller increase in the baseline annual dose and overall benefit. The long-lived isotopes have a dominant impact on dose since they do not reach equilibrium. Therefore, if calculations were performed at actual design end of cycle burnup (approximately 33,000), there would be a much smaller increase from the baseline benefit.

Given that a factor of two margin was used for all cost-benefit analyses to account for such uncertainties, the conclusions of the SAMA cost-benefit analyses would not have changed even if the more conservative nuclide inventories had been used in MACCS2.

Response to 3b.

The release time (PDELAY), duration (PLDUR), warning time (OALARM), release height (PLHITE) and energy (PLHEAT) used in the MACCS2 analysis for each of the release categories are shown below.

MP2: Plume Characteristic Data

STC	OALARM (S)	PLHEAT (w)	PLHITE (m)	PLDUR (s)	PDELAY (s)
M-1A	6012	5.86E+06	0.0	3,600	6012
**M-1A	14400	0.6E+06	0.0	2,880	15,840
M-1B	21708	5.86E+06	19.5	3,600	21708
M-2	6948	44.0E+06	22.4	7,200	14184
M-3	4752	55.7E+06	22.4	7,200	4752
M-4	0.0	20.5E+06	22.4	7,200	6948
M-5	6048	1.32E+08	22.4	1,800	13176
M-6	6048	1.29E+08	22.4	1,800	13176
M-7	6948	1.58E+08	22.4	1,800	108360
M-8	3816	6.5E+06	22.4	1,800	43344
M-9	6948	6.5E+06	22.4	1,800	345600*
M-10	1908	0.0	0.0	36,000	198000
M-11	3816	0.0	0.0	36,000	302400
M-12	6948	0.0	0.0	54,000	14,148

* The maximum value allowed by MACCS2 is 345,600 seconds.

** The MP3 sensitivity plume characteristic data for the M1A source term category

Response to 3c.

The variability noted is an artifact of the random weather sampling used in MACCS2, which is briefly described in the next paragraph. The variation shown between the base case and the 95% evacuation case is not statistically significant and indicates the low sensitivity of the results to small variations in the evacuation effectiveness assumption.

The variability of consequence values in MACCS2 CCDFs (the CCDF is an estimate of the distribution of consequence magnitudes) is due solely to the uncertainty of the weather conditions existing at the time of the accident. A number of weather conditions is sampled from the input meteorological conditions and consequences calculated for each weather trial. Emergency-response scenarios combined using population fractions are a function of the consequence calculated for each meteorological trial/wind direction multiplied by the fraction of people assigned to the scenario. The values utilized in this analysis are the mean values of the sampled distribution trial results. The mean is the average (expected) consequence over all weather trials. This is calculated by taking the sum of all the products [(consequence value) × (associated probability of that value)] for each weather trial.

Response to 3d.

The US Bureau of the Census estimates that the national population of the US will grow about 4% for each five year period in the interval 2010 to 2050 (see Reference). Applying the national growth rate to the 50 mile radius analysis zone for 2025 to 2030, produces a growth projection of 4 %. Table F.3-2 shows that all of the SAMAs except for SAMA #3 screened with costs at least twice the benefit, so it is concluded that the cost-benefit results are highly conservative relative to population uncertainties over a five-year period.

Dominion believes that the use of the year 2030, only five years prior to the end of the renewal period, is conservative. It is overly conservative to assume the accidents occur at the end of the period of extended operation.

Reference:
U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin, available on the website "http://www.census.gov/ipc/www/usinterimproj/", Internet Release Date: March 18, 2004.

Response to 3e.

SECPOP2000 was not used in the analyses as it was not available in the time frame of the submittal preparation; however, actual Census 2000 population data, further projected to 2030, was used to update the SECPOP90 rosette population. Moreover, economic data in the SECPOP90 county data file was adjusted to 2001 dollars using the consumer price index for the SAMA analysis. The expected impact of using SECPOP2000 would be negligible for these reasons.

Resorts are treated in the economic model as other businesses in the region. There is no reason not to expect that resorts are included in the official values for county wealth that have been used in preparing the MACCS2 input. As economic enterprises, resorts are indistinguishable from the other contributors to the non-farm wealth. In addition, since many resorts are seasonal, treating them as any other business is considered conservative.

RAI 4. Since the MPS2 PRA does not include a complete external events model, external events were accounted for by increasing the benefit for SAMAs calculated by the internal events by 30%, which is approximately the relative magnitude of the estimated external events CDF. The SAMA identification process does not specifically address the identification of SAMAs for external events. In this regard, the following information is needed:

a. Table 7.1-1 of the MPS2 IPEEE lists a number of outliers or "Opportunities for Safety Enhancements" identified during the IPEEE. Attachment 8 to the December 31, 1998 response to NRCs RAIs on the MPS2 IPEEE provides the status of these items. Indicate whether the "Opportunities for Safety Enhancements" that address the outliers have been implemented. If not, explain why within the context of this SAMA study.

b. Section F.2.4 of Attachment E gives a seismic contribution to CDF of 9.1E-6/year. The seismic portion of the IPEEE utilized a seismic margins assessment and did not determine the seismic CDF. Provide the basis for this value along with the major contributors. Discuss potential SAMA candidates for reducing the risk from seismic events.

c. Based on the information in the fire TER attached to the IPEEE SER the fire portion of the IPEEE identified five (5) fire zones with a CDF contribution in excess of 0.5% of the internal events CDF (that is a FV of 0.005 equivalent to those items listed in Table F.3-4). For each zone, explain what measures were taken to further reduce risk, and explain why these CDFs can not be further reduced in a cost effective manner.

d. The approach of increasing the benefit determined from the internal events model by 30% to account for external events is valid only if the contributors affected by the SAMA make the same relative contribution for external events as for internal events. Justify this approach or include in the benefit analysis the extra contribution from external events for those SAMAs, which might have a higher relative impact on risk from external events than internal events.

e. The ER indicates that for some SAMAs that relate only to specific internal event initiators, the benefits will not necessarily be multiplied. Please provide a list of those SAMAs that were not multiplied by the external event factor.

Dominion Response to RAI 4:

Response to 4a.

The MP2 IPEEE report has identified 29 potential risk issues throughout the plant. Most of these issues (21) were resolved prior to 2003. The remaining eight open outliers were closed in August 2003. A brief summary of the closures is provided below:

1. *The Chilled Water surge tank anchorage was found to be limiting.*

   The anchorage and component seismic capacity were evaluated using the SQUG criteria and found to be acceptable. The seismic evaluation is contained in the MP2 USI A-46 report, submitted as Docket B15469 on January 22, 1996.

2. *The seismic capacity of the MP3 diesel fire pump fuel tank may not be adequate.*

   The review concluded that the tank has adequate seismic capacity to withstand the IPEEE 0.3g PGA earthquake without a loss of function. The review verified the anchorage capacity of the tank, including the buckling capacity of the legs.

3. *A long run of the fire water header piping along the turbine building north wall appears to have low seismic capacity.*

   The pipe supports in question meet the B31.1 seismic criteria. The installation is consistent with rugged piping evaluated in NUREG-1061 and EPRI NP-5617. Therefore this section of piping has adequate seismic capacity and does not require modification.

4. *The block wall construction of the fire pump house may not provide adequate seismic ruggedness.*

   While no specific seismic structural analysis exists for the fire pump house, the existing calculation indicates that the wall can withstand the forces associated with the probable maximum hurricane surge flood level and the hurricane wind load, which are 184 lb/ft and 2004 lb/ft, respectively. In comparison, the static equivalent of the Safe Shutdown Earthquake seismic load is 675 lb/ft. Therefore, using engineering judgment based on load comparisons for flooding and high winds, and review of the pump house structural details, it can be concluded that the fire house has adequate structural strength to withstand the design seismic event.

5. *Intakes and vents with insufficient height may pose a problem given a large accumulation of ice/snow.*

   A plant design change was implemented to modify Enclosure Building and Control Room Ventilation intakes that were identified as susceptible to snow ingestion and blockage. In addition, structures and architectural details (including roof areas) are regularly monitored per guidance in plant procedure for extreme winter weather.

6. *Evaluate the functionality of the backwash valves to prevent flood waters from flowing into buildings.*

   The issue does not pose an unacceptable risk of external flooding. The station sumps and drains are maintained as Maintenance Rule Category Code "C" system. The system engineering performance monitoring and trending program establishes preventive maintenance and monitoring methods.

   In addition:

   - Given a postulated storm drains check valve failure, there is a finite volume of water that could pass through the limited number of open floor drains that are below flood elevation.

   - Auxiliary Building and Containment drains are aligned to the liquid radwaste system, not to storm drains. Most safety-related equipment is housed in the Auxiliary Building and Containment. Therefore, the consequence of a postulated flooding backwash valve failure on these buildings is negligible.

7. *Underground conduits provide in-leakage paths into buildings.*

   The conduits are either sealed, above flood levels, or evaluated and shown to not be a threat.

8. *Roof penetrations may not be watertight below the highest level of roof ponding*

   The building roofs and penetrations are inspected on a semi-annual or annual basis. These inspections have identified no concerns with ponding.

Response to 4b.

The Millstone Unit 2 IPEEE used the seismic margins methodology to demonstrate that the plant is adequately designed seismically. Therefore, a seismic CDF is not available. However, rather than use zero for the seismic CDF when the external events factor was calculated, it was decided that the Unit 3 seismic CDF of 9.1E-6/year would also be used for Unit 2. Dominion recognizes that even though the units are located on the same site, they are of different design and would likely have a different seismic CDF.

The seismic CDF data in NUREG-1742, Table 2.2, from other IPEEE submittals were reviewed. The CE plants listed in the table are Calvert Cliffs (1.29E-5, using the conservative LLNL seismic profile) and San Onofre (1.70E-5 using the EPRI profile). Other northeastern and mid-Atlantic PWR sites range from 4.7E-6 (Salem) to 5.9E-5 (Indian Point 3). Because the range is so widespread, it was decided to use the Millstone Unit 3 CDF of 9.1E-6. To provide some margin in the use of this number in the SAMA analysis, the external events factor was rounded up from 1.22 to 1.3.

A seismic event is expected to result in a loss of offsite power. Therefore, the systems necessary to mitigate the event are:

1. Emergency diesel generators
2. Auxiliary feedwater pumps (including the water source, CST)
3. Service Water pumps
4. Charging pumps
5. RBCCW pumps
6. AC/DC switchgear

Millstone Unit 2 was designed to withstand the design basis earthquake equal to the peak horizontal ground acceleration of 0.17g and vertical ground acceleration of 0.11 g. The seismic margin earthquake (SME), applicable to a rock site, was scaled to the 0.30g peak ground acceleration value. The seismic capacities of components and structures at Unit 2 were screened to that value. The auxiliary feedwater, charging and RBCCW pumps all met the 0.3g criterion and were screened out since they were seismically rugged. Those SSCs that did not meet the initial screening were subject to an additional analysis, based on the conservative deterministic failure margin determination. The results produced a high-confidence of low probability of failure (HCLPF) seismic capacity for these components. The HCLPF values of these items are listed below.

Structure	HCLPF Capacity
Turbine Building	0.25g (houses the AFW pumps)
RWST	0.34g

Component	HCLPF Capacity
EDG	0.50g
Service Water pumps	0.50g
RBCCW heat exchangers	0.29g
125V DC vital bus 201B	0.26g
125V DC batteries	0.13g*
Chilled Water surge tank	0.22g*

*Subsequent modifications have made these components more seismically rugged.

The limiting SSCs for a seismic scenario, and thus potential SAMA candidates for risk reduction, include the turbine building, the RBCCW heat exchangers and vital bus 201B. However, these SSCs already have the seismic HCLPF capacity that exceeds the design basis. Also, as a result of the IPEEE seismic margins analysis, the 125V DC batteries and the Chilled Water surge tank were made more seismically rugged. The only other potential seismic enhancements to the plant were evaluated and dispositioned in response to RAI 4a. Therefore, based on the adequate seismic margin with the dominant seismic CDF scenario and the complexity associated with increasing the seismic capacity of a structure, no cost effective SAMAs were identified.

Response to 4c.

Main Control Room (A-25) in the IPEEE (Sections 4.6.1.1, 4.8.2.3, and 4.9.4)

The Main Control Room (MCR) has ionization smoke detectors above the control rack, the main control board, and a detector is located in the return air duct. Hose stations and portable extinguishers are available. Manual suppression of the fire by the Control Room operators using portable extinguishers is credited, followed by manual suppression by the Fire Brigade using portable extinguishers and hose stations.

The total fire ignition frequency in the MCR is 9.3E-03/year. The total contribution to core damage in the MCR is 6.57E-07/yr (IPEEE Table 4.9-1). If the detection system and manual suppression were improved until they were 99% successful, the contribution to core damage in the MCR would be about 1.66E-08/yr, resulting in a delta-CDF of 6.40E-07/yr. This would require an additional detection system such as an Incipient Fire Detection system, as well as additional training for the operators. Improvements to obtain such a small decrease in risk would not be cost-effective. Another option would be to separate the trains in the MCR. This would be a large project, since all of the Main Control Boards that contain cables for safe shutdown equipment contain cables from both trains, and many are adjacent to each other in many locations. Cables would have to be wrapped with fire-retardant wrap in all of these locations. The maximum risk benefit would be to reduce the contribution to core damage in the MCR to 0, resulting in a delta-CDF of 6.57E-07/yr. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $3M to $12M depending on the specific details. The low end of the cost estimate range includes design and installation of an additional fire detection system in the MCR similar to the existing ionization detector system, additional training for the operators, new and revised procedures, and all Engineering and Construction services related to the design and implementation of Design Change Packages. This would also require ongoing O&M costs to maintain and test the system regularly. This would increase confidence, but probably not achieve assurance of 100% success of the system. The high end of the cost estimate range includes an allowance to design and implement a Design Change Package to separate the trains' cables in the MCR by installing fire-retardant wrap in the Main Control Boards. Although expected to be quite large, it is unknown how extensive this effort would actually be, and it may not be physically feasible. Therefore, there are no apparent cost-effective changes that could be made in the CR to reduce the risk.

<u>Cable Vault (A-24) in the IPEEE (Sections 4.6.1.6, 4.8.2.2, and 4.9.4)</u>

The Cable Vault (CV) contains a combination of temperature, heat rate-of-rise, and cross-zoned ionization/photoelectric fire detection system. An automatic wet pipe water fire suppression system specifically designed for cable tray fires is installed in the area. In addition, portable fire extinguishers are located in the area, and a hose cabinet in the adjacent area is available for suppression. Both automatic and manual suppression are credited to prevent spread between cable trays.

The total fire ignition frequency in the CV is 1.0E-03/year. The total contribution to core damage in the CV is 2.83E-07/yr (IPEEE Table 4.9-1). If the detection system and suppression were improved until they were 100% successful, the contribution to core damage in the CV would be about 8.5E-08/yr, resulting in a delta-CDF of <u>1.98E-07/yr</u>. Improvements to obtain such a small decrease in risk would not be cost-effective. Another option would be to separate the trains in the CV. This would be a large project, since cables and trays cross over each other or are adjacent to each other in many locations. Cables and trays would have to wrapped with fire-retardant wrap in all of these locations. Alternatively, a fire barrier could be constructed and the cables and trays moved such that the trains are separated. The maximum risk benefit would be to reduce the contribution to core damage in the CV to 0, resulting in a delta-CDF of <u>2.83E-07/yr</u>. However, the cost of either of these options would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $3M to $20M depending on the specific details. The low end of the cost estimate range includes design and installation of improvements to the existing fire detection and suppression system in the Cable Vault. This would increase confidence, but probably not achieve assurance of 100% success of the system. This would also require training and procedures support. Additional redundant systems may be necessary to accomplish the desired improvement. This cost is encompassed within the estimate range. Also within the cost estimate range includes an allowance to design and implement a Design Change

Package to separate the trains' cables in the Cable Vault by installing fire-retardant wrap around cable trays and/or cables as feasible. Although expected to be quite large, it is unknown how extensive this effort would actually be, and it may not be feasible. The high end of the estimate range includes an allowance to design and implement a Design Change Package to install fire barriers in the Cable Vault and re-route the cables and trays to achieve separation. This may require extensive shut down time that has not been accounted for in the estimate range. Therefore, there are no apparent cost-effective changes that could be made in the CV to reduce the risk.

<u>Intake Structure Pump Room (I-1A) in the IPEEE (Sections 4.6.1.31, 4.8.2.4, and 4.9.4)</u>

The Intake Structure Pump Room (IS-PMP) contains ionization smoke detectors in each area of the pump house. Portable CO_2 extinguishers are available in the area, and outdoor hydrants are available adjacent to the building.

The total fire ignition frequency in area IS-PMP is 4.1E-03/year. The total contribution to core damage in IS-PMP is 9.66E-07/yr (IPEEE Table 4.9-1). If an automatic suppression system were installed, which had a failure probability of 0.10, the contribution to core damage in area IS-PMP would be about 9.7E-08/yr, resulting in a delta-CDF of <u>8.69E-07/yr</u>. The cost of installing a suppression system would not be cost-effective. Another option would be to separate the service water trains in the pump house. This would be a large project, since cables and trays cross over each other or are adjacent to each other in many locations. Cables and trays would have to be wrapped with fire-retardant wrap, and/or fire barriers would have to erected and cables trays would have to be moved. The maximum risk benefit would be to reduce the contribution to core damage in area IS-PMP to 0, resulting in a delta-CDF of <u>9.66E-07/yr</u>. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $3M to $10M, depending on the specific details. The low end of the cost estimate range includes design and installation of a new automatic fire suppression system in the Intake Structure Pump Room. This would also require training and procedures support, as well as ongoing O&M costs to maintain and test the system regularly. If a redundant system were also necessary, the costs would be expected to fall within the cost estimate range. Within the cost estimate range includes an allowance to design and implement a Design Change Package to separate the service water trains' cables in the pump house. This would involve wrapping cables and cable trays with fire-retardant wrap. Although expected to be quite large, it is unknown how extensive this effort would actually be, and it may not be feasible. The high end of the estimate range includes an allowance to design and implement a Design Change Package to install fire barriers in the Intake Structure Pump Room and re-route the cables and trays to achieve separation. This may require extensive shut down time that has not been accounted for in the estimate range. Therefore, there are no apparent cost-effective changes that could be made in area IS-PMP to reduce the risk.

Auxiliary Building Areas (AUXB-1) in the IPEEE (Sections 4.6.1.2, 4.8.2.1, and 4.9.4)

The Auxiliary Building corridors (AUXB-1) contain ionization smoke detectors installed throughout the area. There is an automatic wet pipe sprinkler system above and below numerous cable trays in many locations within the corridors. The area is also equipped with hose stations and portable extinguishers.

The total fire ignition frequency in area AUXB-1 is 3.3E-02/year. The total contribution to core damage in area AUXB-1 is 2.76E-06/yr (IPEEE Table 4.9-1). Several locations do not contain automatic suppression. If automatic suppression is added to the RBCCW Pump & Heat Exchanger Area –25'6" (area A-1B), and it is assumed that the suppression is 100% successful, the contribution to core damage in area AUXB-1 would be about 2.24E-06/yr, resulting in a delta-CDF of 5.2E-07/yr. If automatic suppression is added to General Area – 5'0" (area A-1G), and it is assumed that the suppression is always successful, the contribution to core damage in area AUXB-1 would be about 1.07E-06/yr, resulting in a delta-CDF of 1.69E-06/yr. If automatic suppression is added to General Area (+)14'6" (area A-12A), and it is assumed that the suppression is always successful, the contribution to core damage in area AUXB-1 would be about 2.21E-06/yr, resulting in a delta-CDF of 5.5E-07/yr. In each of these areas, the cost of installing a suppression system would not be a cost-effective way to reduce the risk. Costs for design and implementation of the above referenced solutions could be in the range of $5M to $10M depending on the specific details. The cost estimate range includes design and installation of automatic fire suppression systems in the RBCCW Pump & Heat Exchanger Area –25'6" (area A-1B), General Area –5'0" (area A-1G), and General Area (+) 14'6" (area A-12A) of the Auxiliary Building. This would increase confidence, but probably not achieve assurance of 100% success of the system. Additionally, training and procedures support would be necessary, as well as ongoing maintenance to maintain and test the system on a regular basis. Costs would be near the high end of the cost estimate range if redundant systems were necessary to increase system reliability.

Turbine Bldg. General Areas (TB) in the IPEEE (Sections 4.6.1.12, 4.8.2.5, and 4.9.4)

The Turbine Building (TB) has automatic detection systems provided. All areas of the TB have some type of localized automatic suppression system over certain components that have specific fire suppression needs. There are also numerous hose stations and portable extinguishers.

The total fire ignition frequency in the TB is 5.8E-02/year. The total contribution to core damage in the TB is 1.63E-06/yr (Table 4.9-1). The main contributor to core damage in the TB is the total loss of the entire Turbine Building. The remainder of the contributors are all less than 1.0E-08/yr, and are therefore insignificant. The concern of a large TB fire is that the ventilation system in the TB may not be adequate to remove smoke and heat generated by the fire, the sprinklers may not adequately cool the structural supports, or the plant fire pumps do not contain enough capacity to provide sufficient flow to area sprinkler systems and the fire fighters at the same time. This could result in collapse of the TB due to structural failure, and loss of the safe shutdown equipment located in the TB (MFW, AFW, service water, AC power, etc.).

Improvements have been made to reduce the risk due to a large fire in the TB. If a large fire were to occur in the TB, the cables to the SW pump motors could be lost. SW pumps are required to provide cooling to the EDGs, so the fire could result in the loss of onsite AC power. To prevent this, a modification was made to maintain a functional EDG by using the Fire Water system to supply cooling to the EDG heat exchangers. Another improvement was to reroute the cabling to the TDAFW pump such that they do not pass through the main TB. Therefore, currently, a large fire in the TB could cause loss of the MFW pumps, Condensate pumps, MDAFW pumps, and offsite AC power. The fire could lead to a Loss of Offsite Power with failure of all steam generator cooling except the TDAFW pump. Assuming the failure of both EDGs, or the failure of the TDAFW pump (and once through cooling), has a combined failure probability of 0.01, the total contribution to core damage due to a large fire in the TB would be about 1.63E-08/yr. To further reduce the risk, the cables running to the MDAFW pumps could also be rerouted such that they do not traverse the main TB areas. Assuming that this would further reduce the failure probability by an order of magnitude, the delta-CDF is 1.47E-08/yr. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $1M to $3M depending on the specific details. The cost estimate range includes design and installation of a Design Change Package to re-route existing cabling to the MDAFW pumps such that they do not traverse the main TB areas. Therefore, there are no apparent cost-effective changes that could be made in the Turbine Building to reduce the risk.

Response to 4d.

For the Millstone SAMA analyses, the external events factor was utilized because the external events analyses are not readily quantifiable. Increasing the benefit assessment by a ratio of the (internal CDF + external CDF)/internal CDF makes the implicit assumption that the consequences from the external events sequences are proportional to the consequences of the internal events sequences.

The external events analyses are typically dominated by LOOP/SBO. It is possible that the benefit of some SAMAs, especially those related to LOOP/SBO, may have a higher proportional external events contribution than the internal events contribution. Therefore, to demonstrate the robustness of the analysis, the SAMA cost/benefit analyses were re-examined with the external events factor doubled. For Millstone Unit 2, the factor is doubled from 30% to 60% and doubled again to account for uncertainties. These adjusted benefits were compared to the associated cost estimates and all except for SAMA 3 were found not to be cost effective. This result is consistent with the 1.3 multiplier. Thus it is concluded that even if the external events multiplier were doubled the final results would remain the same. Note that the response to RAI 5b provides additional detail of the substantial margin in the cost-benefit calculations.

Response to 4e.

The initiating events for which the external event multiplier does not need to be applied are ISLOCAs and SGTR initiating events. These initiating events bypass the containment as part of the initiating event, and therefore have particularly high offsite consequences. In the external event initiators (fire, seismic, etc.) the representative initiating events in terms of plant response are generally either: Turbine Trip with or without Main Feedwater and Condensate, Loss of Offsite Power, or RCP Seal LOCA. Since none of these external events initiators involve containment bypass as part of the initiating event, it would not be appropriate to increase the SAMAs dealing with these initiators by the external events factor.

The SAMAs in Table F.3-2 for which the benefits were not increased by the external events multiplier are: 87, 93, 94, and 99. Table F.3-2 shows that the cost/benefits of these four SAMAs are:

SAMA 87: Cost = $200-250M; Benefit = $126,876
SAMA 93: Cost = $12-18M; Benefit = $22,082
SAMA 94: Cost = $2-4M; Benefit = $22,082
SAMA 99: Cost = $4-6M; Benefit = $22,082

Therefore, even if the external events factor had been applied to these, they would still have screened out by nearly two orders of magnitude.

RAI 5. The discussion of the consideration of uncertainties in the evaluation of the SAMAs is not clear. In this regard, the following information is needed:

a. In the discussion of cost-benefit analysis in Attachment E Section 4.20.2.2 and in the corresponding section of Appendix F, it is stated that a factor of two is used to account for uncertainties in the cost estimates, while sensitivity analyses were used to account for the uncertainties in the determination of benefits. The impact of uncertainty in CDF and the various release categories apparently has not been considered. Provide an estimate of the uncertainties associated with the calculated core damage frequency (e.g., the mean and median CDF estimates and the 5th and 95th percentile values of the uncertainty distribution). Indicate whether any peer review comments were provided on uncertainty analysis, and if so, what is planned to address the comment(s).

b. Provide an assessment of the impact on the initial and final screening if risk reduction estimates are increased to account for uncertainties in the risk assessment. Please consider the uncertainties due to both the averted cost-risk and the cost of implementation to determine changes in the net value for these SAMAs.

c. Section F.3.3 says that to account for uncertainties, the benefit of each SAMA listed in Table F.3-2 are doubled for the purposes of the comparison with its cost, except for the SGTR and ISLOCA SAMAs. The values in the table do not appear to have been doubled. Please clarify if the values in the table have been doubled.

d. Please justify the last phrase of the first full paragraph on page E-F-41

"... except for SGTR and ISLOCA SAMAs."

This is believed to be an error and applicable to the increase by 30% to account for external events.

e. Potential impact of a power uprate was assessed by a sensitivity case in which core inventory scaling factor was increased by 10%. There is no indication that the replacement power costs were also scaled up by 10%, thus this sensitivity study appears incomplete. Provide a reassessment of this case based on appropriate scaling of both core inventory and replacement power costs.

Dominion Response to RAI 5

Response to 5a.

CDF uncertainty calculations are not available in the current version of the Millstone PRA models. Some insight can be obtained by reviewing the RAI responses to some other utility License Renewal applications. Reviewing the North Anna Power Station, Surry Power Station and D.C. Cook license renewal RAIs, the 5th percentile CDF in each is approximately 2.3 times less than the mean CDF, while the 95th percentile CDF ranged from a factor of 2.0 to a factor of 6.4 greater than the mean CDF. Consistent with traditional PRA approaches, the Millstone SAMA analyses were performed using the mean (best estimate) CDF. To provide an extra measure of conservatism, Dominion chose to compare twice the benefit calculations to the costs, to provide conservatism in a global manner. Additional conservatism appears in the bounding approach taken in the benefit calculations, in which portions of the PRA model were set to 100% successful to analyze SAMA benefits. In some cases, an entire initiating event was even set to zero. In reality, no SAMA would be 100% successful, and in many cases, the benefit estimates in the Environmental Report would be substantially less if a detailed PRA analysis were performed for each SAMA. However, in most cases, the cost of the SAMA far outweighed even the conservative benefit calculations, so refined analysis was not needed.

To provide insight into some of the uncertain areas of the analysis, the Environmental Report also presented several sensitivity calculations. These sensitivities showed that the conclusions of the SAMA analyses did not change even when some of the uncertainties are considered.

Because the uncertainties are accounted for through conservatisms in the bounding benefit calculations and in the "factor of two" criterion applied when comparing benefits with costs, the conclusions of the SAMA analysis are not expected to change as a result of a quantitative uncertainty analysis.

In the response to RAI 1c, the peer review comments are presented. Comments A22, B51, and B59 conclude that no uncertainty analysis was performed for the PRA. This is intended to be addressed in a future update.

Response to 5b.

The uncertainties in the cost of implementation are estimated in Table F.3-2 by presenting a range of anticipated costs. To account for uncertainties in the SAMA benefit calculations, Table F.3-2 presented that the low end of the cost range of each SAMA was more than twice the calculated benefit (except for SAMA #3). A factor of two to account for uncertainties has been used in other license renewal Environmental Reports, and is considered by Dominion to adequately address uncertainties in the Millstone Unit 2 SAMA submittal. Although many of the benefit calculations in Table F.3-2 are very conservative in their bounding approach, the Millstone submittal still chose the criterion of a factor of two increase in benefit to provide strong confidence that benefits were not underestimated. This factor was intended to cover uncertainties in the Level 1, 2 and 3 PRA analyses.

In addition to Dominion's position that the factor of two is sufficient to account for uncertainties, there is substantial margin between the mean benefit calculations and the estimated range of costs. All of the SAMAs in Table F.3-2 (except for SAMA #3, which was screened in by cost-benefit analysis) show a cost that is at least 10 times the mean benefit, except for the following: SAMA #127 has a cost estimate that is 6 to 13 times the mean benefit. SAMA #150 has a cost estimate that is 3 to 11 times the mean benefit. SAMA #175 has a cost estimate that is 4 to 10 times the mean benefit.

Therefore, even if uncertainties from the risk assessment are applied to the benefit calculations, there is still high confidence that all SAMAs, other than SAMA #3, would screen out.

Response to 5c.

The statement in RAI 5c is correct - the numbers appearing in Table F.3-2 are not doubled. During the cost/benefit analysis, the cost was compared to twice the benefit, to ensure conservatism in the conclusions. This fact is stated in the last column of Table F.3-2, where all SAMAs (other than #3) are stated to have a cost that is "> 2 x Benefit".

Response to 5d.

The phrase "except for SGTR and ISLOCA SAMAs" should not appear in that sentence, because the sentence is referring to the doubling (or cost > 2 x Benefit) that was used as the screening criterion for all the SAMAs in Table F.3-2.

Response to 5e.

The replacement power costs were not increased by 10% in Sensitivity Case 6. The following shows a reassessment of the sensitivity with the replacement power costs increased by 10%:

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table F.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
3	Enhance Loss of RBCCW procedure to ensure cool down of RCS prior to seal LOCA.	$173,337	$175,869	$181,325
8	Eliminate RCP thermal barrier dependence on RBCCW, such that loss of RBCCW does not result directly in core damage.	$155,543	$157,920	$162,759
10	Create an independent RCP seal cooling system, with dedicated diesel.	$135,409	$137,468	$141,679
11	Create an independent RCP seal cooling system, without dedicated diesel.	$135,409	$137,468	$141,679
22	Improve ability to cool RHR heat exchangers.	$7,321	$7,488	$7,695
34	Install a containment vent large enough to remove ATWS decay heat.	$204,311	$206,328	$213,301
35	Install a filtered containment vent to remove decay heat.	$414,336	$423,129	$434,528
36	Install an unfiltered hardened containment vent.	$414,336	$423,129	$434,528
43	Create a reactor cavity flooding system.	$84,732	$92,576	$92,576
44	Creating other options for reactor cavity flooding.	$84,732	$92,576	$92,576
75	Create a water backup for diesel cooling.	$44,593	$46,026	$47,087
77	Provide a connection to alternate offsite power source (the nearest dam).	$234,886	$241,931	$247,754
81	Install a fast acting MG output breaker.	$29,224	$30,089	$30,821
87	Replace steam generators with new design.	$126,876	$132,916	$174,894
93	Install additional instrumentation and inspection to prevent ISLOCA sequences.	$22,082	$13,135	$17,181
94	Increase frequency of valve leakage testing.	$22,082	$13,135	$17,181
99	Ensure all ISLOCA releases are scrubbed.	$22,082	$13,135	$17,181

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table F.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
100	Add redundant and diverse limit switch to each containment isolation valve.	$28,707	$17,076	$17,181
123	Provide capability for diesel driven, low pressure vessel makeup.	$0	$0	$0
124_125	Provide an additional high pressure injection pump with independent diesel.	$286,137	$293,446	$300,806
127	Implement an RWST makeup procedure.	$7,356	$7,629	$7,778
150	Provide an additional I&C system (e.g., AMSAC).	$177,909	$179,646	$185,726
159	Install turbine driven AFW pump.	$178,128	$180,729	$186,379
165	Install independent RBCCW/ESFRS AOV similar to 2-RB-68.1A.	$4,912	$5,083	$5,191
166	Install additional MD AFW pump.	$47,403	$47,970	$49,540
170	Install redundant parallel valve equivalent to 2-CS-16.1A.	$146,859	$149,675	$153,887
172	Add a redundant 125VDC bus equivalent to bus 201A and 201B.	$4,070	$4,200	$4,298
173	Install diverse bypass valve around AOV's SW-8.1A/B/C.	$175,003	$177,386	$183,015
174	Install redundant valve in line for backup to valve RB-8.1A/B.	$74,872	$75,950	$78,327
175	Install redundant diverse bypass valve equivalent to 2-CS-16.1A/B.	$338,405	$344,901	$354,586
176	Install additional SW AOV similar to SW-8.1A to provide a reliable flowpath.	$48,635	$49,317	$50,869
179	Automate RCP trip circuitry on loss of seal cooling.	$135,409	$137,468	$141,679
182	Automate the start and alignment of the RBCCW pump.	$0	$0	$0
183	Automate isolation feature of faulted SG.	$27,418	$27,699	$28,630
184	Install redundant AFW Reg valve following Reg valve FTO.	$15,947	$16,159	$16,679
185	Install redundant ESFRS fan equivalent to F-15B.	$4,857	$5,025	$5,133

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table F.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
186	Install diverse strainers L-1A, B, C to all 3 SW pump discharge lines to prevent CCF.	$13,185	$13,539	$13,886
187	Automate start capability of Terry Turbine.	$4,477	$4,620	$4,728
189	Automate emergency boration of RCS.	$18,736	$18,970	$19,588
190	Install redundant line to RWST equivalent to 2-CH-192.	$22,063	$22,334	$23,060
191	Add additional AFW bypass line with diverse reg valve to protect against CCF of existing valves 2-FW-43A and 43B.	$15,947	$16,159	$16,679
192	Install additional MOV on VCT outlet line similar to MOV-CH-501 for closure to assure boric acid flow to charging pump.	$15,540	$15,740	$16,250
193	Install additional AFW bypass line with diverse check valves and reg valves similar to check valves 2-FW-12A and 2-FW-12B and reg valves 2-FW-43A and 43B to SGs.	$21,682	$21,929	$22,655
195	Add additional MOV around valves 2-RB-68.1A&B.	$11,646	$12,041	$12,289

Increasing the replacement power costs by 10% in this sensitivity case increases the benefit by a few percent, but the conclusion of the sensitivity is unchanged - that a 10% increase in power would not have a significant impact on the SAMA analyses.

RAI 6. Please provide the following information regarding the initial list (Table F.3-1) of candidate improvements:

a. For each dominant contributor (in Table F.3-4), provide a cross-reference to the SAMA(s) evaluated in the ER (Table F.3-1) that address that contributor. If a SAMA was not evaluated for a dominant risk contributor, justify why SAMAs to further reduce these contributors would not be cost-beneficial.

b. The use of Criterion B (already implemented at MPS2) to screen out SAMAs identified from review of the PRA is misleading. The proposed SAMAs from the review of the PRA should address the cause of the CDF contributor in the PRA. If the importance of the item after implementation, as indicated by the PRA, is high enough to suggest a potential SAMA, a further quantitative evaluation would appear warranted. For example, SAMA 163 was screened out since the common cause failure (CCF) of the RBCCW pumps is already low. However, this SAMA is in the list because the CCF basic event is high in the list of FV importance. SAMA 171 is screened out with the explanation that it is not expected to impact CDF, yet the FV importance for this operator error is 0.03. Please provide a further quantitative evaluation of those SAMAs identified from the PRA that were screened out using Criterion B.

c. ER indicates 44 SAMAs remained after initial screening. This number can only be obtained if 124/125 count as one SAMA. Briefly explain.

d. The source for SAMAs 159 and higher (which are the SAMAs resulting from the MPS2 PRA) is given as Reference 21. However, Reference 21 is the Calvert Cliffs submittal. Please correct this discrepancy. Confirm if the other references in the table are correct.

e. It is noted that while nearly 12% of the CDF is due to LOOP initiated accidents, no plant-specific SAMAs address LOOP or SBO. While related generic SAMAs are listed, they are screened out. Please evaluate the cost-benefit of reasonable SAMAs that would reduce the LOOP CDF contribution.

f. SAMA 61, use fuel cells instead of batteries, and SAMA 64, alternate battery charging capability, are said to be bounded by SAMA 60, provide additional battery capacity. The latter is screened out due to a modification being made to create a swing battery charger. This modification will not have significant impact on SBO sequences and therefore does not address the issue discussed for each SAMA. Please provide a reevaluation of SAMAs 61 and 64. Also, please provide the status of the modification addressed

by SAMA 60, and an assessment of its impact on other dc power-related SAMAs.

g. SAMA 113, provide portable generators to be connected to the turbine driven AFW after battery depletion, was screened out on the basis that there is an existing EOP to manually control level. However, this SAMA could offer further risk reduction and could be cost-beneficial. Please provide a reevaluation of SAMA 113.

Dominion Response to RAI 6

Response to 6a.

As shown in RAI 1a, the latest version of the model available at the time was used to determine the plant specific SAMAs, which was different from the latest version available at the time for quantification. Below is a comparison of the Fussell-Vesely importance for both versions of the model, demonstrating how the plant-specific SAMAs were identified.

Note that only those Basic Events that were considered as systems, structures, components or operator actions were considered as a potential SAMA. The Basic Events that were not considered include some Initiating Events, Flag Events, or Fraction/Factor Events identified as N/A in the table below. Such basic events do not have a significant meaning in an importance list, and do not translate well into specific alternatives for the plant.

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
BUS24C	DELETED	STATION BLACKOUT FLAG - BUS24C	2.12E-01	0.00E+00	N/A
FWXMOD1	FWXP9TDAP4FN	FAILURE OF TERRY TURBINE	1.95E-01	6.69E-02	159
BUS24D	DELETED	STATION BLACKOUT FLAG - BUS24D	1.81E-01	0.00E+00	N/A
HPSIFAILS	DELETED	HPSI SYSTEM FAILS FLAG	1.42E-01	0.00E+00	N/A
RCPSF	RCPSF	RCP SEAL FAILURE GIVEN THE AFFECTED RCP(S) HAVE BEEN TRIPPED	1.38E-01	1.45E-02	10
%GPT	%GPT	GENERAL PLANT TRANSIENT	1.09E-01	1.23E-01	N/A
ACSWING24C	ACSWING24C	BUS 24C ALIGNED TO POWER SWING BUS 24E	1.04E-01	7.88E-02	N/A
RB2P11COP	RB2P11CX18C	RBCCW PUMP P-11C IS OPERATING	1.00E-01	1.63E-01	N/A
STUCKPORV	PORVCHLG	STUCK OPEN PORV OR SAFETY VALVE	9.05E-02	6.07E-02	161
%RBP4RP11CFN	%RBP4RP11CFN	RBCCW PUMP P-11C FAILS TO RUN (INITIATOR)	8.78E-02	2.68E-02	162
OPSAFETY	OPSAFETY	FRACTION OF THE TIME SAFETY WILL OPEN (SCREENING)	8.53E-02	5.42E-02	N/A
RB1P11AOP	RB1P11AX18A	RBCCW PUMP P-11A IS OPERATING	6.45E-02	1.62E-01	N/A
%RBP433FTRFN	DELETED	CCF OF 3/3 RBCCW PUMPS TO RUN (INITIATOR)	6.32E-02	0.00E+00	163
DC1BKD0103NF	DC1BKD0103NF	BUS FEED BREAKER D0103 FAILS TO REMAIN CLOSED (SUPPLY TO 201A)	5.90E-02	3.33E-03	164
RTELEC	RTELEC	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)	5.34E-02	9.20E-02	150
%RBP4RP11AFN	%RBP4RP11AFN	RBCCW PUMP P-11A FAILS TO RUN (INITIATOR)	5.25E-02	2.68E-02	162
%LNPPC	%LNPPC	LOSS OF NORMAL POWER - PLANT CENTERED	5.18E-02	2.75E-02	N/A
RB1AVH681ANN	RB1AVH681ANN	RBCCW/ESFRS AOV 2-RB-68.1A FAILS TO OPEN	5.14E-02	1.05E-03	165
FW2MOD1	FW2P8FWP9BNN	'B' MOTOR DRIVEN AFW PUMP FAILS	4.70E-02	9.27E-03	166
FW1MOD1	FW1P8FWP9ANN	'A' MOTOR DRIVEN AFW PUMP FAILS	4.69E-02	1.19E-02	166
%SLOCA1A	%SLOCA1A	SMALL LOCA INITIATOR IN LOOP 1A	4.68E-02	8.13E-02	N/A
%SLOCA1B	%SLOCA1B	SMALL LOCA INITIATOR IN LOOP 1B	4.68E-02	8.13E-02	N/A
%SLOCA2A	%SLOCA2A	SMALL LOCA INITIATOR IN LOOP 2A	4.68E-02	8.13E-02	N/A
%SLOCA2B	%SLOCA2B	SMALL LOCA INITIATOR IN LOOP 2B	4.68E-02	8.13E-02	N/A
DC2BKD0203NF	DC2BKD0203N	BUS FEED BREAKER D0203 FAILS TO REMAIN CLOSED (SUPPLY TO 201B)	4.50E-02	3.14E-03	164
PRXRVRC201FF	PRXRVRC201FF	SAFETY RELIEF VALVE RC-201 FAILS TO CLOSE DUE TO MECHANICAL FAILURE	4.26E-02	3.25E-02	124
PRXRVRC200FF	PRXRVRC200FF	SAFETY RELIEF VALVE RC-200 FAILS TO CLOSE DUE TO MECHANICAL FAILURE	4.26E-02	3.25E-02	124
OARDC	OADCALTCHG	FAILURE TO RECOVER DC POWER	4.24E-02	6.98E-03	60
FW2P8FWP9BBQ	FW2P8FWP9BBQ	MOTOR DRIVEN AFW PUMP P-9B OOS FOR MAINTENANCE	3.95E-02	9.58E-03	166
OABAF	OAPBAF	OPERATOR FAILS TO ESTABLISH BLEED AND FEED	3.93E-02	2.01E-02	167_168
SW2P5COP	DELETED	SERVICE WATER PUMP P-5C OPERATING	3.74E-02	0.00E+00	N/A

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
%SWP3P5ABCFN	%SWP3PP5ACFN	CCF OF 3/3 SERVICE WATER PUMPS P- 5A, B, AND C TO RUN (INITIATOR)	3.62E-02	1.01E-04	9
RBCAVR81ABNN	RBCAVR81ABNN	CCF OF 2/2 RBCCW 2-RB-68.1A & B AOVS TO OPEN	3.54E-02	1.02E-03	195
%SSLOCA	DELETED	SMALL SMALL LOCA INITIATOR	3.52E-02	0.00E+00	N/A
AC1DGDGH7AFN	AC1DGDGH7AFN	DIESEL GENERATOR 'A' (15G-12U) FAILS TO RUN	3.51E-02	3.59E-02	59
%LMFW	%LMFW	LOSS OF MAIN FEEDWATER	3.50E-02	3.34E-02	N/A
RB2AVHV81BNN	RB2AVHV81BNN	RBCCW/ESFRS AOV 2-RB-68.1B FAILS TO OPEN	3.46E-02	1.04E-03	195
%LNPW	%LNPW	LOSS OF NORMAL POWER - WEATHER RELATED	3.32E-02	6.83E-02	N/A
FW1P8FWP9AAQ	FW1P8FWP9AAQ	MOTOR DRIVEN AFW PUMP P-9A OOS FOR MAINTENANCE	3.25E-02	1.02E-02	166
AC2DGDGH7BFN	AC2DGDGH7BFN	DIESEL GENERATOR 'B' (15G-13U) FAILS TO RUN	3.17E-02	3.96E-02	59
OACST	DELETED	OPERATOR FAILS TO PROVIDE MAKEUP TO THE CST	3.13E-02	0.00E+00	169
CS1MVCS16ANN	CS1MVCS16ANN	MOTOR OPERATED VALVE 2-CS-16.1A FAILS TO OPEN ON DEMAND	3.08E-02	6.23E-02	170
OALPMINI	DELETED	OPERATOR FAILS TO POSITION THE SI PUMP MINI-FLOW LINE VALVES TO OPERATE	3.04E-02	0.00E+00	171
%LDCA	DELETED	LOSS OF 125VDC BUS 201A (PLANT SPECIFIC DATA)	3.00E-02	0.00E+00	172
DC2BTBATTBFF	DC2BTBATTBFF	BATTERY 201B FAILS TO PROVIDE OUTPUT ON DEMAND (DB2-201B)	2.94E-02	2.75E-02	60
MTC	MTC	PROBABILITY OF AN ADVERSE MTC WITH TURBINE TRIP	2.91E-02	4.17E-02	150
%LDCB	DELETED	LOSS OF 125VDC BUS 201B (PLANT SPECIFIC DATA)	2.87E-02	0.00E+00	172
SWCAV81BCONN	SWCAV81BCONN	CCF OF 2/3 SERVICE WATER AOVS SW-8.1A/B/C TO OPEN	2.86E-02	3.49E-02	173
RB1AVRB81AFF	RB1AVRB81AFF	AIR OPERATED VALVE RB-8.1A FAILS TO CLOSE DUE TO MECHANICAL FAILURE	2.84E-02	3.64E-02	174
SW5P5BOPB	DELETED	SERVICE WATER PUMP P-5B OPERATING ON HDR 'B'	2.84E-02	0.00E+00	N/A
RB5P11BOPB	DELETED	RBCCW PUMP P-11B OPERATING ON HDR 'B'	2.81E-02	0.00E+00	N/A
DC1BTBATTAFF	DC1BTBATTAFF	BATTERY 201A FAILS TO PROVIDE OUTPUT ON DEMAND (DB1-201A)	2.79E-02	2.68E-02	60
RECMFW	RECMFW	FAILURE TO RECOVER MFW OR CONDENSATE	2.64E-02	1.92E-02	166
RB1X18AOP	RB1P11AX18A	RBCCW HX X-18A IS OPERATING	2.58E-02	1.62E-01	N/A
SW1P5AOP	DELETED	SERVICE WATER PUMP P-5A OPERATING	2.43E-02	0.00E+00	N/A
CS2MVCS16BNN	CS2MVCS16BNN	MOTOR OPERATED VALVE 2-CS-16.1B FAILS TO OPEN ON DEMAND	2.35E-02	4.81E-02	170
FWCP8FP9ABNN	FWCP8FP9ABNN	CCF TO START OF MOTOR DRIVEN AFW PUMPS P-9A AND P-9B	2.33E-02	1.74E-02	159
CSCMVCS161NN	CSCMVCS161NN	CCF OF 2/2 CS MOTOR OPERATED VALVES 2-CS-16.1A&B TO OPEN ON DEMAND	2.29E-02	4.19E-02	175
%SWP3SWP5CFN	%SWP3SWP5CFN	SERVICE WATER PUMP P-5C FAILS TO RUN (INITIATOR)	2.28E-02	2.56E-02	9
%DCBKD0103NF	%DCBKD0103NF	BUS FEED BREAKER D0103 FAILS TO REMAIN CLOSED (SUPPLY TO 201A)	2.24E-02	6.16E-02	164

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
SW1AVSW81ANN	SW1AVSW81ANN	SERVICE WATER AOV SW-8.1A FAILS TO OPERATE	2.17E-02	2.48E-02	176
%DCBKD0203NF	%DCBKD0203NF	BUS FEED BREAKER D0203 FAILS TO REMAIN CLOSED (SUPPLY TO 201B)	2.12E-02	5.72E-02	164
SICAVSI659FF	SICAVSI659FF	CCF OF 2/2 MINI FLOW ISOLATION AOVS 2-SI-659 & 660 TO CLOSE	2.11E-02	3.69E-05	177
RB2AVRB81BFF	RB2AVRB81BFF	AIR OPERATED VALVE RB-8.1B FAILS TO CLOSE DUE TO MECHANICAL FAILURE	2.10E-02	3.15E-02	174
RB2AVRB210FF	RB2AVRB210FF	AIR OPERATED VALVE RB-210 FAILS TO CLOSE DUE TO MECHANICAL FAILURE	2.09E-02	3.15E-02	178
OATRIPRCP	OAPRCPTRIP	OPERATOR FAILS TO TRIP THE RCPS	2.06E-02	6.14E-02	179
%DCBSBATTAFN	%DCBSBATTAFN	125VDC ELECTRICAL BUS FAULT (BATTERY BUS 201A)	2.05E-02	5.93E-03	172
%DCBSB201AFN	%DCBSB201AFN	125VDC ELECTRICAL BUS 201A FAULT	2.05E-02	5.93E-03	172
RB2X18COP	RB2P11CX18C	RBCCW HX X-18C IS OPERATING	1.97E-02	1.63E-01	N/A
%DCBSB201BFN	%DCBSB201BFN	125VDC ELECTRICAL BUS 201B FAULT	1.93E-02	5.50E-03	172
%DCBSBATTBFN	%DCBSBATTBFN	125VDC ELECTRICAL BUS FAULT (BATTERY BUS 201B)	1.93E-02	5.50E-03	172
%SLOCA	%SLOCA	SMALL LOCA INITIATOR	1.84E-02	2.93E-02	N/A
OAADV1	DELETED	LOCAL MANUAL OPERATION OF AN ADV	1.82E-02	0.00E+00	196
OADCRVENT	OADCRVENT	OPERATOR FAILS TO RECOVER 125V DC VENTILATION.	1.64E-02	3.15E-02	180
SW2AVSW81CNN	SW2AVSW81CNN	SERVICE WATER AOV SW-8.1C FAILS TO OPEN	1.59E-02	2.14E-02	181
%SWP3SWP5AFN	%SWP3SWP5AFN	SERVICE WATER PUMP P-5A FAILS TO RUN (INITIATOR)	1.45E-02	1.96E-02	9
OEP9BMAINT	OEP9BMAINT	OPERATOR FAILS TO RESTORE MOTOR DRIVEN AFW PUMP P-9B AFTER MAINTENANCE	1.38E-02	3.73E-03	166
OEP9AMAINT	OEP9AMAINT	OPERATOR FAILS TO RESTORE MOTOR DRIVEN AFW PUMP P-9A AFTER MAINTENANCE	1.37E-02	4.82E-03	166
OARBPUMP	OAPRBPUMP	OPERATOR FAILS TO MANUALLY START AND ALIGN AVAILABLE PUMP	1.27E-02	5.86E-05	182
OASGI	OASGI	OPERATOR FAILS TO ISOLATE FAULTED SG	1.26E-02	1.46E-02	183
OABYPASS	OABYPASS	OPERATOR FAILS TO OPEN AFW REG VALVE BYPASS FOLLOWING REG VALVE FTO	1.19E-02	9.12E-03	184
RUPTLPSI	RUPTLPSI	RUPTURE OF 6" - GCB-2 AT 1300 PSIG (HPSI DISCHARGE PRESSURE)	1.05E-02	2.01E-02	125
%SLBUO	%SLBUO	STEAMLINE BREAK UPSTREAM OF THE NRVS AND OUTSIDE CTMT	1.03E-02	1.55E-02	N/A
OASWSTRAIN	OASWSTRAIN	OPERATOR FAILS TO RECOVER STRAINER	1.02E-02	9.83E-03	23
SG2FAULTED	SG2FAULTED	STEAM GENERATOR #2 FAULTED	1.01E-02	1.06E-02	N/A
OEP4TM	OEP4TM	FAILURE TO RESTORE THE TERRY TURBINE AFTER TEST OR MAINTENANCE	9.77E-03	4.03E-03	159
EV2FNHV15BNQ	EV2FNHV15BNQ	ESFRS FAN F-15B OOS FOR MAINTENANCE	8.19E-03	2.69E-04	185
%SWSTSWABCNF	%SWSTSWABCNF	CCF OF STRAINERS L-1A, B, AND C TO OPERATE (INITIATOR)	8.01E-03	6.36E-03	186

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
FWXP9TDAP4NQ	FWXP9TDAP4NQ	TERRY TURBINE (P4) OOS FOR MAINTENANCE	7.96E-03	3.12E-03	159
OATDAFW	OATDAFW	OPERATOR FAILS TO START THE TERRY TURBINE (P4)	7.77E-03	3.19E-03	187
RTMECH	RTMECH	REACTOR TRIP FAILS DUE TO MECHANICAL ROD BINDING	7.72E-03	1.34E-02	188
SG1FAULTED	SG1FAULTED	STEAM GENERATOR #1 FAULTED	7.69E-03	8.38E-03	N/A
OAEMBOR	OAEMBOR	OPERATOR FAILS TO INITIATE EMERGENCY BORATION	7.57E-03	1.08E-02	189
CHXAVCH192NN	CHXAVCH192NN	RWST ISOLATION VALVE 2-CH-192 FAILS TO OPEN ON DEMAND	7.42E-03	1.04E-02	190
FWCAVF43ABNN	FWCAVF43ABNN	CCF TO OPEN OF AFW REG VALVES 2-FW-43A AND 2-FW-43B	6.70E-03	4.87E-03	191
%LNPGR	%LNPGR	LOSS OF NORMAL POWER - GRID RELATED	6.57E-03	2.11E-02	N/A
EV1FNHV15ANQ	EV1FNHV15ANQ	ESFRS FAN F-15A OOS FOR MAINTENANCE	6.19E-03	1.39E-04	185
DC1BSBATTAFN	DC1BSBATTAFN	125VDC ELECTRICAL BUS FAULT (BATTERY BUS 201A)	6.17E-03	3.14E-04	172
%SGTR	%SGTR	STEAM GENERATOR TUBE RUPTURE	6.17E-03	3.09E-02	N/A
AC1DGDGH7AAQ	AC1DGDGH7AAQ	DIESEL GENERATOR 'A' (15G-12U) OOS FOR MAINTENANCE	6.15E-03	6.15E-03	59
SW2P3SWP5CCQ	SW2P3SWP5CCQ	SERVICE WATER PUMP P-5C OOS FOR MAINTENANCE	5.56E-03	4.36E-05	9
AC2DGDGH7BBQ	AC2DGDGH7BBQ	DIESEL GENERATOR 'B' (15G-13U) OOS FOR MAINTENANCE	5.20E-03	5.96E-03	59
CH1MVCH501FF	CH1MVCH501FF	MOV CH-501 FAILS TO CLOSE ON DEMAND	5.17E-03	7.41E-03	192
%SLBUI	%SLBUI	STEAMLINE BREAK UPSTREAM OF THE NRVS AND INSIDE CTMT	5.14E-03	5.78E-03	N/A
FW2AVFW43BNN	FW2AVFW43BNN	AIR OPERATED VALVE 2-FW-43B FAILS TO OPEN ON DEMAND	4.67E-03	3.65E-03	193
FW1AVFW43ANN	FW1AVFW43ANN	AFW REG VALVE 2-FW-43A FAILS TO OPEN ON DEMAND	4.67E-03	3.65E-03	193
FWCCVF12ABNN	FWCCVF12ABNN	CCF TO OPEN OF CHECK VALVES 2-FW-12A AND 2-FW-12B	4.66E-03	3.41E-03	193
OAPCONDDC	OAPCONDDC	OPERATOR FAILS TO ALIGN CONDENSATE SYSTEM FOR DECAY HEAT REMOVAL	4.65E-03	5.08E-03	166

Response to 6b.

The plant-specific SAMAs that were screened using Criterion B were 161, 162, 163, 164, 167, 168, 169, 171, 177, 178, 180, 181, 188 and 196. In the subsequent discussion, more detail is provided as to the reason that some were screened qualitatively. For the others, a quantitative evaluation is provided. Each of the SAMAs is discussed in turn, and where benefit values are presented, they have all been increased by a factor of 1.3 to address external events and doubled to account for uncertainties.

SAMA 161 - Install redundant isolation valves on the Pressurizer PORVs: The conservative, bounding benefit was calculated by setting the basic event for PORV challenges, PORVCHLG, to zero. The resulting benefit is $296k. The cost estimated for such a modification is $2M to $4M, so the SAMA is not cost beneficial.

SAMA 162 – Install an additional RBCCW Pump of the same design as the existing pumps: A conservative, bounding benefit of $310k was calculated for SAMA 8 ($155k before doubling) by setting all RBCCW basic events to zero in the model. The cost estimated for such a modification is $6M to $11M ($3M to $6M for a new pump and $3M to $5M to construct a building to house it due to existing space limitations), so the SAMA is not cost beneficial.

SAMA 163 – Install a fourth RBCCW Pump of a different design (eliminate common cause failures): A conservative, bounding benefit of $310k was calculated for SAMA 8 ($155k before doubling) by setting all RBCCW basic events to zero in the model. The cost estimated for such a modification would be greater than that for SAMA 162, as additional engineering analyses would be required to evaluate system operation with a pump of a different design. Therefore, since SAMA 162 was not cost beneficial, SAMA 163 is also not cost beneficial.

SAMA 164 - Install a redundant feeder breaker (similar to D0103/D0203) to 125 DC vital facility bus: The basic events %DCBKD0103NF and %DCBKD0203NF, which represent the DC Bus 201A and 201B feeder breakers respectively, rank high in Fussell-Vesely importance but are initiating events and as such have skewed importance. However, even if the SAMA is considered as described, the benefit would be on the order of SAMA #172 (add a redundant 125V DC bus), which is small enough that no modification would be cost beneficial.

SAMA 167 - Automate feed and bleed (once-through cooling): If this SAMA were implemented, it would create some increased risk to the plant that would offset its benefit. Besides creating additional means for a spurious PORV opening or safety injection, automating once-through cooling would take away some of the control that an operator would have over the plant if secondary heat removal were lost. Nonetheless, a benefit calculation was performed for this SAMA by setting to zero the HEP for OTC (basic event OAPBAF), yielding a benefit of only $74k. Developing and implementing this modification would be at least an order of magnitude higher in cost, and would therefore not be cost beneficial.

SAMA 168 – Provide additional training for feed and bleed (once-through cooling) operation: The SAMA was created because the operator action basic event, OABAF, had a relatively high Fussell-Vesely importance. However, this basic event had a probability of 0.1 in the PRA model, which is a conservatively high number. Millstone Unit 2 operators have already been extensively trained on Once-Through Cooling (OTC) in the loss of all feedwater procedure. The tasks and related training associated with OTC are selected for training to be performed every two years (on a recurring basis) for the Licensed Operator Requalification Training (LORT) program. Training includes both classroom and simulator activities. The classroom training has even included input from the PRA analysis of OTC. Training is also provided to the students in every Licensed Operator Initial Training (LOIT) and Licensed Operator Upgrade Training (LOUT) class. Because of the extensive recurring classroom and simulator training provided to operators on OTC, additional training was judged not to be a significant benefit.

SAMA 169 – Automate makeup to the CST: This SAMA was created from the importance of basic event OACST, which is failure to makeup inventory to the CST. However, in a subsequent update to the Millstone Unit 2 PRA, the operator action OACST was deleted from the model, which is why it is qualitatively screened from the SAMA list that was compiled from a previous version of the PRA. There is sufficient inventory available to the AFW to maintain decay heat removal in excess of 24 hours without the need for the operators to provide makeup to the Condensate Storage Tank.

SAMA 171 - Automate LPSI/HPSI mini-flow line valve position: The failure of the operator action to close the SI pump mini-flow valves upon recirculation (OALPMINI) was deleted in the latest update of the model, which is why it is qualitatively screened from the SAMA list that was compiled from a previous version of the PRA. The analysis shows that, with these valves remaining open, the HPSI system is still able to inject sufficient water to remove the decay heat and keep the core covered. The maximum flow diversion would be less than 30 gpm, which is too small to fail recirculation.

SAMA 177 – Install MOV isolation valves for HPSI, CS and LPI mini-flow: This SAMA is qualitatively screened with the same basis as SAMA 171 was screened.

SAMA 178 – Install redundant valve equivalent to RB-210 to assure isolation: The benefit of this SAMA was calculated in the PRA by setting to zero the failure of RB-210 to close (basic event RB2AVRB210FF). The resulting benefit was calculated to be $122k. Any hardware modification adding a valve to this line would be at least an order of magnitude greater in cost than this benefit, so the SAMA is not cost-beneficial.

SAMA 180 – Install backup 125V DC ventilation: The benefit for this SAMA was calculated by setting the operator action for recovery of 125V DC ventilation, OADCRVENT, to zero. The resulting benefit was $134k, compared to a cost estimated at $4M to $6M, so the SAMA is not cost-beneficial.

SAMA 181 - Install a bypass line around SW-8.1C to provide additional flow capacity: The benefit of this SAMA was calculated by setting to zero the independent and common cause failures of SW-8.1A/C to close (basic events SW1AVSW81ANN, SW2AVSW81CNN and SWCAV81BCONN). The resulting benefit was $323k, compared to an estimated cost of $3M to $5M, so the SAMA was not cost-beneficial.

SAMA 188 – Install a more reliable reactor control rod assembly or a diverse boron injection system: This SAMA was identified from the basic event that represents mechanical binding of the control rods. The benefit was calculated by setting all reactor trip failures (electrical and mechanical) to zero. This conservative calculation yielded a benefit of $208k. Any design and installation of either new control rod assemblies or a diverse boron injection system would have a cost at least an order of magnitude greater, so this SAMA is not cost beneficial.

SAMA 196 – Install redundant ADV control and power supply circuitry: In the PRA model used to develop the original SAMA list, the ADVs were credited for manual depressurization of the secondary side to use the LPSI pumps for safety injection if the HPSI system had failed. However, this action is no longer credited, and the operator action has been taken out of the model. In the current model, the HPSI system is now credited to provide the bulk of the safety injection at all pressures, with the result that the ADVs have dropped in the importance ranking. Therefore, there is no need to implement a redundant ADV control and power supply circuitry.

Response to 6c.

The observation noted in the RAI is correct. The number 44 was arrived at by counting 124/125 as one. If the two are counted separately, then 45 SAMAs remained after initial screening.

Response to 6d.

The correct source for SAMAs 159 and higher was a review of the basic events considered of high importance using the Fussell-Vesely risk measure. This analysis does not appear in the references in Section F.3, but was documented in a Dominion calculation. The only other SAMA presented with the incorrect reference is SAMA 121, which should be Reference 22, the Surry and North Anna license renewal applications.

Response to 6e.

Compared to many industry PRAs, a 12% contribution from LOOP/SBO is not unusually large. As with all other initiators in the Millstone Unit 2 PRA, identification of plant specific SAMAs was performed by a review of the Fussell-Vesely importance list. SAMAs 159 through 196 present the plant specific SAMAs identified during the importance review. In Table F.3-1, they are shown as coming from Reference 21, but they actually came from a review of the Fussell-Vesely importance listing for the Millstone Unit 2 PRA. Not shown are many other components that appeared in the importance review but already had SAMAs representing them. For example, if a diesel generator had a high importance, a new SAMA was not generated for it because SAMA #59 already existed for analysis of a new diesel generator.

The plant specific SAMAs that deal with SBO are 159 and 160 (subsumed by SAMA 10). From Table F.3-1, some of the other SAMAs that deal with LOOP and SBO are 10, 14, 19, 28, 37, 38, 43, 44 (part b), 50, 58, 59, 60, 61, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 75, 76, 77, 78, 79, 80, and 81. Many others also provide benefit in LOOP/SBO sequences, in a less direct manner.

Because the Unit 2 LOOP/SBO CDF is not unusually large, because plant-specific importance analysis was used to identify significant components, and because many SAMAs already deal with benefits during a LOOP/SBO, no additional SAMAs are needed to address LOOP/SBO.

Response to 6f.

SAMA 61 was reevaluated by setting the recovery of offsite power within 105 minutes (prior to battery drain) from grid, plant-centered and weather-related events to successful (basic events SITE105GR, SITE105PC and SITE105W). The benefit was calculated to be $23k, after doubling to account for uncertainties. In the Millstone Unit 3 analysis, Table G.3-2 of the Environmental Report, fuel cells were estimated to cost $3M to $5M. The cost at Unit 2 is expected to be of the same order of magnitude as in the Unit 3 analysis, leading to the conclusion that SAMA 61 is not cost effective.

Similar DC power-related SAMAs, #60 and #64, are also assessed with the small benefit of $23k. With such a small benefit, no hardware changes would be cost-beneficial.

The modification associated with SAMA 60 is currently being evaluated for alternatives. The alternative chosen will be either an additional battery and swing charger, or additional batteries. Final implementation is anticipated in the plant's refueling outage #17, currently scheduled for the Fall of 2006. It should be noted that this project is currently budgeted for more than $1.2 million in the year 2005 alone. It is projected that this modification will ultimately cost nearly $3 million, far surpassing any benefit that could be derived by any dc power-related SAMAs. As noted above, the benefit for this SAMA is only $23K.

Response to 6g.

An evaluation has been made of SAMA 113. The MP2 TDAFW pump can be controlled locally without the need for electrical power. It is recognized that electrical power could provide SG level indication to prevent over/under filling the SG; however, level could also be maintained by an existing procedure, which provides guidance to the operator to regulate feedwater flow rate to the SG. The minimum required feed flow rate could be determined based on the decay heat level in the reactor core. Although accuracy of this method is limited, it would provide a means to keep the SG filled until emergency power was restored. Battery power is expected to last approximately 8 hours following loss of emergency power.

The benefit of implementing SAMA 113 was calculated to be $20,335. Based on the small benefit provided, it is concluded that this SAMA is not cost beneficial.

RAI 7. For the SAMAs considered in the cost-benefit analysis (Table F.3-2), the following information is needed to better understand the modification and/or the modeling assumptions:

a. Please describe in more detail the general process used for determining the impact of the various SAMAs on the CDF, person-rem, and offsite economic impact. Discuss such things as: was the complete model run for each case; in general, what changes were made to the model and what assumptions were made concerning the effectiveness of the modifications. Provide specific details on the evaluations for three example benefit calculations, including SAMA 3.

b. It would appear that the benefit for SAMA 10 would be greater than that for SAMA 8 since the former includes a diesel and thus does not depend on offsite or onsite emergency power. Please describe how these SAMAs are different and how the reduction in CDF was determined for each.

c. The benefits of SAMA 36 (unfiltered hardened vent) appear unrealistically high (e.g., a 16% reduction in both CDF and person-rem for Unit 2). The estimated costs also seem very high compared to the costs to implement similar modifications in Mark I containments. Please provide the basis for the benefit estimates. Also, justify why the containment cannot be vented via an existing penetration in accordance with severe accident management guidelines, and why the development of such a procedure would not be cost-beneficial.

d. For SAMA 93, provide a description of which penetrations constitute the dominant contributors to ISLOCA risk, and whether some subset of these lines can be tested at an increased frequency without the need for significant hardware modifications, thereby deriving some of the benefit without the large cost of adding or modifying test lines and instrumentation.

e. SAMA 179, which involves automation of operator actions to trip reactor coolant pumps, is indicated to have approximately a 6% reduction in CDF. However, based only on the top cutsets, this basic event should have a FV importance of something greater than 0.08. Please describe how this 6% reduction was determined.

Dominion Response to RAI 7

Response to 7a.

The general process for the SAMA evaluations was to run the complete Millstone Unit 2 CAFTA model using the CAFTA computer code at a truncation value of 1.0E-11, or, when a complete model resolution was not necessary, the plant damage cutsets could be directly modified. In general, the changes to the model were made with a conservative change to the model (one that would maximize benefit by assuming complete effectiveness), and if the conservative benefit was large, then the SAMA was reassessed with more realistic and detailed changes to the model. The CAFTA code produced new PDS frequencies, which were then translated to new STC frequencies as described in the Environmental Report section F.2.3.

Example Benefit Calculations:

SAMA 3 - Enhance Loss of RBCCW procedure to present desirability of cooling down RCS prior to seal LOCA. - Provided a conservative, bounding estimate of the benefit by setting basic events RCPSF (Reactor Coolant Pump Seal Failure) and %RB* (RBCCW failures) in plant damage class cutsets to be successful. The new PDS frequencies are as follows:

SAMA No.	AEC	AEF	AEH	AEL	AL	ALC	ALFH	ALFL	SECH	SECL	SEF
3	2.25E-07	1.26E-07	1.19E-08	1.82E-07	3.02E-08	2.67E-08	3.21E-09	3.37E-07	3.78E-06	3.25E-06	2.60E-07

SEGH	SEH	SEL	SLCH	SLCL	SLFH	SLFL	SLH	SLL	TECH	TEFH	TEGH
1.28E-10	3.70E-06	8.70E-07	7.80E-06	1.01E-07	7.11E-06	1.69E-08	5.63E-06	2.28E-08	1.47E-06	3.67E-07	3.79E-07

TEH	TL	V	V2	Total	ΔCDF
1.30E-05	1.50E-05	1.07E-07	2.24E-06	6.61E-05	5.63E-06

The Source term categories for SAMA 3 are:

CET E.S (Source Term Category)	Base	SAMA 3
M1A	1.07E-07	1.07E-07
M1B	2.36E-06	2.35E-06
M2	0.00E+00	0.00E+00
M3	6.86E-07	6.12E-07
M4	0.00E+00	0.00E+00
M5	5.48E-06	5.30E-06
M6	1.37E-05	1.34E-05

CET E.S (Source Term Category)	Base	SAMA 3
M7	2.14E-05	1.86E-05
M8	1.71E-05	1.55E-05
M9	0.00E+00	0.00E+00
M10	0.00E+00	0.00E+00
M11	0.00E+00	0.00E+00
M12	1.08E-05	1.02E-05

The benefit calculation for SAMA 3 is:

Case->	SAMA 3
Offsite Annual Dose (Rems)	16.5719
Offsite Annual Property Loss ($)	$ 13,112
Comparison CDF	7.16E-05
Comparison Dose	17.4193
Comparison Cost	$13,707
Reduction in CDF	7.77%
Reduction in Offsite Dose	4.86%
Onsite Short Term Dose Savings (Best Est)	$395
Onsite Long Term Dose Savings (Best Est)	$1,723
Onsite Prop Cost Savings	$64,600
Total Onsite Benefit (without Replacement Power)	$66,718
Replacement Power Cost	$41,970
Total Onsite Benefit (with Replacement Power)	$108,688
Offsite Dose Savings	$18,241
Offsite Prop Cost Savings	$6,406
Total Offsite Benefit	$24,648
Total Benefit (Onsite + Repl Pwr + Offsite)	$133,336
Total Benefit without Replacement Power	$91,366
Total Benefit (Onsite + Repl Pwr + Offsite)*1.3	$173,337

SAMA 159 - Install turbine driven AFW pump. - Provided a conservative, bounding estimate by setting basic events FWXP9* to successful (zero) in plant damage cutsets. This makes the existing turbine-driven AFW pump always successful. The new PDS frequencies are as follows:

SAMA No.	AEC	AEF	AEH	AEL	AL	ALC	ALFH	ALFL	SECH	SECL	SEF
159	2.25E-07	1.26E-07	1.19E-08	1.82E-07	3.02E-08	2.67E-08	3.21E-09	3.37E-07	3.89E-06	3.29E-06	2.76E-07

SEGH	SEH	SEL	SLCH	SLCL	SLFH	SLFL	SLH	SLL	TECH	TEFH	TEGH
1.28E-10	3.75E-06	8.84E-07	9.70E-06	1.65E-07	8.56E-06	2.46E-08	6.85E-06	2.31E-08	5.71E-07	1.80E-07	5.58E-08

TEH	TL	V	V2	Total	ΔCDF
9.41E-06	1.49E-05	1.07E-07	2.22E-06	6.58E-05	5.88E-06

The Source term categories for SAMA 159 are:

CET E.S (Source Term Category)	Base	SAMA 159
M1A	1.07E-07	1.07E-07
M1B	2.36E-06	2.33E-06
M2	0.00E+00	0.00E+00
M3	6.86E-07	6.74E-07
M4	0.00E+00	0.00E+00
M5	5.48E-06	5.10E-06
M6	1.37E-05	1.29E-05
M7	2.14E-05	1.93E-05
M8	1.71E-05	1.64E-05
M9	0.00E+00	0.00E+00
M10	0.00E+00	0.00E+00
M11	0.00E+00	0.00E+00
M12	1.08E-05	9.06E-06

The benefit calculation for SAMA 159 is:

Case->	SAMA 159
Offsite Annual Dose (Rems)	16.5355
Offsite Annual Property Loss ($)	$ 13,202
Comparison CDF	7.16E-05
Comparison Dose	17.4193
Comparison Cost	$13,707
Reduction in CDF	8.04%
Reduction in Offsite Dose	5.07%
Onsite Short Term Dose Savings (Best Est)	$409
Onsite Long Term Dose Savings (Best Est)	$1,784
Onsite Prop Cost Savings	$66,899
Total Onsite Benefit (without Replacement Power)	$69,093
Replacement Power Cost	$43,464
Total Onsite Benefit (with Replacement Power)	$112,556
Offsite Dose Savings	$19,025

Offsite Prop Cost Savings	$5,440
Total Offsite Benefit	$24,465
Total Benefit (Onsite + Repl Pwr + Offsite)	$137,022
Total Benefit without Replacement Power	$93,558
Total Benefit (Onsite + Repl Pwr + Offsite)*1.3	$178,128

SAMA 179: Automate RCP trip circuitry on loss of seal cooling - Provided a conservative, bounding estimate by setting the failure to trip the RCPs, basic event OAPRCPTRIP to successful (zero) in the plant damage cutsets. The new PDS frequencies are as follows:

SAMA No.	AEC	AEF	AEH	AEL	AL	ALC	ALFH	ALFL	SECH	SECL
179	2.25E-07	1.26E-07	1.19E-08	1.82E-07	3.02E-08	2.67E-08	3.21E-09	3.37E-07	3.72E-06	3.29E-06

SEF	SEGH	SEH	SEL	SLCH	SLCL	SLFH	SLFL	SLH	SLL	TECH
2.53E-07	1.28E-10	3.65E-06	8.74E-07	8.10E-06	0.00E+00	7.16E-06	1.19E-08	5.99E-06	2.20E-08	1.53E-06

TEFH	TEGH	TEH	TL	V	V2	Total	ΔCDF
3.94E-07	3.79E-07	1.36E-05	1.51E-05	1.07E-07	2.24E-06	6.74E-05	4.35E-06

The Source term categories for SAMA 179 are:

CET E.S (Source Term Category)	Base	SAMA 179
M1A	1.07E-07	1.07E-07
M1B	2.36E-06	2.35E-06
M2	0.00E+00	0.00E+00
M3	6.86E-07	6.22E-07
M4	0.00E+00	0.00E+00
M5	5.48E-06	5.36E-06
M6	1.37E-05	1.35E-05
M7	2.14E-05	1.94E-05
M8	1.71E-05	1.56E-05
M9	0.00E+00	0.00E+00
M10	0.00E+00	0.00E+00
M11	0.00E+00	0.00E+00
M12	1.08E-05	1.04E-05

The benefit calculation for SAMA 179 is:

Case->	SAMA 179
Offsite Annual Dose (Rems)	16.7337
Offsite Annual Property Loss ($)	$ 13,194
Comparison CDF	7.16E-05
Comparison Dose	17.4193
Comparison Cost	$13,707
Reduction in CDF	5.99%
Reduction in Offsite Dose	3.94%
Onsite Short Term Dose Savings (Best Est)	$305
Onsite Long Term Dose Savings (Best Est)	$1,329
Onsite Prop Cost Savings	$49,855
Total Onsite Benefit (without Replacement Power)	$51,490
Replacement Power Cost	$32,390
Total Onsite Benefit (with Replacement Power)	$83,880
Offsite Dose Savings	$14,758
Offsite Prop Cost Savings	$5,523
Total Offsite Benefit	$20,281
Total Benefit (Onsite + Repl Pwr + Offsite)	$104,161
Total Benefit without Replacement Power	$71,771
Total Benefit (Onsite + Repl Pwr + Offsite)*1.3	$135,409

The complete list of changes to the PRA model for the SAMA benefit calculations in Table F.3-2 follows:

SAMA No.	Potential Improvement	PRA Model Modification
3	Enhance Loss of RBCCW procedure to present desirability of cooling down RCS prior to seal LOCA.	Set basic events RCPSF, and %RB* in plant damage class cutsets to be successful.
8	Eliminate RCP thermal barrier dependence on RBCCW, such that loss of RBCCW does not result directly in core damage.	Set basic events %RB* in plant damage class cutsets to be successful.
10	Create an independent RCP seal cooling system, with dedicated diesel.	Set gate LOSC in master fault tree to be successful.
11	Create an independent RCP seal cooling system, without dedicated diesel.	Bounded by SAMA #10.

SAMA No.	Potential Improvement	PRA Model Modification
22	Improve ability to cool RHR heat exchangers.	Set basic events RB?HX* in plant damage class cutsets to be successful.
34	Install a containment vent large enough to remove ATWS decay heat.	Set basic events RT* in plant damage class cutsets to be successful.
35	Install a filtered containment vent to remove decay heat.	Set basic events CS* in plant damage class cutsets to be successful.
36	Install an unfiltered hardened containment vent.	Bounded by SAMA #35.
43	Create a reactor cavity flooding system.	Add containment release frequencies M5 and M7 to containment release frequencies M8 and M9 respectively and then set containment release frequencies M5 and M7 to zero.
44	Creating other options for reactor cavity flooding.	Bounded by SAMA #43.
75	Create a river water backup for diesel cooling.	Set basic events AC?DGDGH7??Q and ACCDGDH7AB?N in plant damage class cutsets to be successful.
77	Provide a connection to alternate offsite power source (the nearest dam).	Add to mutually exclusive logic a LOOP gate, which is an OR of the LOOP initiators %3LNPPC, %LNPGR, and %LNPW.
81	Install a fast acting MG output breaker.	Set basic events %DCBSB201* in plant damage class cutsets to be successful.
87	Replace steam generators with new design.	Set basic events %SGTR in plant damage class cutsets to be successful.
93	Additional instrumentation and inspection to prevent ISLOCA sequences.	Set the containment release category frequency M1A to zero and set the rest of the containment release category frequencies equal to those in the base case.
94	Increase frequency of valve leak testing.	Bounded by SAMA #93.
99	Ensure all ISLOCA releases are scrubbed.	Bounded by SAMA #93.
100	Add redundant and diverse limit switch to each containment isolation valve.	Bounded by SAMA #93.
123	Provide capability for diesel driven, low pressure vessel makeup.	Set basic events SI?P1* in plant damage class cutsets to be successful.
124_ 125	Provide an additional high pressure injection pump with independent diesel.	Set basic events HP?P2P41* and HP*MODP41* in plant damage class cutsets to be successful.
127	Implement an RWST makeup water source.	Set basic events RW?TK41*TN and RW1TKTRAINAQ in plant damage class cutsets to be successful.
150	Provide an additional I&C system (e.g., AMSAC).	Set basic events RTELEC and TTRIP in plant damage class cutsets to be successful.
159	Install turbine driven AFW pump.	Set basic events FWXP9* in plant damage class cutsets to be successful.
165	Install independent RBCCW/ESFRS AOV similar to 2-RB-68.1A.	Set basic event RB1AVH681ANN in plant damage class cutsets to be successful.

SAMA No.	Potential Improvement	PRA Model Modification
166	Install additional MD AFW pump.	Set basic events FW1P8FWP9A?N and FW2P8FWP9B?N in plant damage class cutsets to be successful.
170	Install redundant parallel valve equivalent to 2-CS-16.1A.	Set basic events CS1MVCS16ANN, CS1MVCS16ANQ, and CS1BKCS16AFF in plant damage class cutsets to be successful.
172	Add a redundant 125VDC bus equivalent to bus 201A and 201B.	Set basic events %LDCA, %LDCB, and DC?BSB201?FN in plant damage class cutsets to be successful.
173	Install diverse bypass valve around AOV's SW-8.1A/B/C.	Set basic events SW?AVSW81?MM, SW?AVSW81?NN, SWCAV81BCMMM, and SWCAV81BCONN in plant damage class cutsets to be successful.
174	Install redundant valve in line for backup to valve RB-8.1A/B.	Set basic event RB1AVRB81AFF in plant damage class cutsets to be successful.
175	Install redundant diverse bypass valve equivalent to 2-CS-16.1A/B.	Set basic events CS?MVCS16?NN, CS?MVCS16?NQ, CS?BKCS16?FF and CSCMVCS161NN in plant damage class cutsets to be successful.
176	Install additional SW AOV similar to SW-8.1A to provide a reliable flowpath.	Set basic event SW1AVSW81ANN in plant damage class cutsets to be successful.
179	Automate RCP trip circuitry on loss of seal cooling.	Set basic event OAPRCPTRIP in plant damage class cutsets to be successful.
182	Automate the start and alignment of the RBCCW pump.	Set basic event OAPRBPUMP in plant damage class cutsets to be successful.
183	Automate isolation feature of faulted SG.	Set basic event OASGI in plant damage class cutsets to be successful.
184	Install redundant AFW Reg valve following Reg valve FTO.	Set basic event OABYPASS in plant damage class cutsets to be successful.
185	Install redundant ESFRS fan equivalent to F-15B.	Set gates EVB023 and EVB025 as well as basic events EV1FNHV15ANQ, EV2FNHV15BNQ, and EVCFNF15ABNN in master fault tree to be successful.
186	Install diverse strainers L-1A, B, C to all 3 SW pump discharge lines to prevent CCF.	Set basic events %SWSTSWABCNF and SW?STSWL1?NF in plant damage class cutsets to be successful.
187	Automate start capability of Terry Turbine.	Set basic event OATDAFW in plant damage class cutsets to be successful.
189	Automate emergency boration of RCS.	Set basic event CHXAVCH192NN in plant damage class cutsets to be successful.
190	Install redundant line to RWST equivalent to 2-CH-192.	Set basic events CHXAVCH192NN and CHXSVCH192NN in plant damage class cutsets to be successful.
191	Add additional AFW bypass line with diverse reg valve to protect against CCF of existing valves 2-FW-43A and 43B.	Set basic events FW?AVFW43?N?, FW?AVFW43?FF, FW?SVFW43?NN, and FWCAVF43ABNN in plant damage class cutsets to be successful.

SAMA No.	Potential Improvement	PRA Model Modification
192	Install additional MOV on VCT outlet line similar to MOV-CH-501 for closure to assure boric acid flow to charging pump.	Set basic events CH1*501* in plant damage class cutsets to be successful.
193	Install additional AFW bypass line with diverse check valves and reg valves similar to check valves 2-FW-12A and 2-FW-12B and reg valves 2-FW-43A and 43B to SGs.	Set basic events FW?AVFW43?N?, FW?AVFW43?FF, FW?SVFW43?NN, FWCAVF43ABNN, FWCCVF12ABNN, and FWXCVF12??NN in plant damage class cutsets to be successful.
195	Add additional MOV around valves 2-RB-68.1A&B.	Set basic events RB1AVH681AN?, RB2AVHV81BN? and RBCAVR81ABNN in plant damage class cutsets to be successful.

Response to 7b.

SAMA 8 is described in the Environmental Report Table F.3-2 as eliminating the RCP seal dependence on RBCCW. While the intent of the SAMA may have been to provide a new, AC-powered cooling source to the RCP seals to back up RBCCW, a conservative, bounding calculation was performed by setting all RBCCW basic events (%RB*) to zero in the model. Therefore, besides making seal cooling always successful, all RBCCW events were also successful.

SAMA 10 is described as providing an independent, diesel-driven seal cooling system. The benefit was calculated by making the RCP seals (PRA gate LOSC) 100% successful in the model.

Both calculations are conservative, but the approach to SAMA 8 was overconservative because it affected more than just the RCP seals and because it made seal cooling successful even during an SBO. A more detailed analysis would lower the benefit dollar value. However, since the conservative benefit for SAMA 8 was only $156k, compared to a cost estimated at $5M-8M, no refinement of the conservatism was necessary.

Response to 7c.

Dominion agrees that the benefit calculated for SAMA 36 is unrealistically high, which is very conservative in terms of a SAMA analysis. Because the cost estimate of SAMA 36 was $10M to $15M, no benefit calculation was performed. Rather, the benefit calculation for SAMA 35 was utilized, as it would be bounding. SAMA 35 is identical to 36 except that the vent would filter any fission products released. Even the benefit calculation for SAMA 35 is conservatively high, as it was run by setting all containment spray basic events to zero in the model. This has the effect of both suppressing containment pressure (offsite dose benefit) and guaranteeing containment heat removal (a significant CDF benefit).

Comparing the cost of an unfiltered vent at Unit 2, or any PWR, with that of a BWR is something that Dominion would not typically do, since the designs of the BWR NSSS and containments are so different. The comparison does not seem appropriate. The cost rationale for SAMA 36 is detailed in Dominion's response to RAI #10. Also detailed in that response is discussion of an alternate means of venting containment via an existing pathway. This is, in fact already covered by an existing SAMG.

It should also be noted that, as discussed in the response to Millstone 3 RAI 4a, Dominion's cost estimate for a filtered hardened vent is consistent with that of NUREG-1152.

Response to 7d.

The bounding benefit from SAMA 93, which was applied to all ISLOCA sequences, is $22,062 ($44k after doubling to account for uncertainties), and the cost is $12-18M. A subset of the ISLOCA sequences would yield a smaller benefit, but even if the benefit stayed the same, it is still so small that it would be much less than the cost.

Response to 7e.

The 6% reduction in CDF was accomplished by setting basic event OAPRCPTRIP in plant damage class cutsets to be successful. In addition, there was an error in Table F.2-2, as discussed and corrected in the response to RAI 1f. The correct Fussell-Vesely for OAPRCPTRIP is 0.06. The correct top 30 cutsets are shown in response to RAI 1f.

RAI 8. A licensee for another CE plant identified the following six SAMAs as potentially cost-beneficial. These SAMAs or equivalents were not addressed in the SAMA analyses submitted for MPS2.

a. Modify procedures to conserve or prolong the inventory in the refueling water storage tank during SGTRs, including procedures to refill the tank

b. Add accumulators or implement training on refueling water storage tank bubblers and recirculation valves in order to prevent a premature recirculation actuation signal and ECCS pump damage due to inadequate net positive suction head

c. Add capability for steam generator level indication during a station blackout using a portable 120V AC generator

d. Provide a 480V AC power supply to open the power-operated relief valve and reduce the potential for temperature-induced SGTR, and high pressure melt ejection

e. Add capability to flash the field on the emergency diesel generator (using a portable generator) to enhance station blackout event recovery

f. Add manual steam relief capability and associated procedures to provide an alternate cooldown path to increase the capability of the plant to cope with ISLOCAs, SGTRs, and long-term station blackouts

Please provide a brief explanation regarding the applicability/feasibility of these SAMAs for MPS2. Also, SAMA 21 in the MPS2 evaluation ("Create procedure and operator training enhancements in support-system failure sequences, with emphasis on anticipating problems and coping") was deemed cost-beneficial at the other CE plant; however, Dominion eliminated it from further consideration because the SAMA had been implemented or the intent was met. Please explain in more detail how this SAMA was implemented or how the intent of this SAMA was met.

Dominion Response to RAI 8

Response to 8a.

EOP's at Unit 2 for SGTR are written to cool the Unit down to isolate the affected Steam Generator and then depressurize the RCS to within 50 psid of the Affected Steam Generator in order to reduce the amount of Safety Injection flow as quickly as possible and to reach Safety Injection Termination Criteria. This will thereby reduce inventory loss of the RWST. It is highly unlikely that the RWST would be emptied during an SGTR. This is consistently demonstrated through training and examination on the plant simulator. Alternate methods to refill the RWST are as follows:

Chemical and Volume Control System procedure– Normal make up flow path to RWST from PMW and Boric Acid Storage Tanks (BAST's). As the BAST's will probably be empty (<10% level) during CTMT recirculation the makeup would consist of only PMW.

Spent Fuel Pool Cooling and Purification procedure gives direction on how to fill the RWST from the Spent Fuel Pool using the purification pumps. There are several sources of make-up water to the Spent Fuel Pool:

a. Direct PMW fill;
b. Pumping Cask Laydown Pit to RWST;
c. Filling SFP from Aux Feed;
d. Fill with Fire Hoses.

Coolant Waste System procedure describes how to transfer the contents of the Coolant Waste Receiver Tanks to the RWST.

Shutdown Cooling System procedure allows alignment of the LPSI pumps with a suction from the SFP to the LPSI Injection Header. LPSI pumps are automatically secured on a Sump Recirc Signal.

Response to 8b.

MP2 does not have RWST Bubblers. The ESAS Recirculation valves are supplied with accumulators that are tested on a periodic basis per existing procedure. Operators receive training to ensure that SRAS is never manually actuated unless the Automatic Setpoint is exceeded. Also, the automatic initiation setpoint value already accounts for any instrument uncertainties, such that early auto-initiation would not occur.

Response to 8c.

The Wide Range Steam Generator Level indications are powered from Vital 120v sources VA-10 and 20. These buses are powered from the respective battery buses. Each Steam Generator has an indicator from both power sources. To supply temporary power to these buses would require the installation of a disconnect switch (Plant Modification) and purchasing a temporary generator to connect to the buses. This would also require a new Severe Accident Management Guideline. The benefit of this SAMA, after doubling, would be approximately $23K. The cost, including all engineering associated with a minor plant modification, development of a SAMG, field verification and incorporation into training, would exceed $130K. Therefore, this SAMA would not be cost beneficial.

Response to 8d.

MP2 has Pilot Operated Relief Valves, not Power Operated Relief Valves. These valves are powered from DC, not AC. Installation of a 480 vac source would not be of any benefit. The PORV Block valves are 480vac MOV's that are normally open.

Response to 8e.

The D/G field is normally flashed from the DC Bus. This would likely require a plant modification to install a disconnect to allow connecting a temporary generator whose output would be rectified to D.C. This would also require a new Severe Accident Management Guideline. If a plant modification were required, the cost of approximately $130K would exceed the expected benefit of $23K. If this can be accomplished via a SAMG, without a plant modification, this mitigation strategy will be incorporated when unit-specific SAMGs are developed.

Response to 8f.

At MP2, the Atmospheric Dump Valves (ADV's) can be operated manually at the valve. This Operation is outlined in an existing EOP. This operation requires NO power or air.

As for how SAMA 21 is implemented at MP2, EOP Training and construction are designed to provide major milestones/ success paths in the place keeping section of the procedures. If it is apparent during a transition brief of the crew that the milestones cannot be met, the plant conditions are reevaluated to determine the correct success path.

RAI 9. For certain SAMAs considered in the ER, there may be lower-cost alternatives that could achieve much of the risk reduction at a lower cost. In this regard, please provide the following:

a. For the subset of plant-specific SAMAs identified in Table F.3-1 and for the Phase 2 SAMAs, discuss whether any lower-cost alternatives to those considered in the ER would be viable and potentially cost-beneficial.

b. A plant has recently installed a direct-drive diesel to power an auxiliary feed water (AFW) pump for under $200K. Please provide the averted-risk benefit of supplemental AFW capability at MPS2, and an assessment of whether such a SAMA could be a cost-beneficial alternative to an additional motor-driven or turbine driven pump (SAMAs 159 and 166).

Dominion Response to RAI 9

Response to 9a.

After reviewing the plant-specific SAMAs from Table F.3-1, and the Phase 2 SAMAs from Table F.3-2, several lower-cost alternatives have been identified. Some are covered in the existing plant Severe Accident Management Guidelines (SAMGs), and others may be candidates for use in an extreme emergency, provided the Technical Support Center of the Station Emergency Response Organization (SERO) evaluates their viability versus plant conditions at the time. Others may be lower-cost, but could not be considered without a comprehensive safety evaluation and installation of equipment that would prevent additional risk to the plant. Following are the alternatives considered:

- **Alternative to SAMA 22: Installing a RBCCW header cross-tie.** While the cost of installing an actual cross-tie would far exceed the benefit associated with this SAMA, MPS2 currently has a cross-tie installed. This cross-tie could be used in the event of an emergency, following an appropriate evaluation by the Technical Support Center of SERO.

- **Alternative to SAMA 36: Use of hydrogen purge system as an unfiltered hardened containment vent.** The hydrogen purge system exists and, assuming containment pressure remains within system parameters, could be used for non-ATWS decay heat removal. System operation is already covered by an Emergency Operating Procedure (EOP).

- **Alternative to SAMA 43 and 44: Use of existing systems to flood reactor cavity.** Under severe accident conditions, existing plant systems, such as containment spray, could be used to flood the cavity. This would be performed under an existing SAMG, under the direction of the Technical Support Center of SERO.

- **Alternative to SAMA 127: RWST makeup.** MPS2 has a procedure for RWST makeup, which could be used during an emergency.

- **Alternative to SAMA 159: Use of Diesel Fire Pump as backup to Turbine Driven Aux Feedwater Pump.** Under low system pressure circumstances, the Diesel Fire Pump can be aligned to pump water into the steam generators. This is covered by an existing SAMG, and could be accomplished under guidance provided by the Technical Support Center of SERO for system pressure reduction and initiation of pump.

Response to 9b.

It is Dominion's understanding that the plant being referred to had purchased a diesel pump "for scrap" more than ten years ago, and that it had been installed at that time to address an AFW redundancy issue that Millstone does not have. It is also Dominion's understanding that it was installed as non-safety grade, and that the $200K figure may have included the installation of the pump, but many of the actual costs of connecting to the system, including the engineering, were not included in that figure.

Millstone 2 does not have the room or proper ventilation capability to place a diesel engine in the present location of the Aux Feedwater Pumps. In order to install a new diesel pump as a backup (assuming that the pump itself is not required to be Category 1), the following equipment would be required:

1. The pump itself, including either a self-enclosed fuel storage tank or a separate fuel tank;
2. A separate building or enclosure;
3. A significant run of piping from pump to feedwater piping, some of which would have to be Category 1;
4. A new run of piping from the water source to the new pump;
5. Redundant isolation valves between the seismic and non-seismic portions of the piping.

In addition to the above equipment, the following would also be required:

1. Extensive engineering for the installation and operation of the pump and support equipment;
2. A new Emergency Operations Procedure (EOP)
3. Incorporation into training
4. Regular surveillance and maintenance of the new diesel and other equipment.

While it is possible that several of the above items were not included in the $200,000 cost at the other plant, they are, in fact, a part of the cost of installing such equipment at Millstone. The cost of this option at Millstone, if done in accordance with station practices, would exceed several million dollars.

It should be noted that, as described above in the response to RAI 9a, Millstone 2 currently has a Severe Accident Management Guideline for using the Diesel Fire Pump to send water to the auxiliary feedwater system. This pump provides the backup that would be accomplished by this additional pump.

RAI 10. The costs of many SAMAs appear to be over estimated. Provide an explanation/justification for some of the high costs for those SAMAs that have significant benefits, e.g.:

- SAMA 36 unfiltered hardened vent @ $10M - $15M
- SAMA 44 options for flooding reactor cavity @ $18M - $24M

Dominion Response to RAI 10

The following table provides more detailed discussion of the components and activities that were considered in estimating costs of those Table F.3-2 SAMAs for which the benefit was determined to be $50,000 or more.

These cost estimates were based on known costs of similar or other existing projects, and were made with the collaborative input of:

- Two operations shift managers with more than 50 years of collective operations experience;
- Two senior engineering professionals with more than 50 years of engineering experience, including extensive project management expertise;
- A senior nuclear project controls specialist with more than 20 years of experience in cost estimating.

In cases involving actual equipment installation, the elements involved were determined using the intent of the SAMA analysis. For example, in instances involving the creation of a new penetration through containment, or new equipment or components installed in containment or other Category 1 areas, the system was designed in a manner to minimize the introduction of new risk to the plant. For many SAMAs, it would be counterproductive to contemplate less robust alternatives, and would introduce additional risk that would affect the very benefit the SAMA is attempting to achieve.

In those instances where less robust alternatives would not violate the intent of the SAMA, those alternatives are discussed. If the alternative substantially changed the cost estimate, it is discussed above, in the response to RAI 9a.

It is also important to note that the actual installation of new equipment does not end the cost associated with a particular SAMA. The new equipment often generates a need for procedure changes and operator training. It also creates new surveillance, calibration and maintenance requirements for the duration of plant operations, all of which are part of the cost of instituting the SAMA. Dominion believes that these all are appropriately considered in the cost/benefit analysis.

<table>
<tr><th>SAMA Number</th><th>Potential Improvement</th><th>Discussion</th><th>Benefit (bounding)</th><th>Cost Estimate And Basis For Conclusion</th></tr>
<tr><td>3</td><td>Enhance Loss of RBCCW procedure to ensure cool down of RCS prior to seal LOCA</td><td>Potential reduction in the probability of RCP seal failure. The RBCCW provides seal, thermal barrier, upper and lower bearing cooling for the RCP's</td><td>$173,337</td><td>Estimate Range: $100,000 - $200,000 Cost beneficial, since benefit is within estimated cost range.</td></tr>
<tr><td colspan="5">Cost estimate includes participation in industry effort; procedure modification, including safety review; incorporation of procedure changes into operator training program, plus periodic training. Total engineering person-hours: 2,000.</td></tr>
<tr><td>8</td><td>Eliminate RCP thermal barrier dependence on RBCCW, such that loss of RBCCW does not result directly in core damage.</td><td>Would prevent loss of RCP seal integrity after a loss of RBCCW. Watts Bar IPE said this could be done with SW connection to charging pump seals. Notes: Assumes separate cooling train</td><td>$155,543</td><td>Estimate Range: $5M - $8M Not cost beneficial: since cost is greater than twice the benefit.</td></tr>
<tr><td colspan="5">This would require a new and separate seal cooling system, independent of RBCCW (essentially the same as SAMA 11 below). Such a system would entail piping, heat exchanger, cooling source (e.g., new tie-in to service water), redundant isolation valves, new wiring, instrumentation and controls. System inside containment (at a minimum) would be required to be seismic, Category 1. Would also include new requirements for regular surveillances, instrument calibration, safety analysis, and incorporation into training.</td></tr>
<tr><td>10</td><td>Create an independent RCP seal cooling system, with dedicated diesel</td><td>Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling or SBO. Notes: Based on ranges for similar projects inside Containment</td><td>$135,409</td><td>Estimate Range: $6M - $10M Not cost beneficial: since cost is greater than twice the benefit.</td></tr>
<tr><td colspan="5">Such a system would entail piping, heat exchanger, cooling source (e.g., new tie-in to service water), redundant isolation valves, new wiring, instrumentation and controls. System inside containment (at a minimum) would be required to be seismic, Category 1. New diesel would require piping runs from diesel to new system, plus diesel housing. Would also include new requirements for regular surveillances, instrument calibration, safety analysis, and incorporation into training.</td></tr>
</table>

SAMA Number	Potential Improvement	Discussion	Benefit (bounding)	Cost Estimate And Basis For Conclusion
11	Create an independent RCP seal cooling system, without dedicated diesel	Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling, but not SBO.	$135,409	Estimate Range: $5M - $8M Not cost beneficial: since cost is greater than twice the benefit.
Such a system would entail piping, heat exchanger, cooling source (e.g., new tie-in to service water), redundant isolation valves, new wiring, instrumentation and controls. System inside containment (at a minimum) would be required to be seismic, Category 1. Would also include new requirements for regular surveillances, instrument calibration, safety analysis, and incorporation into training.				
34	Install a containment vent large enough to remove ATWS decay heat	Assuming injection is available, would provide alternative decay heat removal in an ATWS.	$204,311	Estimate Range: $10M - $15M Not cost beneficial: since cost is greater than twice the benefit.
Because of the magnitude of ATWS decay heat, this would require engineering, design and installation of a large piping system through containment. New containment penetration would require redundant isolation valves, entire system would require seismic design, safety analysis. New wiring to control room, which requires cable tray analysis. New instrumentation, which requires periodic maintenance. New or modified procedures, and incorporation into training.				
35	Install a filtered containment vent to remove decay heat	Assuming injection is available (non-ATWS sequences), would provide alternate decay heat removal with the released fission products being scrubbed.	$414,336	Estimate Range: $12M - $18M Not cost beneficial: since cost is greater than twice the benefit.
Although the magnitude would be less than for SAMA 34, this would still require engineering, design and installation of a piping system through containment. New containment penetration would require redundant isolation valves, entire system would require seismic design, safety analysis. New filter system. New wiring to control room, which requires cable tray analysis. New instrumentation, which requires periodic maintenance. New or modified procedures, and incorporation into training. A potential alternate currently exists via the hydrogen purge system, and is covered under the plant's Emergency Operating Procedures. This would not involve any additional cost, and constitutes "already implemented" status.				

<table>
<tr><th>SAMA Number</th><th>Potential Improvement</th><th>Discussion</th><th>Benefit (bounding)</th><th>Cost Estimate And Basis For Conclusion</th></tr>
<tr><td>36</td><td>Install an unfiltered hardened containment vent.</td><td>Provides an alternate decay heat removal method (non-ATWS), which is not filtered.</td><td>$414,336</td><td>Estimate Range: $10M - $15M Not cost beneficial: since cost is greater than twice the benefit.</td></tr>
<tr><td colspan="5">This would require engineering, design and installation of a piping system through the containment wall. New containment penetration would require redundant isolation valves, entire system would require seismic design, safety analysis. New wiring to control room, which requires cable tray analysis. New instrumentation, which requires periodic maintenance. New or modified procedures, and incorporation into training.

A potential alternate currently exists via the hydrogen purge system, and is covered under the plant's Emergency Operating Procedures. This would not involve any additional cost, and constitutes "already implemented" status.</td></tr>
<tr><td>43</td><td>Create a reactor cavity flooding system</td><td>Would enhance debris coolability, reduce core concrete interaction and provide fission product scrubbing.</td><td>$84,732</td><td>Estimate Range: $18M - $24M Not cost beneficial: since cost is greater than twice the benefit.</td></tr>
<tr><td colspan="5">Assumes a new source of water (new, large capacity storage tank), new containment penetration, redundant isolation valves, seismic piping inside containment, new instrumentation, cables to control room, cable tray analysis, safety analysis, new or modified procedures, incorporating into training, regular maintenance of system.

If one assumes using existing equipment in a severe accident situation, Millstone 2 SAMGs currently have a provision for this option. The SAMG would rely on the Technical Support arm of the Station Emergency Response Organization to provide information on available options during the evolution.</td></tr>
<tr><td>44</td><td>Creating other options for reactor cavity flooding</td><td>Flood cavity via systems such as diesel driven fire pumps.</td><td>$84,732</td><td>Estimate Range: $18M - $24M Not cost beneficial: since cost is greater than twice the benefit.</td></tr>
<tr><td colspan="5">Same assumptions for SAMA 43 were used in this analysis.

If one assumes using existing equipment in a severe accident situation, Millstone 2 SAMGs currently have a provision for this option. The SAMG would rely on the Technical Support arm of the Station Emergency Response Organization to provide information on available options during the evolution.</td></tr>
</table>

SAMA Number	Potential Improvement	Discussion	Benefit (bounding)	Cost Estimate And Basis For Conclusion
77	Provide a connection to alternate offsite power source (the nearest dam).	Increase offsite power redundancy	$234,886	Estimate Range: $6M - $10M Not cost beneficial: since cost is greater than twice the benefit.
Assumes dedicated poles & overhead HV line approx 20 miles to Hydro facility at Norwich via existing right of ways. Includes transformers, breakers, etc. Assumes all necessary right of ways exist no clearing or access fees required.				
87	Replace steam generators with new design	Lower frequency of SGTR	$126,876	Estimate Range: $200M - $250M Not cost beneficial: since cost is greater than twice the benefit.
Based on actual costs from Unit 2 replacement: $200M actual in 1992				
124/125	Provide an additional high pressure injection pump with independent diesel	Reduce frequency of core melt from small LOCA sequences, and from SBO sequences.	$286,137	Estimate Range: $10M - $16M Not cost beneficial: since cost is greater than twice the benefit.
Room not available in existing buildings. This would require new, seismic building for pump and diesel, Category 1 pump and diesel, new piping from pump to RCS, new containment penetration, redundant isolation, seismic supports for entire system inside containment, new cables to control room, cable tray analysis, new or modified procedures, incorporation into training, regular system maintenance. **Placing the additional train of equipment in a non-seismic building would reduce the cost to approximately $8M-$14M.**				
150	Provide an additional I&C system (e.g., AMSAC).	Improve I&C redundancy and reduce ATWS frequency. Currently MPS2 only has the ATWS system in place. The ATWS system only trips the plant i.e. drops rods and starts the AFW pumps. AMSAC in addition to the above will also trip the main turbine.	$177,909	Estimate Range: $600,000 - $2M Not cost beneficial: since cost is greater than twice the benefit.
Adding an additional system would require: the new system itself, which could cost $1 million, installation, testing, etc., power to system, new controls, instrumentation; regular system testing, calibration and maintenance; new or modified procedures, modified training.				

SAMA Number	Potential Improvement	Discussion	Benefit (bounding)	Cost Estimate And Basis For Conclusion
159	Install turbine driven AF pump	Additional TDAFW pump would provide a backup to existing pump.	$178,128	Estimate Range: $12M - $16M Not cost beneficial: since cost is greater than twice the benefit.
Room not available in existing buildings. This would require new, seismic building for pump and diesel, Category 1 pump, new piping from pump to feedwater piping, new cables to control room, cable tray analysis, new or modified procedures, incorporation into training, regular system maintenance. Placing the pump in a non-seismic building would reduce the expense, but cost would still be $10M-14M. Note: The Diesel Fire Pump is capable of sending water to the auxiliary feedwater system under low system pressure circumstances, and this is covered in the Millstone 2 SAMGs.				
170	Install redundant parallel valve equivalent to 2-CS-16.1A.	This additional parallel valve would provide additional flow path for the CS and HPSI pumps during containment swapover in recirculation mode.	$146,859	Estimate Range: $2M - $5M Not cost beneficial: since cost is greater than twice the benefit.
This would require the installation of large piping and valves in an area that does not have extra space. This would also require engineering, design and installation of new piping, large gate valves, cables, instrumentation, cable tray analysis, safety analysis, and a modified procedure.				
173	Install diverse bypass valve around AOV's SW-8.1A/B/C	CCF of 2/3 SW AOV's SW-8.1A/B/C to open	$175,003	Estimate Range: $1M - $3M Not cost beneficial: since cost is greater than twice the benefit.
This would require engineering, design and installation of new piping, valves, cables, seismic supports, instrumentation, cable tray analysis, and safety analysis.				
174	Install redundant valve in line for backup to valve RB-8.1A/B	Air operated valves RB-8.1A/B fail to close due to mechanical failure	$74,872	Estimate Range: $2M - $4M Not cost beneficial: since cost is greater than twice the benefit.
This would require new valves in series with each existing valve, seismic supports, controls, procedure changes, training incorporation, regular system surveillance and maintenance. In addition, the new equipment would introduce additional risk, thus decreasing the actual benefit.				

SAMA Number	Potential Improvement	Discussion	Benefit (bounding)	Cost Estimate And Basis For Conclusion
175	Install redundant diverse bypass valve equivalent to 2-CS-16.1A/B.	CCF of 2/2 CS MOV's 2-CS-16.1A&B to open on demand Notes: Assumes DCP, valve, piping	$338,405	Estimate Range: $2M - $5M Not cost beneficial: since cost is greater than twice the benefit.
Would require installation of large piping and valves in an area that does not have extra space. Would require Engineering, design and installation of new piping, large gate valves, cables, instrumentation, cable tray analysis, safety analysis, modified procedure.				
179	Automate RCP trip circuitry on loss of seal cooling.	Operator fails to trip the RCP's.	$135,409	Estimate Range: $3M - $5M Not cost beneficial: since cost is greater than twice the benefit.
In this instance, a major overhaul of reactor coolant pump trip logic would be required. This would include redundant channels, controls, wiring, procedures, training, and regular system calibration, surveillance and maintenance.				

RAI 11. SAMA 3 is identified as being in the range of being cost-beneficial, but is deferred to Dominion's following of industry efforts. Briefly describe the expected resolution and when it might be implemented.

The resolution of this issue is expected to be either a new procedure or procedure modification that will require actions to prevent/mitigate a seal LOCA upon loss of RBCCW. It is anticipated to be implemented before the period of extended operation, and is being addressed under the current license.

Attachment 2

Response to Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives (SAMA) for Millstone Power Station (MPS) Unit 3

RAI 1. The SAMA analysis is based on the "current" version of the Millstone Probabilistic Risk Analysis (PRA), which is a modification to the Individual Plant Examination (IPE) submittal. Please provide the following information regarding the PRA model used for the SAMA analysis:

a. Indicate which revision was used for the SAMA analysis (i.e., provide a date or revision number).

b. Provide a description of the internal and external peer review of the level 1, 2, and 3 portions of the PRA used for the SAMA analysis

c. Provide a description of the overall findings of the Peer Review (by element) and discussion of any elements rated low (e.g., rated less than a 3 on a scale of 1 to 4 or rated a conditional 3) or any facts and observations (e.g., A and B Facts and Observations) that could potentially affect the SAMA identification and evaluation process, and how Dominion has addressed these findings for this application (including for example sensitivity studies).

d. For each model revision listed in Table G.2-1, provide the approximate CDF and large early release frequency (LERF), and a description of the major hardware and/or Level 1/Level 2 modeling changes from the prior version. Specifically, identify and discuss any changes made to address the weaknesses identified in the NRC staff SER on the MPS3 IPE. Include a description of the major differences between the PRA version peer reviewed in 1999 and the PRA used for the SAMA analysis.

e. Provide a breakdown of the internal event CDF by accident class, specifically include the contribution from station blackout, anticipated transient without scram (ATWS), and internal flooding.

f. Provide the plant damage states for each of the top 30 cutsets in Table G.2-2.

g. Describe any credit taken for equipment in either Units 1 or 2 and the assumptions concerning this equipment's availability as a result of conditions at the other unit.

h. Attachment E, Section G.1.2.2 indicates that source terms were generated for the dominant core damage sequences presented in the IPE. Since the dominant sequences probably have changed since the IPE, for each release category identify the dominant sequences and their frequencies, and the sequence on which the source terms are based. If the sequence

used to generate the current source terms is not the dominant sequence for each category, please discuss and justify.

I. ***Provide an explanation of why all early failures are zero for Unit 3.***

Dominion Response to RAI 1

Response to 1a.

For Plant Specific SAMA Identification:
Model #M3990927, Calculation #PRA95YQA-01127S3, "MP3 Final Quantification", Rev. 4, Oct. 1999.

For SAMA ΔCDF Quantification:
Model #M3021001, Calculation #PRA02YQA-01822S3, "Millstone 3 PRA Model", Rev. 0, Oct. 2002.

Response to 1b.

The PRA external peer review process, performed in 1999, was a one-time evaluation of the then current PRA model and its maintenance and update methods. This review followed a process adapted by the Westinghouse Owners Group (WOG) from the review process that was originally developed and used by the Boiling Water Reactor Owners Group (BWROG)[1] and subsequently broadened to be an industry-applicable process, through the Nuclear Energy Institute Risk Applications Task Force. This review was conducted under WOG sponsorship as part of a program to perform such reviews for operating domestic WOG member plants. The PRA Peer Review team assigned grades to the various technical elements of the PRA. The grades denote the relative capability of the technical elements for use in PRA applications. The overall objective of the peer review process was to provide a method for establishing the technical quality and adequacy of a PRA for a spectrum of potential risk-informed plant applications for which the model may be used. The table below describes the Peer Review Team and their positions within the nuclear industry.

Reviewer Affiliation	Reviewer Degree	Industry Experience	Years PRA Experience
Pacific Gas & Electric	M.S. Mechanical Engineering	19	16

1 BWROG-97026, "Transmittal of BWR Owners' Group Document, 'PRA Peer Review Certification Implementation Guidelines,'" Boiling Water Reactor Owners Group, January 31, 1997.

Reviewer Affiliation	Reviewer Degree	Industry Experience	Years PRA Experience
NAESCO	M.S. Physics M.S. Nuclear Engineering	19	17
Commonwealth Edison	MME Mechanical Engineering	27	7
Erin Engineering & Research	M.S. Nuclear Science and Engineering	27	25
Scientech	B.S. Nuclear Engineering MBA Management	21	16
Westinghouse Electric	M.S. Mechanical Engineering	24	15

The general scope of the PSA Peer Review included review of eleven main technical elements for the at-power PRA. These were: initiating events, accident sequence analysis, thermal hydraulic and system analysis, data and dependency analysis, human reliability, structural analysis, quantification process, Level 2 (containment) analysis and PSA maintenance an update process. Internal peer reviews are performed routinely in accordance with Appendix B program whenever a model update is necessary.

Response to 1c.

Table 1 below provides the overview of the peer review comments for level A and B comments (lower level comments are not included since they are deemed less significant to the overall quality of the PSA). Table 2 lists the level A and B peer review comments and evaluates their impact on the SAMA analysis. It is anticipated that the remaining comments will be resolved in the next model upgrade.

Note: References to "NU" in reviewer comments refer to Northeast Utilities, the owner and operator of the plant at the time of the peer review.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis If Comment Not Incorporated
Initiating Events (IE)	An initiating event dependency matrix would be useful to document the impacts of initiators and to show why initiators were grouped. The loss of SW initiator model should be evaluated to ensure that it is as realistic as possible. Consideration should be given to evaluating the effects of a loss of ventilation initiator.	Negligible impact on the SAMA analysis. A dependency matrix is a modeling aid and therefore, would have no quantitative impact on the SAMA analysis. The loss of SW initiator was deemed overly conservative by the peer review. Incorporating the comments led to a reduction in CDF. Adding a loss of ventilation initiator is not expected to be a significant CDF contributor since the ventilation system failure that would trip the plant would have no impact on equipment credited with mitigating a general plant transient.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
Accident Sequence Evaluation (event trees) (AS)	Either reconstruct the technical bases of the accident sequence model from the Probabilistic Safety Study (PSS) or develop new bases from new thermal hydraulic analyses using MAAP and other appropriate engineering calculations. The updated documentation should be enhanced to address all the technical issues discussed above and in the Fact and Observation sheets for this Probabilistic Risk Assessment (PRA) element.	Negligible impact on the SAMA analysis. A technical basis was ultimately developed for the dominant contributors to CDF; station blackout/RCP seal LOCA and small LOCA. The success criteria for the remaining scenarios were reviewed against other Westinghouse units and deemed reasonable. Incorporating the new success criteria led to a reduction in CDF as the previous criteria were determined to be overly conservative. A reduction in CDF would yield lower dollar values in the benefit calculations.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis If Comment Not Incorporated
Thermal Hydraulic Analysis and Other Eng. Calculations (TH)	Update/upgrade all success criteria analyses that have been carried over from the PSS (contingent grade item). Clarify the definition of core damage for the entire PRA, and consider adopting a criterion such as MAAP 4 hot node temperature less than 1200°F, for consistency with the EOP/SAMG transfer criterion on core exit thermocouple temperature, and to avoid the need to consider clad oxidation calculations. Create a success criteria notebook or notebook section that includes, for each criterion specified, an indication of the MAAP run number or reference to other supporting calculations, and also an indication of all the corresponding master fault tree identifier(s) (or event tree branch names) where the success criterion is applied.	Negligible impact on the SAMA analysis. A technical basis was ultimately developed for the dominant contributors to CDF using an ASME PRA Standard definition of core damage; station blackout/RCP seal LOCA and small LOCA. The basis resides in a Dominion calculation that documents all the success criteria and corresponding MAAP runs. The remaining scenarios were reviewed against other Westinghouse units and deemed reasonable. Incorporating the new success criteria led to a reduction in CDF as the previous criteria were determined to be overly conservative. A reduction in CDF would yield lower dollar values in the benefit calculations. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis If Comment Not Incorporated
System Analysis (SY)	Specific recommendations have been noted in the F&O sheets. In addition, NU should continue actions previously planned (new MAAP runs, etc), and review all spatial dependencies.	Negligible impact on the SAMA analysis. New MAAP runs were performed, as described above. Regarding spatial dependencies, Unit 3 has 5 buildings which house the risk significant PRA-credited equipment: 1) The intake structure houses the 2 SW trains consisting of two 100% capacity pumps per train. The trains are compartmentalized and therefore, have no spatial dependency. 2) The control building consists of four floors of equipment. The two 4160VAC emergency switchgear and associated load centers and DC switchgear are on the lower elevation. The cable spreading area is on the next elevation. The control room is the next elevation and the control building ventilation system is on the top floor. Each emergency switchgear train is contained in its own room. One of the switchgear rooms has a service water pipe encased within another pipe that would contain any leakage. Each switchgear room has two ventilation pipes routed such

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
System Analysis (SY) (Cont.)		that no equipment is expected to be impacted by spray effects. 3) The emergency diesel enclosures are separate structures divided by train. 4) The auxiliary building houses charging and RPCCW pumps within the same room. However, the pumps are on opposite sides of the room with the 3 charging pumps each housed in their own cubicle. The charging pumps provide the high head safety injection function, in addition to the normal charging functions. A diverse method of ECCS injection and recirculation exists in a separate building. 5) The ESF building houses the AFW, HPSI, RHR, Quench Spray, and RSS pumps. Each AFW pump is contained in its own cubicle. The RSS trains have their own compartments. One HPSI, RHR, and Quench Spray pump is housed in the same room. The RHR pump at Unit 3 only serves the LPSI function as the RSS pumps provide the sump recirculation function.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis If Comment Not Incorporated
Data Analysis (DA)	Implement the new common cause failure methods/data described in the current procedure (after updating in response to comments provided). Consider other minor comments provided in the Fact & Observation Sheets.	Negligible impact on the SAMA analysis. Incorporating the latest CCF method is not expected to significantly impact the CDF or the dominant contributors. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
Human Reliability Analysis (HR)	Follow the Millstone HRA guidance document. Include Type A errors, especially where multiple trains and/or systems may be affected. The methodology described in the guidance document should be implemented fully for all risk significant actions. The HRA screening values used in the model seem to be too low to be considered as screening values.	Negligible impact on the SAMA analysis. Including more Type A errors is not expected to identify any significant CDF contributor. Millstone 3 has a high degree of redundant and diverse systems. The most significant latent error, which is to inadvertently isolate the RWST, is included. The post-initiator HRA is structured such that no dependencies exist within the quantification, which is why the screening values appeared low to the reviewers. Subsequent calculation of HEPs using the latest methods revealed that the screening values are acceptable.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
Dependency Analysis (including internal flooding) (DE)	The bases for addressing or not addressing spatial dependencies should be reviewed, brought up to date, and documented. Examples of spatial dependencies include High Energy Line Break (HELB) effects, flooding, spray effects.	Negligible impact on the SAMA analysis. These issues are not significant contributors to CDF at Unit 3 due to its physical layout, as described in the response to the SY element.
Structural Response (ST)	Update the Level 2 containment performance analysis, the Inter System Loss of Coolant Accident (ISLOCA) analysis, include pressurized thermal shock, and model Reactor Pressure Vessel (RPV) rupture events.	Negligible impact on the SAMA analysis. Westinghouse performed a detailed Level-2 PRA analysis for Millstone Unit No. 3. The analysis included containment structural response as well as potential severe accident phenomena and their uncertainties. Since the state of knowledge of severe accident phenomenology did not advance substantially over the years since the Westinghouse study for Unit No. 3, the impact of not updating the Level 2 study is judged to be negligible.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
Quantification (QU)	Ensure PRA software versions have appropriate capabilities. Review dominant sequences for excessive conservatism and compare PRA results to those of similar plants to ensure consistency. Perform truncation studies and sensitivity studies to validate the model's results and perform at least a qualitative evaluation of uncertainties.	Negligible impact on the SAMA analysis. The latest versions of EPRI Risk and Reliability software tools were used. Truncation and sensitivity studies were not performed; however, doubling the benefit compensates for this model uncertainty.
Containment Performance Analysis and LERF (L2)	The Large Early Release Frequency (LERF) capability should be updated. Options include using NUREG/CR-6595 or a full scope update using MAAP 4.0. The plant damage states and Level 1/Level 2 interface will also have to be revised.	Negligible impact on the SAMA analysis. LERF is not applicable for the SAMA application. The discussion regarding the level 2 analysis is contained within the ST element.

Table 1—Peer Review Comments by Element

Peer Review Element	Recommended Enhancement	Comment Disposition/Impact on SAMA Analysis if Comment Not Incorporated
Maintenance and Update Process (MU)	The process of model updates should include at least two key elements: a review of changes to the plant and operating experience and a rigorous review and validation of the results.	Comment resolved. All plant modifications to Maintenance Rule risk significant systems are procedurally required to be reviewed by the PRA section. The PRA analysis, which forms the basis of the submittal, was completed by an engineering calculation that included an independent reviewer and approver.

Table 2—Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.1) The event sequences generally reflect dependencies among top events. However, in at least one instance, the success criteria for a top event did not appear to reflect the dependency on success of failure of the previous event: in the SGTR event tree, the AFW success criterion appears to be the same regardless of success or failure of the previous event (SG isolation function). This does not appear to be correct. (AS-15)	No actions required. The peer reviewer was not familiar with the fault tree linking approach to modeling various success criteria within one system analysis.	No impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.2) Common cause failures and test & maintenance unavailabilities are modeled in the fault trees. However, operator errors within and across trains (e.g., equipment misposition/miscalibration errors) and false instrument signals were not observed in the models. NU has indicated that it plans to include such modeling, however. **(SY-4)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Including more Type A errors is not expected to identify any significant CDF contributor. Millstone 3 has a high degree of redundant and diverse systems. The most significant latent error, which is to inadvertently isolate the RWST, is included.
A.3) While there is guidance to consider and include Type A in the system fault trees, the process of implementing this guidance in support of the current update is still in progress and has only been implemented for a couple of human interaction modes for the RHR and SIH systems. **(HR-1)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Including more Type A errors is not expected to identify any significant CDF contributor. Millstone 3 has a high degree of redundant and diverse systems. The most significant latent error, which is to inadvertently isolate the RWST, is included.

Table 2—Individual Peer Review Comments

Peer Review Level A Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
A.4) While there is guidance to perform more detailed HRA on risk significant actions following the screening evaluation, the current PRA update has performed a detailed HRA for only one class of actions: Operators fail to switch ECCS from injection phase to recirculation phase following Large, Medium, or Small LOCA. (HR-3)	A detailed quantification of all post-initiators has been performed, and was included in the version of the model used for SAMA quantification.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.1) While the initiating event selection and grouping methodology used in the original PSS appears sound and is adequately documented, there is no guidance for how these activities should be updated, or how reviews of plant operating experience (or updates of the previous reviews) should be performed. This is inconsistent with other aspects of the PRA process, which are already proceduralized. (IE-1)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The initiating events modeled within the PRA are consistent with other Westinghouse PRAs.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.2) The current PRA relies on the initiating event identification and grouping analysis that was performed in the PSS. That analysis seems to be thorough. However, there is no documentation to indicate that this initial set of selected initiators was reviewed against more recent plant/industry experience for completeness. Since the time of the PSS, several initiators have been added, and several have been deleted. But evidence of a systematic review is lacking. (IE-2)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The peer reviewer indicated that the analysis seems thorough, but the documentation is not complete. Improving the analysis documentation is not expected to result in a CDF impact.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.3) A documented structured approach for support system Initiating Event selection should be included. A number of support system initiators were considered in the PSS and a systematic approach was used. The current PRA has added and deleted various events, but a structured approach was not used. (IE-4)	Comment not yet incorporated.	No impact on the SAMA analysis. The documented approach is strictly a reviewer's aid and, therefore, would have no quantitative impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.4) The argument provided for screening out loss of HVAC initiators is not convincing, for the following reasons. • Loss of an active system is a relatively high frequency event (redundancy argument is not good for normally-running systems which have to operate all the time. • Operator action time windows are based not only on tech specs but time to thermal damage of components, which is uncertain. • HRA of actions based on off-normal procedures might not result in low human error probabilities. • If loss of switchgear ventilation is a concern in 24 hours after an accident, it could be important as an initiator (e.g., as was found in Beaver Valley, STP, TMI-2, Diablo Canyon). • The argument is whether or not a quantification is justified, not what the result will be. Other plants that have found important contributors from reactor trip followed by loss of HVAC have generally found comparably important support system initiating events (e.g., as was the case with Beaver Valley, STP, TMI-1). (IE-7)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Adding a loss of ventilation initiator is not expected to be a significant CDF contributor since the ventilation system failure that would trip the plant would have no impact on equipment credited with mitigating a general plant transient. The control building ventilation system cools the control room, and instrument rack room, as well as, the switchgear rooms. Ventilation is not modeled as a support system for the switchgear rooms per the conclusion of room heat-up analysis. Any failure of that system would be readily apparent to the operators given the temperature rise that would be experienced in the control room.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.5) NU has performed a thorough review of plant operating history to determine if new initiators should be considered. However, no documentation of a review of industry events was provided in the PRA. (IE-8)	Comment not yet incorporated.	No impact on the SAMA analysis. The initiating events modeled within the PRA are consistent with other Westinghouse PRAs.
B.6) It appears that each initiating event is quantified properly. However, there is not a traceable basis for how the quantification method for each initiating event frequency was determined. (IE-10)	Comment not yet incorporated.	No impact on the SAMA analysis. Improving the analysis documentation is not expected to result in a CDF impact.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.7) The inclusion of common cause failures of the normally running service water pumps as an initiating event is indicative of a thorough search for initiating events. However, the quantification of the initiating event frequency using generic estimates of the common cause factors is inadequate for such a high risk contributor. Such high contributions to CDF or LERF from events that have been quantified should be followed by a detailed quantification that takes into account plant specific factors. In addition, a recovery factor was applied that was not supported by a detailed HRA. It is acknowledged that NU has taken steps to evaluate possible design modifications that would be helpful to mitigate the consequences of an interruption of service water flow. **(IE-12)**	The CCF analysis was revised and the recovery factor removed for the version of the model used for SAMA quantification.	Comment resolved. The result was a significant reduction in CDF due to incorporating a more realistic CCF analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.8) The success criteria and associated bases, including the definition of core damage, that were used to develop the event tree logic were originally developed in the PSS. While the SBO Coping Studies used an acceptable definition of core damage (Peak core temperatures > 2200° F) those bases are not always clearly stated in the documentation of the current PSA update, e.g., the event tree calculational files. It is not clear that a consistent definition of core damage was used to develop all the success criteria and operator time windows. (AS-1)	A technical basis was ultimately developed for the dominant contributors to CDF using an ASME PRA Standard core damage definition of core exit thermocouples exceeding 1200 °F. Incorporating the standard core damage definition led to less restrictive success criteria and a reduction in CDF as the previous criteria were determined to be overly conservative.	Negligible impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.9) While the 24 hour mission time is generally used, there are examples where it is bypassed. In an earlier version of the SBO event tree, there was a top event "MIT" to capture the functions of mitigating the RCP seal LOCA after electric power recovery was a success. In the most recent update this function was not included, so there seem to be successfully terminated sequences where there is a seal LOCA initiated, AC is restored, and the mission time for LOCA mitigation is truncated at the time of successful recovery. This assumption is optimistic but probably does not impact the CDF calculation in a significant way. (AS-4)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. As the peer reviewer noted, this comment would most likely not impact CDF. Unit 3 has two redundant and diverse methods of high head injection; charging and HPSI which are capable of providing RCS makeup after power is restored from an SBO scenario that results in an RCP seal LOCA.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.10) There is only indirect evidence available to verify that intentional decisions were made and actions taken to ensure PSA model is consistent with the current plant configuration. The calculations are signed off, which implies the models were approved by cognizant personnel as representing the as-built, as-operated plant. This would be made more clear if the documentation for the PSA event sequence model included a design freeze date, and a data cutoff date. The fact that the models and assumptions have been validated against the current design and procedures could thereby be made more explicit. (AS-8)	The PRA group receives every implemented design change per the Millstone Design Control Manual. The PRA group is also on distribution for every plant procedure change. Any potentially impacting design change or procedure change is placed into a PRA database used to prioritize necessary model update changes.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.11) Treatment of the SGTR sequences involving successful steam generator isolation (SGI), successful AFW, and successful HPI seems to be non-conservative and inconsistent with the treatment of the same type of sequences in the SLOCA event tree. The SLOCA tree questions recirculation following the successful operation of AFW and HPI. In the SGTR tree such sequences are assumed to result in non-core damage and a stable end state. (AS-11)	The inventory loss from SGTRs is assumed to be much smaller than from a Small LOCA. Therefore, given that Unit 3 has a 1.2 million gallon RWST, ample time would be available for the operators to refill the RWST or depressurize and place the unit on RHR cooling. Consequently, the treatment of SLOCA scenarios is probably overly conservative for not considering the possibility of the operators refilling the RWST if the sump recirculation function fails.	Negligible impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.12) The event sequence pictures in the MP3 event tree analysis notebook show, for small LOCA, an EDG branch, which the notebook explains is a way to filter out contributions from station blackout-related loss of RCP seal cooling during the quantification. However, inspection of the quantification fault tree model showed the expected logic (i.e., no EDG branch), where any SLOCA contributor was "and"ed with SLOCA mitigation logic. Another example is the absence, on the transient event trees, of PORV challenges, which are in fact modeled in the quantification fault tree. The event sequence illustrations and explanation in the event tree notebook are somewhat confusing relative to what is modeled in the actual CDF model. (AS-12)	The event trees diagrams were modified to match what is in the model.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.13) The event tree calculation and the systems notebooks appear to include a relatively large number of conservative assumptions. While each of these viewed singly are reasonable, the peer review team is concerned that the accumulation of so many small conservative assumptions may influence the CDF estimate and may distort the relative risk significance of modeled SSCs. Achievement of the higher grades 3 and 4 in this certification process emphasize the realism of the PSA. (AS-13)	A technical basis was ultimately developed for the dominant contributors to CDF; station blackout/RCP seal LOCA and small LOCA. The success criteria for the remaining scenarios were reviewed against other Westinghouse units and deemed reasonable.	Negligible impact on the SAMA analysis. Incorporating the new success criteria led to a reduction in CDF as the previous criteria were determined to be overly conservative.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.14) Not all relevant systems are credited. For example, MFW, IA, condensate systems are not included in the model as a backup to the AFW system. By not including these systems the importance of the AFW system may be over-stated (may mask other risk significant contributors). **(AS-14)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model conservatism.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.15) With the exception of selected cases (such as the MAAP 4 evaluation of RCP seal LOCA SBO sequences, selected hand calcs for some HRA time windows, and the room heat-up calculations), nearly all of the TH analyses that support sequence modeling and system success criteria are from the original PSS. While the PSS analyses that were performed to support the Level 1 aspects may still be valid today (this needs to be confirmed) the severe accident TH analyses from the PSS were based on a pre-MAAP era level of severe accident technology (March-COCO Class 9). As noted in an NU Self Assessment report, NU plans to update supporting TH analyses with MAAP 4.0. The peer review team concurs with this decision as necessary to the technical basis for the event tree and system success criteria and time windows as well as to support the Level 2 update. **(TH-1)**	A technical basis was ultimately developed for the dominant contributors to CDF; station blackout/RCP seal LOCA and small LOCA. The success criteria for the remaining scenarios was reviewed against other Westinghouse units and deemed reasonable.	Negligible impact on the SAMA analysis. Incorporating the new success criteria led to a reduction in CDF as the previous criteria were determined to be overly conservative.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.16) In the original PSS there is a good traceable reference path from the success criteria assumed in the event trees, fault trees, and human actions analysis to the supporting thermal hydraulics analysis (see Table 2.2.2.2-1 of the PSS). Unfortunately some of the original documents have not been retrieved or reviewed to verify continued applicability to the current design. When updating thermal hydraulic analyses using MAAP 4 or verifying applicability of the PSS analyses, such a traceable path to the current PSA logic should be established. (TH-3)	This comment has been incorporated. The success criteria documentation now provides a traceable path between the event trees, fault trees, and human actions.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.17) Plant-specific MAAP code runs have been performed to support timing success criteria for SBO. A calculation lists the definition of acceptable results as maximum core node temperature less than 2200°F and less than 1% clad oxidation. The calc note states that "These requirements were chosen arbitrarily since no specific guidance exists." Although the selected criterion is among those included in such sources as the draft ASME Level 1 PRA Standard (Rev 10 and 11), the documentation for the thermal hydraulic analysis/success criteria supporting the PRA should clearly define this, so that the definition of core damage, which affects all aspects of the level 1 model, is clear. (TH-5)	A technical basis was ultimately developed for the dominant contributors to CDF using an ASME PRA Standard core damage definition of core exit thermocouples exceeding 1200 °F.	Negligible impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.18) Many of the current success criteria are based on analyses performed for the original Millstone3 PSS. A review of the success criteria discussion in the PSS indicates that some of these underlying analyses exist only in Westinghouse calculation notes (1983 vintage) for which NU apparently does not have documentation, and in NU calc notes, some of which appeared to be not readily retrievable by the NU PRA group. The lack of this information makes it impossible to examine the analyses or determine their current applicability. (TH-6)	A technical basis was ultimately developed for the dominant contributors to CDF; station blackout/RCP seal LOCA and small LOCA. The success criteria for the remaining scenarios were reviewed against other Westinghouse units and deemed reasonable.	Negligible impact on the SAMA analysis. Incorporating the new success criteria led to a reduction in CDF as the previous criteria were determined to be overly conservative.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.19) In the event sequences, credit is taken for availability of AFW for 24 hours following an initiating event. The ability of AFW to provide decay heat removal for the sequence mission times (generally 24 hours) depends on the inventory available in the DWST. It was not clear to the reviewers from information in the current notebooks whether an evaluation had been made to determine that DWST volume would be sufficient to provide AFW for (and beyond) the entire mission time. (TH-8)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. There have been no formal evaluations made. A scoping analysis indicated that the DWST, by itself, is not enough. Technical specifications require that a specific combined volume be maintained within the DWST and the condensate storage tank (CST), which is the alternate suction supply to the AFW pumps. Placing the operator action and equipment necessary to align the AFW pumps to take suction from the CST into the PRA model is not expected to have an impact on CDF. The scoping study estimated that the DWST has at least 9 hours of inventory, giving the operators ample time to align the alternate suction source and/or provide makeup to the DWST.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.20) The reviewers found no specific evidence in the systems analysis documentation of a check of the ability of equipment to perform in degraded environments during accidents. Although a high energy line break (HELB) analysis / Hazards Analysis have been performed, the results have apparently not been factored into the PRA in a formal manner. It is acknowledged that positive actions in this arena have been taken (such as the current modification to the Control Room entry area based on proximity of high energy lines), and that there appears to be very little, if any, HELB threat in the Control, ESF, and Aux Buildings. (SY-7)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. As the peer reviewer noted, this is primarily a documentation issue. Unit 3 has a high degree of diversity, redundancy, and physical separation.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.21) The modeling for some systems has been "simplified" by selecting the most limiting success criterion and applying this whenever the system is required for mitigation, regardless of the initiating event. (An example is AFW, for decay heat removal, where flow to 2 SG's is modeled for all cases.) While this may be simpler, it may be conservative, result in less meaningful results, and is less likely to be able to support a wide range of applications. **(SY-11)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The most limiting success criteria were chosen due to the absence of success criteria documentation pointed out numerous times during the review. Removing conservatisms from the model would lower the CDF, thereby decreasing the dollar values of the SAMA benefit calculations.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.22) Loss of service water pumphouse ventilation is modeled differently for single train LOSW than for dual train LOSW. Although a reason is provided in the SW system notebook, this appears to be an overly conservative approach. Since LOSW is an important contributor to CDF, this should be re-considered. Per conversation with the PRA staff, it was noted that loss of ventilation was **not** supposed to be modeled at all. Hence there appears to be a mismatch between the model and the documentation. **(SY-13)**	The comments regarding the LOSW event were incorporated prior to the SAMA analysis being completed.	Comment resolved.
B.23) For plant-specific data updates, the current process directs using Bayesian update only if there is a "sufficient" amount of data. **(DA-1)**	Comment incorporated. The PRA engineer intended to say that Bayesian updating only makes a significant impact if there is a sufficient amount of data.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.24) For failure probabilities, valves are grouped by actuator type – motor, check, and air operated valves. There are no criteria for other data groupings of valves, for example those used in different systems. **(DA-2)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.
B.25) T&M unavailabilities for like components in the same system (e.g., individual Service Water pumps) are calculated separately. **(DA-3)**	Comment not incorporated. Using an average value in these cases would mask the contribution from components with unusually high unavailabilities. Dominion believes its methodology is sound.	No impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.26) Discussion of the common cause coupling mechanisms for on-site AC power should be provided. (See checklist sub-element DA-11 for list). **(DA-4)**	Comment not yet incorporated. A common cause coupling between the emergency diesel generators and the station blackout diesel is unlikely. They have different manufacturers and designs, they are maintained and tested on separate intervals, and they are housed in different areas of the site.	No impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.27) The coverage of modeled common cause component groups is fairly complete but there appear to be a small number of common cause groups for which there are existing CCF data that have not been modeled. These include: CCF between motor and steam driven AFW pumps (the drivers are diverse, but the mechanical pumps may not be); batteries: transformers: reactor trip breakers. If there are components or failure modes in the CCF data that are not modeled a justification should be provided. (DA-12)	With the exception of reactor trip breakers, the comment is not yet incorporated.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.28) The HRA screening values seems to be too low to be considered as screening values. For example, the HRA value of 2.0E-4 for mis-alignment of the RHR manual return valve to the RWST (RHXVMRV43NX) seems to be very low for a screening value. Also, the screening values used do not seem to be consistent in comparison with one another. For example, the HEP value used for leaving two valves in undesired position after the test (e.g. SIBP1S1P1ANX) is assumed to be twice as much as leaving one valve in an undesired position (RHXVMRHV43NX). Such a treatment assumes total independence between the test and maintenance of the two valves configuration and in this case is conservative. **(HR-2)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The events identified are latent errors, which are not expected to significantly contribute at Millstone 3 since the plant has a high degree of redundant and diverse systems.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.29) The ORE method requires simulator input. This has not yet been done, although the PRA engineer indicated that training simulator evaluations are planned for dominant actions. Formal review of risk-important operator actions by plant operations staff has not yet been undertaken. (HR-5)	The ORE method does not specifically require simulator input; however, it does require timing input for operator actions. The detailed post-initiator HRA performed following the peer review used timing input from the operations staff. The risk important operator actions are posted on CDF contributor charts in the control room, which the shifts receive formal training on.	Comment resolved.
B.30) The reviewers noted cases where credit was taken for non-proceduralized actions. (HR-6)	The cases involving credit for non-proceduralized actions are well documented and have been discussed with the plant operations staff. The actions all involve loss of room ventilation for which control room annunciators exist.	Comment resolved

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.31) The ISLOCA evaluation is a generic assessment of pipe overpressurization pathways, and appears to have considered only a limited number of potential pathways and failure mechanisms. Since ISLOCA is typically an important LERF contributor, a more complete, updated evaluation should be prepared for use with risk-informed applications of the PRA. (ST-2)	Comment not yet incorporated.	Negligible impact on SAMA analysis. The Millstone 3 systems that interface with the RCS boundary are equipped with redundant isolation capability. Per the Westinghouse PSA Comparison Database, the Millstone 3 ISLOCA CDF value of 2.21E-07/yr is comparable with sister units (Braidwood/Byron - 3E-07/yr. Comanche Peak - 2.04E-07/yr. Seabrook - 6.36E-08/yr). Consequently, expending the resources to further improve the analysis documentation is not expected to provide additional risk insights. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.32) The existing quantification calculation file provides a description of the quantification process. However, the write-up assumes that the reader is familiar with the NU-specific quantification process. A more detailed description should be provided that would allow a PRA-knowledgeable user to more easily reconstruct the analysis process. Since many of the other PRA analysis steps are described in standard procedures, consideration should be given to providing this guidance in a procedure on quantification. **(QU-1)**	The quantification calculation for the model used for the SAMA analysis clearly documents the process used.	No impact on the SAMA analysis.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.33) The PRA group is using the EPRI R&R Workstation suite of PRA software. This software has been validated and provides an adequate array of analysis features to support current PRA applications. However, NU does not appear to be using the latest versions of these codes, and is also using some in-house developed software that does not have as much functionality as the EPRI software. In some cases, limitations in the current versions (e.g., number of cutsets that can be generated as quantification cutoff is reduced) are limiting the ability of the PRA group to perform various sensitivity studies. **(QU-3)**	The latest versions of the codes were used to support the SAMA analysis.	Comment resolved

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.34) No formal convergence studies have been performed for the current PRA. The most recent revision to the model notes that a decrease of a factor of 10 in the truncation level from the previous revision resulted in 5 times as many cutsets as before. **(QU-11)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The SAMA analysis was performed using a truncation value of 1E-11 to ensure a sufficient number of cutsets were obtained.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.35) During a review of non-dominant sequences, it was noted that the TLR1 sequence of the SLBI event tree has cutsets that imply failure of HPI. However, the definition of this sequence includes the *success* of HPI. Subsequent review of the quantification details indicates that the limits of the PRA software were exceeded for this sequence. While an error message was written to a log file, this error was not evident. NU PRA staff noted that this software limitation exists in the current version of their software, but that the current software versions (not yet installed at NU) would correct this problem. **(QU-12)**	The latest versions of the codes were used to support the SAMA analysis; no such error existed in that version.	Comment resolved.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.36) While the mutually exclusive rule file appears to have been constructed correctly, there is very little documentation of the rationale for each of the rules. This makes review difficult , and may result in incorrect rules begin placed in the rule file in a future update. **(QU-13)**	Comment not yet incorporated. The mutually exclusive file is now maintained in fault tree format containing two branches. One branch models physically impossible plant configurations and the other models combinations that would violate technical specifications.	No impact on the SAMA analysis.
B.37) No uncertainty analyses have performed for the current PRA model. Uncertainty analysis is an important attribute of a complete PRA, particularly for usage of the PRA for risk-informed applications. **(QU-14)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.38) In quantification of the V-sequence frequency and any other cutsets whose frequency is proportional to X^N where X is a failure rate and N is a number of independent events in the cutset having the same failure rate, the mean frequency is not equal to the Nth power of the mean failure rate. For N=2 and the case where X is lognormally distributed, $\langle X^2 \rangle = M^2 + s^2$, where M is the mean failure rate and s^2 is the variance of the lognormal distribution. The problem is more complicated with N>2. When dealing with the V-sequence the failure rates are very low and the variance is very high such that the variance term dominates. When this is taken into account the Mean V-sequence frequency is normally at least an order of magnitude greater than the result obtained using a mean point estimate (M^2). It is not clear that this has been taken into account in the V-sequence quantification. See the Seabrook PRA for an example of correct calculation. **(QU-15)**	Comment not yet incorporated.	Negligible impact on the SAMA analysis. The dominant V-sequence contributors are the 2 RHR suction lines, which each contain 3 normally locked closed MOVs in series and have 2 relief valves in between the MOVs with setpoints of 2470 and 440 psig, respectively. Two of the three MOVs also have permissives, which won't allow the valves to open above a certain pressure. The peer reviewer has questioned the CDF calculation method used for this scenario, but not the design, which adequately addresses defense in depth.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.39) While the PRA software provides the capability to perform sensitivity studies, there is no procedural requirement to perform sensitivity studies on the PRA model, and only a very limited set of sensitivity studies has been performed. (QU-16)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Doubling the benefit for each SAMA compensates for this type of model uncertainty.
B.40) The quantification calculation file includes a brief summary of overall results (total CDF and breakdown of CDF contribution by initiating event). However, this level of detail should be expanded to be consistent with practices used in other PRAs. This will aid in the communication of risk results and insights to plant management and staff. (QU-17)	Comment not yet incorporated.	No impact on the SAMA analysis. This is an administrative issue that has no impact on the SAMA results.

Table 2—Individual Peer Review Comments

Peer Review Level B Comment	Comment Disposition	Impact of Not Incorporating Comment on SAMA Analysis
B.41) The success criteria and supporting thermal hydraulic analyses for Level 2 are from the PSS which used computer codes which were the best available at that time but are now viewed as very conservative in the modeling of early containment failure challenges. In addition, the MARCH code, used in the PSS, does not realistically model Level 2 phenomena. NU plans to update the Level 2 using MAAP 4.0, which is expected to support a more realistic evaluation of the severe accident phenomena that contribute to LERF. (L2-2)	Comment not yet incorporated.	Negligible impact on the SAMA analysis. Westinghouse performed a detailed Level-2 PRA analysis for Millstone Unit No. 3. The analysis included containment structural response as well as potential severe accident phenomena and their uncertainties. Since the state of knowledge of severe accident phenomenology did not advance substantially over the years since the Westinghouse study for Unit No. 3, the impact of not updating the Level 2 study is judged to be negligible.

Response to 1d.

The table below provides the overview of the NRC staff SER comments, when they were incorporated and the impact of not incorporating them on the SAMA analysis.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
The licensee stated that loss of HVAC is not a "significant" core damage issue, based on the design, improved room cooling reliability in response to the Station Blackout Rule, and operators' awareness of potential equipment failure due to high temperature. The staff finds this rationale reasonable in meeting the intent of Generic Letter 88-20, however, the staff believes that explicit modeling of the HVAC would provide additional insights and certainty in plant behavior during situations involving loss of HVAC.	In December 1995 the MP3 model incorporated explicit fault tree modeling of the HVAC system.	Comment resolved.
The licensee acknowledged that the PSS model lack explicit illustration of DC power dependencies and dependencies on DC power in the support system model, but stated that dependencies were considered implicitly. The licensee provided a system dependency matrix to illustrate dependencies on DC power, and agreed to update the analysis with explicit treatment of DC power following completion of IPEs for other units (1993).	In December 1995 the MP3 model incorporated explicit fault tree modeling of other systems' dependencies upon DC power as well as dependencies of the DC power system.	Comment resolved.

NRC SER Review Comment	Comment Incorporation	Impact of Not Incorporating Comment on SAMA Analysis
For a plant with limited operating experience, the staff finds the use of generic data reasonable, but also believes that the licensee would benefit from examination of future plant-specific information for potentially unrecognized component failure modes and sequences. In addition, the staff believes that validation of maintenance unavailabilities against plant-specific information would also help assure that employed generic unavailability estimates are being met.	In December 1995 the MP3 model database was updated with the then current plant specific data and initiating event frequencies.	Comment resolved.

IPE (8/90)

CDF = 5.524E-5/yr.
LERF = (Not developed)

Revision 0 (12/1995)

CDF = 5.99E-5/yr.
LERF = (Not developed)

The changes from the IPE revision are as follows:

- Model converted from support state to linked fault tree methodology.
- Ventilation dependencies were explicitly modeled.
- DC power dependencies were explicitly modeled.
- Total loss of service water initiator was modeled.
- Plant-specific data update was performed.

There were no major hardware or Level 1/2 model changes made.

Revision 1 (not generated)

This revision to the model does not exist. The Nuclear Records department skipped this revision number.

Revision 2 (9/98)

CDF = 5.72E-5/yr.
LERF = (Not developed)

The changes from the previous revision are as follows:

- The failure probability for OASWREC listed in the Recovery Rule file (Attachment D) was changed to 0.1 to agree with the value assigned within its Operator Action Quantification Worksheet provided in Attachment B. This resulted in the truncation of 4 cutsets, two from the LSWA and 2 from the LSWB event sequences.
- Two cutsets were truncated from the SLOCA sequence that should not have survived the previous quantification as recovery rules existed to recover these cutsets.

- The two basic events modeling the Station Blackout diesel were modularized into event ACMODSBO. Since the modularized probability is higher than the individual basic event probabilities, a slight increase in the SBO sequence contribution resulted. This also required a revision to the Recovery Rule file, which had rules listing the individual basic events.

<u>Revision 3 (10/98)</u>

CDF = 6.55E-5/yr.
LERF = 9.71E-7/yr.

The changes from the previous revision are as follows:

- The Station Blackout (SBO) logic was modified to take into consideration the SBO diesel battery capacity limitation and the hardware/procedural changes implemented to cope with the condition. The logic change involved redefining the SBO event to consist of 2 scenarios, which evolved around the SBO diesel battery capacity. Other changes include:
  1. modifying the event tree success node, EDG, to account for the 2 possible scenarios,
  2. modifying two operator actions, OASBODG and OASBODGAL, to account for operator failure to start the SBO diesel prior to battery depletion and then failure to align the SBO diesel to bus 34C or 34D.
- The cross-tie feature of the CCE system and its associated support systems (Instrument Air/Turbine Plant Component Cooling Water) were modeled in accordance with the normal system alignment and following a loss of Service Water. The change was necessitated due to an improper assumption made regarding normal system alignment (resulting in not modeling the cross-tie) and a revision to the loss of Service Water procedure.
- The HRA for transfer to pump recirculation, OAREC, was reanalyzed per Ref. 16 guidance. The reanalysis resulted in the addition of OARECS to model failure to transfer to sump recirculation following a small LOCA and the subsequent deletion of recovery actions RCP and SMREC. These recovery events were originally used in lieu of creating a separate operator error event for small LOCAs.
- Deleted recovery action OARECIRCMOV2 from the model. This action modeled failure to manually close the RSS spray header valve(s), MOV 20A(B), given the valve(s) failed to close during the transfer to sump recirculation sequence. A mid-cycle 6 design change to the RSS system resulted in the elimination of the requirement to close the header valves from the transfer to sump recirculation procedure.
- Renamed OARECIRCLPI to OADIRREC. The basic events model the same operator action to align direct injection from RSS to the RCS.

- Incorporated the latest revision of the Unit 3 plant-specific database.
- The General Plant Transient (GPT) initiating event was separated into two initiators during the database update. The new initiating event is comprised of transients caused by or resulting in a reactor trip (i.e., where the control rods successfully insert into the core). This initiating event category was created to preclude "reactor trip" GPTs from being analyzed by the ATWS and steamline break scenarios. As a result, a new initiating basic event, %RT, was added to the list of transients analyzed.
- The Loss of Offsite Power initiating event was added as an event, which results in failure of the Main Feedwater node.
- The system fault tree developed to support pressure relief node, PR, was revised to be consistent with the event tree analysis. This involved addition of basic event, ATWSFRAC, to model the fraction of time that maximum RCS pressure relief is insufficient to mitigate an ATWS.
- The recovery rule file was split into two separate files. One file supports quantification of the level 1 internal events model and the other file supports the EOOS risk monitor model. Several human error events were deleted from the rule files in an effort to limit the number of recovery rules to those that have a measurable impact on CDF.
- Added operator actions OAESFAS and OATRIP to model recovery from failure of automatic ESFAS and reactor trip actuations, respectively. (Note: OATRIP replaces OARXBKR.)
- Modified the quantification batch file, RUNMP3.BAT, to include several success paths for scenarios in which improper cutsets (i.e., consequential initiating event scenarios in which an event tree already models) were being generated.
- Modified the Service Water (SW) system fault tree to include support system failures that may lead to a total loss of SW event. In addition, changed the common cause failure beta factor used to model the loss of 2 SW pumps in the same train.
- Basic events RCPSEALLOCA and SBO_TRACE were added to the master fault tree file. The RCPSEALLOCA event was added to identify RCP seal LOCA scenarios. These scenarios are not easily recognized since they are generated by any transient initiator coupled with failure of seal injection and thermal barrier cooling. The SBO_TRACE event was added for use in the EOOS model quantification process.

Revision 4 (10/99), Model #M3990927

CDF = 7.54E-5/yr.
LERF = 8.70E-7/yr.

The changes from the previous revision are as follows:

- The Station Blackout (SBO) event tree was modified to incorporate results of plant-specific time to core uncovery calculations based on the most probable RCP seal LOCA leakage rates. In addition, the loss-of-offsite-power initiating event frequency was modified and a distribution of offsite power recovery probability vs. time was developed based on the loss-of-offsite-power events that have occurred in the industry.
- Lowered truncation limit for CDF calculation from 1E-08 to 1E-09 to ensure all significant contributors were identified. This resulted in a significant increase in CDF. A detailed review of the "new" cutsets from a human reliability analysis (HRA) perspective was not completed as part of this revision. However, this was addressed in Model #M3021001 by incorporating a fault-tree based method of post-processing operator recoveries using QRECOVER.
- The rule recovery file was modified as follows:
    1. The rules were reordered such that the operator recovery actions with the highest success rate are applied first.
    2. The rules for OAVENT and OASTARTAFW were optimized (i.e., only rules applicable to current model revision were retained.)
    3. Rules impacted by basic event changes made in the RSS system notebook and as a result of the time-dependent station blackout analysis were revised accordingly.
    4. Exclusion logic was added to the rules for OAESFAS.
    5. Merged rules OAINTERLOCK and OADIRREC since they both involve failure of high head recirculation and require the operators to establish an alternate method of core cooling. The more conservative failure probability of 0.5 was applied.
    6. Removed rules no longer necessary as a result of the room heat-up calculations described below.
    7. Increased failure probability of OARECIRCSW to 0.1.
    8. Reduced failure probability of SWREC1 and SWREC2 based on the uncertainty associated with CCF factor applied in the total loss of SW fault tree.

- Incorporated the results of room heat-up calculations documented in ERC 25203-ER-99-1001, "MP3 Loss of Ventilation Analyses Results for Maintenance Rule", Rev. 0. This included deleting recovery action, OAMCCVENT, and removing ventilation dependencies as documented in the AFW, HVAC, RSS, and AC power system analysis notebooks.
- The RSS, RHR, SW, and SIH fault trees were revised to incorporate the current NNECO common cause failure (CCF) and human reliability analysis (HRA) methodology in NUSCO PRA Guideline #5 and #15 respectively. The SW system fault tree was specifically revised to incorporate the latest CCF methodology due to the system's impact on CDF. The other 3 system fault trees were revised for various reasons and incorporating the latest revision of the CCF guideline was deemed prudent. Similarly, it was deemed prudent to incorporate the HRA guideline (specifically, latent error modeling, which did not exist during initial development of the system fault trees), into these 4 system fault trees being revised for the update.
- The RSS fault tree was also revised to incorporate the impact on system operation (e.g., RSS pump surveillances now performed one at a time) made as a result of several design changes completed during the mid-cycle 6 outage.
- The RHR, SIH, AC, power, AFW, HVAC, CHS fault trees were revised to model the SSCs credited for use during shutdown modes. This logic will in turn be used within the EOOS model which tracks compliance with the shutdown risk defense in depth procedure.
- Combinations were removed from the mutually exclusive file which are no longer applicable

Revision 0 (10/02), Millstone 3 PRA Model #M3021001

CDF = 2.04E-5/yr.	Truncation = 1.00E-09
LERF = 3.17E-7/yr.	Truncation = 1.00E-09

The changes from the previous model are as follows:

- Incorporated accident sequence analysis completed for LOCAs, station blackout, ATWS, and total loss of service water.
- A separate event tree was developed to explicitly model the core damage contribution from reactor coolant pump seal leak scenarios. This scenario is a top contributor for Unit 3.
- The individual accident sequences of the Unit 3 PRA are now quantified using the PRAQUANT computer code. An internally developed macro process had been used in the previous version.

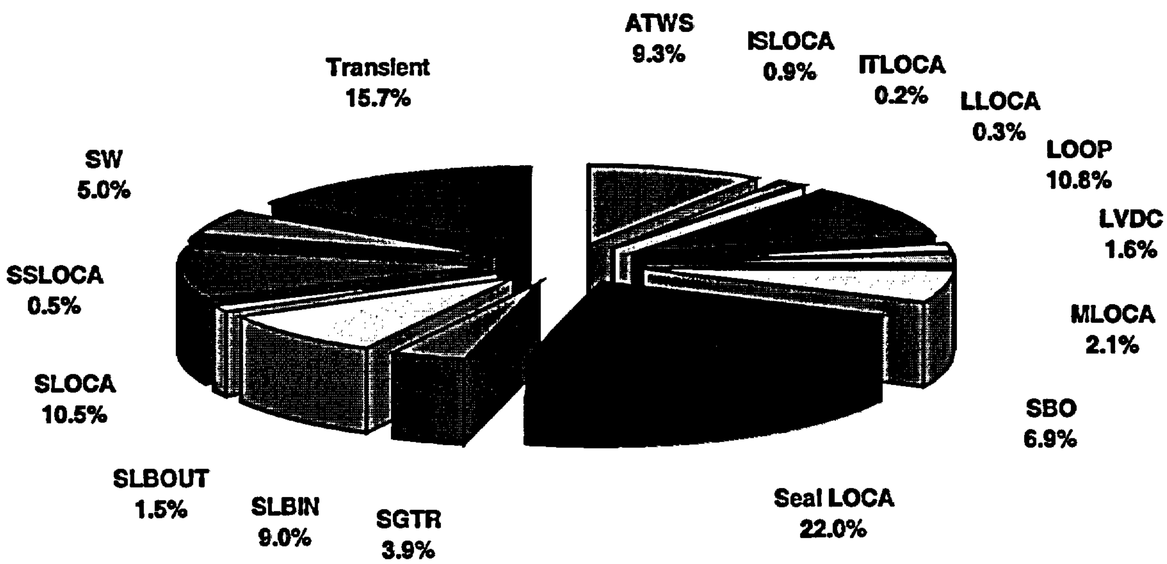
- Incorporated a fault-tree based method of post-processing operator recoveries using QRECOVER. In addition, a more formalized method of quantifying post-initiator operator action failure probabilities was used.
- Incorporated a fault-tree based method of deleting mutually exclusive combinations.
- NUREG/CR-5750 was used as the source of generic initiating event frequencies. The most recent operating experience was incorporated into the plant-specific initiating event frequency calculations.
- WCAP-15376 was used as the basis for the probability of failure of the reactor protection system. NUREG/CR-5500 Volume 2 was used as the basis for the mechanical control rod binding probability.
- Maintenance unavailability values are based on data collected in support of the Maintenance Rule. Volume II documents the reference used. Several instances were identified where the scope of the data collection did not match the system fault tree models. Examples include: RPCCW and CHS data collected on a train level rather than component level, NSST and RSST outages occur at power, and data is now available for ventilation units. For these cases, the system fault trees were revised accordingly.
- Fully incorporated revision 1 of the common cause failure (CCF) PSA guideline. This resulted in the creation of several type codes for specific CCF combinations.
- Emergency diesel generator reliability values are now based on data collected and transmitted by the system engineer.
- Fault exposure factors were eliminated for all instances where the surveillance test interval is less than or equal to 1 refueling cycle based on a peer review comment. Volume II documents the changes made.
- Eliminated vital switchgear room ventilation dependency based on empirical data. Volume III documents the analysis used.
- Removed CCF to run initiating events for combinations of 3 and 4 service water pumps based on industry guidance on identification of CCF groupings (i.e., since only 2 service water pumps are normally operating, the population size for failure to run is only 2). The industry reference used is documented in Volume III.
- Removed opposite train service water pump combinations from the mutually exclusive file based on the recently revised technical requirements manual (TRM) clarification of the service water technical specification. The TRM allows 1 pump in each train to be inoperable for up to 72 hours.

Response to 1e.

The following table was generated using model #M3021001 at a truncation value of 1.0E-11.

Accident Class	CDF (yr^{-1})	% Contribution
RCP Seal LOCA	5.66E-06	22.0
Transient	4.04E-06	15.7
Loss of Offsite Power	2.77E-06	10.8
Small Break LOCA	2.71E-06	10.5
ATWS	2.39E-06	9.3
Steamline Break Inside Containment	2.31E-06	9.0
Station Blackout	1.78E-06	6.9
Total Loss of Service Water	1.28E-06	5.0
Steam Generator Tube Rupture	1.00E-06	3.9
Medium Break LOCA	5.28E-07	2.1
Loss of One Vital DC Bus	4.18E-07	1.6
Steamline Break Outside Containment	3.79E-07	1.5
Interfacing Systems LOCA	2.21E-07	0.9
Small Small Break LOCA	1.19E-07	0.5
Large Break LOCA	6.53E-08	0.3
Instrument Tube LOCA	5.04E-08	0.2
Total Loss of Vital DC	8.22E-10	~0
Internal Flooding (not included in TOTAL below)	8.58E-07	3.3
TOTAL	**2.57E-05**	**100%**

The following figure replaces Figure G.2-1 of the Environmental Report, due to truncation considerations.



Response to 1f.

The top 30 cutsets are shown below with their respective plant damage states. These plant damage states are defined in Table G.2-3 of the Environmental Report.

Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
1	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	1.29E-06
		FWCP0FWAP1N2	CCF TO START OF MD AUX FEEDWATER PUMPS FW*P1A AND FW*P1B	1.42E-04	1.00	1.42E-04	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
2	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	8.18E-07
		STUCKROD35	CCF OF 35 OR MORE CONTROL RODS TO INSERT		6.60E-07	6.60E-07	
3	V2E	%SGTR	STEAM GENERATOR TUBE RUPTURE		7.00E-03	7.00E-03	3.77E-07
		FWBP0FWP1BBQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B OOS FOR MAINTENANCE	7.35E-03	1.00	7.35E-03	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
4	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	3.63E-07
		FWCP0FWAP1N2	CCF TO START OF MD AUX FEEDWATER PUMPS FW*P1A AND FW*P1B	1.42E-04	1.00	1.42E-04	
		FWXP5FWAP2NN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO START	3.38E-02	1.00	3.38E-02	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
5	ALS	%MLOCA	MEDIUM BREAK LOCA INITIATING EVENT FREQUENCY		4.00E-05	4.00E-05	2.40E-07
		OAPREC	OPERATORS FAIL TO ESTABLISH SUMP RECIRCULATION (LARGE OR MEDIUM LOCA)		6.00E-03	6.00E-03	
6	SLQ	%SLOCA	SMALL BREAK LOCA INITIATING EVENT FREQUENCY		3.33E-04	3.33E-04	1.99E-07
		SWCMSV50ABF1	CCF TO CLOSE MOV50A AND MOV50B (MOV 54A,B,C,D PERMISSIVE)	5.97E-04	1.00	5.97E-04	
7	SLQ	%SLOCA	SMALL BREAK LOCA INITIATING EVENT FREQUENCY		3.33E-04	3.33E-04	1.99E-07
		SWCMSV71ABF1	CCF TO CLOSE 3SWP*MOV71A AND 3SWP*MOV71B (FLOW DIVERSION PATH)	5.97E-04	1.00	5.97E-04	
8	V	%RHRSUCTION	ISLOCA VIA RHR SUCTION LINES		1.93E-07	1.93E-07	1.93E-07
9	TES	%SLBO	STEAMLINE BREAK OUTSIDE CONTAINMENT		1.00E-02	1.00E-02	1.92E-07
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	

Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
10	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	1.82E-07
		FWXTKFDWSTTN	DWST RUPTURES	1.00E-07	24.00	2.40E-06	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
11	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	1.69E-07
		FWCP0FWAP1N2	CCF TO START OF MD AUX FEEDWATER PUMPS FW*P1A AND FW*P1B	1.42E-04	1.00	1.42E-04	
		FWXP5FWAP2NQ	AFW TURBINE DRIVEN PUMP FW*P2 OOS FOR MAINTENANCE	1.57E-02	1.00	1.57E-02	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
12	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	1.34E-07
		FWAP0FWP1ANN	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1A FAILS TO START	2.01E-03	1.00	2.01E-03	
		FWBP0FWP1BBQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B OOS FOR MAINTENANCE	7.35E-03	1.00	7.35E-03	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
13	SL	%LOOPWR	LOSS OF OFFSITE POWER (WEATHER RELATED EVENTS)		5.20E-03	5.20E-03	1.21E-07
		ACADG3EGSAFN	DIESEL GENERATOR A FAILS TO RUN	3.39E-03	24.00	8.14E-02	
		ACBDG3EGSBFN	DIESEL GENERATOR B FAILS TO RUN	3.39E-03	24.00	8.14E-02	
		ACXBGSBODGFN	SBO DIESEL FAILS TO RUN	2.00E-03	24.00	4.80E-02	
		OSPRN1WR	FAILURE TO RECOVER WEATHER-RELATED LOOP - PORVs,AFW AVAIL (0-400 GPM)		0.14	1.35E-01	
		RCPSL1	21 GPM PER RCP SEAL LEAK		0.79	7.90E-01	
		CDF990	MISSION TIME ADJUSTMENT SINCE CORE DAMAGE OCCURS IN 16.5 HOURS		0.69	6.88E-01	
14	V2E	%SGTR	STEAM GENERATOR TUBE RUPTURE		7.00E-03	7.00E-03	1.06E-07
		FWBP0FWP1BBQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B OOS FOR MAINTENANCE	7.35E-03	1.00	7.35E-03	
		FWXP5FWAP2NN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO START	3.38E-02	1.00	3.38E-02	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	

Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
15	V2E	%SGTR	STEAM GENERATOR TUBE RUPTURE		7.00E-03	7.00E-03	1.03E-07
		FWBP0FWP1BNN	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B FAILS TO START	2.01E-03	1.00	2.01E-03	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
16	TES	%LOOPPC	LOSS OF OFFSITE POWER (PLANT-CENTERED EVENTS)		0.02	2.25E-02	9.85E-08
		ACADG3EGSAFN	DIESEL GENERATOR A FAILS TO RUN	3.39E-03	24.00	8.14E-02	
		FWBP0FWP1BBQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B OOS FOR MAINTENANCE	7.35E-03	1.00	7.35E-03	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
17	SLQ	%SLOCA	SMALL BREAK LOCA INITIATING EVENT FREQUENCY		3.33E-04	3.33E-04	9.76E-08
		HVCACAC2ABN2	CCF OF RSS ACU UNITS TO START	2.93E-04	1.00	2.93E-04	
18	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	9.58E-08
		FWAP0FWP1AAQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1A OOS FOR MAINTENANCE	5.25E-03	1.00	5.25E-03	
		FWBP0FWP1BNN	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B FAILS TO START	2.01E-03	1.00	2.01E-03	
		FWXP5FWAP2FN	AFW TURBINE DRIVEN PUMP FW*P2 FAILS TO RUN	5.00E-03	24.00	1.20E-01	
		MODE1	MODE 1		1.00	1.00E+00	
		OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED		0.06	6.10E-02	
19	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV20AFF	STEAM GENERATOR ATMOS RELIEF VALVE (PV20A) FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
20	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV20BFF	STEAM GENERATOR ATMOS RELIEF VALVE (PV20B) FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	

Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
21	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV20CFF	STEAM GENERATOR ATMOS RELIEF VALVE (PV20C) FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
22	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV20DFF	STEAM GENERATOR ATMOS RELIEF VALVE (PV20D) FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
23	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV47AFF	AIR OPERATED VALVE PV47A FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
24	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV47BFF	AIR OPERATED VALVE PV47B FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
25	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV47CFF	AIR OPERATED VALVE PV47C FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
26	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV48AFF	AIR OPERATED VALVE PV48A FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
27	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV48BFF	AIR OPERATED VALVE PV48B FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP		1.92E-05	1.92E-05	

Summary of Top 30 Cutsets of PRA Model

#	PDS	Inputs	Description	Failure Rate	Exposure	Event Prob	Probability
			BREAKERS)				
28	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV48CFF	AIR OPERATED VALVE PV48C FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
29	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV49AFF	AIR OPERATED VALVE PV49A FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECTRICAL FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BREAKERS)		1.92E-05	1.92E-05	
30	TES	%GPT	GENERAL PLANT TRANSIENT		1.24	1.24E+00	7.90E-08
		MSXAVPV49BFF	AIR OPERATED VALVE PV49B FAILS TO CLOSE ON DEMAND	3.32E-03	1.00	3.32E-03	
		RPSFAILURE	ELECT FAILURE OF RPS (EXCLUDING CCF OF RX TRIP BRKRS)		1.92E-05	1.92E-05	

Response to 1g.

The Millstone 3 PRA model does not credit any equipment operated by Units 1 or 2. The station blackout diesel generator, which is operated by Unit 3, is shared between Units 2 and 3; however, Unit 3 has priority for an SBO at both units, and this priority is factored into the model.

Response to 1h.

The Millstone Unit 3 Level 1 PRA model has been updated six times since the original MP3 IPE was issued in August 1990. The latest PRA model was completed in October of 2002. After many PRA model revisions, it is likely that the dominant sequences have changed from the original IPE model. Although some dominant sequences may not be exactly matched to the original model, the current model is still considered valid. This is explained further below.

The sequences are binned into plant damage states defined to group sequences together with similar characteristics such that their subsequent behavior in the accident progression past core damage onset can be expected to be similar. Once they are so binned, they are treated as a class. The Level 2 portion of the IPE PRA for Millstone Unit 3 has not been updated.

To calculate the complete accident progression and the subsequent fission product releases, a sequence selected from a plant damage state bin is used as characteristic of the Level 1 portion and is combined with a particular path through the containment event tree. The dominant Level 1 sequence in a plant damage state bin is not always chosen as the characteristic, the reason being most often to achieve some diversity in the calculated progressions. With properly defined plant damage state bins, any of the sequences in the bin can be, in principal, selected for the characteristic Level 1 portion of the sequence. It is true that the results will differ somewhat depending on which particular Level 1 sequence is coupled with which particular containment event tree trajectory, but this is considered an acceptable result of using binning at the Level 1 and Level 2 end stages. For a given release category (or source term bin), the binning at the end of the Level 2 stage usually contains contributions from several plant damage state bins and several different containment event tree trajectories.

There are uncertainties in the source terms resulting from binning-related averaging process and uncertainties due to the actual progression. The phenomenological containment event tree itself is an expression of the uncertainty of the severe accident modeling and quantification, i.e., it is not a stochastic model as the Level 1 accident tree is, and there is not a dominant sequence in the Level 1 sense. The use of the dominant Level 1 sequence may reduce the stochastic portion of the uncertainty, but only within the band of that particular plant damage state and that particular source term bin. The Level 2 uncertainty contribution normally outweighs because of the unknowns of the phenomenology.

Taking into account the following variables that include; the continuity of the dominant sequences occurrence in the updating, the objectives of the plant damage state binning, the uncertainties of the containment event tree, and the level of discrimination in the SAMA cost/benefit comparisons, it is concluded that, the possible variations in the end result from using alternate sequences in a given plant damage state bin, as characteristic of that bin, are considered to be within acceptable bounds for the purposes of the SAMA evaluations.

Since the Level 1 IPE sequence data files could not be located, a comparison of the PDS and the STC frequencies was made for the IPE and SAMA analysis. Table 1h-1 below shows the PDS comparison between the IPE and the revised values used for the SAMA analysis in descending order. There were a total 27 PDS for the IPE and SAMA analysis. The nomenclature for SAMA PDS was modified (from the IPE) for some of the PDS as shown below. As shown, the frequency ranking of some of the PDS are not matched well between the SAMA and IPE values. It is concluded that the differences in the ranking as noted between the IPE and SAMA PDS are due to plant modifications and PRA model updates that were made over the past 10 years.

Table 1h-1

No.	SAMA PDS	Freq /yr	% CDF	IPE PDS	Freq /yr	% CDF
1	TES	8.59E-06	33.18%	TEC	2.17E-05	39.32%
2	SL	3.27E-06	12.63%	ALC	1.32E-05	23.84%
3	SES	2.84E-06	10.97%	SLC	6.74E-06	12.20%
4	SE	2.72E-06	10.50%	TE	3.73E-06	6.75%
5	TLS	1.81E-06	6.99%	AEC	3.70E-06	6.70%
6	SLS	1.66E-06	6.41%	ALC'	1.67E-06	3.03%
7	TLQ	1.18E-06	4.56%	SE	1.28E-06	2.31%
8	SLQ	1.14E-06	4.40%	SLC'	1.14E-06	2.07%
9	V2E	9.26E-07	3.58%	SEC	1.10E-06	1.99%
10	TL	4.93E-07	1.90%	TEC'	4.86E-07	0.88%
11	ALS	3.83E-07	1.48%	V	2.21E-07	0.40%
12	V	2.21E-07	0.85%	V2EC	1.51E-07	0.27%
13	TE	1.83E-07	0.71%	SLC"	5.05E-08	0.09%

14	ALQ	1.21E-07	0.47%	ALC"	2.05E-08	0.04%
15	SEQ	9.36E-08	0.36%	AEC'	1.74E-08	0.03%
16	TEQ	7.63E-08	0.29%	V2EC'	1.19E-08	0.02%
17	AES	7.55E-08	0.29%	SL	1.14E-08	0.02%
18	V2L	7.37E-08	0.28%	SEC'	6.70E-09	0.01%
19	AEQ	1.44E-08	0.06%	AE	6.13E-09	0.01%
20	SER	1.13E-08	0.04%	V2E	3.77E-09	0.01%
21	TLR	6.78E-09	0.03%	AL	2.55E-09	0.00%
22	SLR	1.80E-09	0.01%	S'E	1.62E-09	0.00%
23	TER	1.55E-09	0.01%	V2LC	1.37E-09	0.00%
24	ALR	5.09E-10	0.00%	S'L	1.24E-09	0.00%
25	AE	1.82E-10	0.00%	V2LC'	3.27E-10	0.00%
26	AL	8.21E-11	0.00%	V2LC"	1.80E-11	0.00%
27	AER	4.74E-11	0.00%	V2L	4.36E-12	0.00%
			100.00%			100.00%

The description of the SAMA PDS are shown in Table 1h-2 below.

Table 1h-2

SAMA PDS	Description
AE	Large or medium LOCA, early core damage
AEQ	Large or medium LOCA, early core damage, quench spray available
AER	Large or medium LOCA, early core damage, recirculation spray available
AES	Large or medium LOCA, early core damage, quench and recirculation spray available
AL	Large or medium LOCA, late core damage
ALQ	Large or medium LOCA, late core damage, quench spray available
ALR	Large or medium LOCA, late core damage, recirculation spray available
ALS	Large or medium LOCA, late core damage, quench and recirculation spray available
SE	Small LOCA, early core damage
SEQ	Small LOCA, early core damage, quench spray available
SER	Small LOCA, early core damage, recirculation spray available
SES	Small LOCA, early core damage, quench and recirculation spray available
SL	Small LOCA, late core damage
SLQ	Small LOCA, late core damage, quench spray available
SLR	Small LOCA, late core damage, recirculation spray available
SLS	Small LOCA, late core damage, quench and recirculation spray available

TE	Transient, early core damage
TEQ	Transient, early core damage, quench spray available
TER	Transient, early core damage, recirculation spray available
TES	Transient, early core damage, quench and recirculation spray available
TL	Transient, late core damage
TLQ	Transient, late core damage, quench spray available
TLR	Transient, late core damage, recirculation spray available
TLS	Transient, late core damage, quench and recirculation spray available
V	Interfacing System LOCA
V2E	Steam Generator Tube Rupture, early core damage
V2L	Steam Generator Tube Rupture, late core damage

The description of the STCs are shown in Table 1h-3 below.

Table 1h-3

No.	STC	Description
1	M1A	Containment Bypass, V-Sequence
2	M1B	Containment Bypass, SGTR
3	M2	Early Failure/Early Melt, No Sprays
4	M3	Early Failure/Late Melt, No Sprays
5	M4	Containment Isolation Failure
6	M5	Intermediate Failure/Late Melt, No Sprays
7	M6	Intermediate Failure/Early Melt, No Sprays
8	M7	Late Failure, No Sprays
9	M8	Intermediate Failure With Sprays
10	M9	Late Failure With Sprays
11	M10	Basemat Failure, No Sprays
12	M11	Basemat Failure With Sprays
13	M12	No Containment Failure

The sorted release categories reported for the IPE and the SAMA analysis are listed in Table 1h-4 below. These release category frequencies were sorted in descending order based on percent of CDF. It is seen that the largest contribution to CDF for the IPE and SAMA analysis is no containment failure (NCF) release category M12. The second largest contributor to CMF for the IPE and SAMA release category is M7. Release category M7 is described as late containment failure with no sprays. The No.3 ranking was assigned to IPE category M11 versus the SAMA category M9. As shown, based on frequency ranking, the release categories are not exactly matched. It is concluded that the differences in the ranking as noted between the IPE and SAMA RCs are due to plant modifications and PRA model updates that were made over the past 10 years.

Table 1h-4

	SAMA STC	Freq /yr	% CDF	IPE STC	Freq /yr	% CDF
1	M12	1.46E-05	50.69%	M12	4.40E-05	79.73%
2	M7	7.79E-06	27.05%	M7	6.12E-06	11.09%
3	M9	1.60E-06	5.55%	M11	2.39E-06	4.33%
4	M10	1.60E-06	5.55%	M9	1.70E-06	3.08%
5	M11	1.60E-06	5.55%	M10	4.29E-07	0.78%
6	M1B	1.00E-06	3.47%	M1A	2.21E-07	0.40%
7	M1A	2.21E-07	0.77%	M1B	1.73E-07	0.31%
8	M5	1.96E-07	0.68%	M6	8.38E-08	0.15%
9	M6	1.96E-07	0.68%	M8	3.08E-08	0.06%
10	M2	0.00E+00	0.00%	M5	1.74E-08	0.03%
11	M3	0.00E+00	0.00%	M4	1.10E-08	0.02%
12	M4	0.00E+00	0.00%	M2	7.09E-09	0.01%
13	M8	0.00E+00	0.00%	M3	4.90E-09	0.01%
			100.00%			100.00%

Response to 1i.

The MP3 IPE document shows that there were in fact some early failures on Table 3.4-5 for M2, M3 and M4, but their contributions to containment failure were considered to be low. MP3 IPE Table 5.3-1 titled as the "Simplified Containment Matrix" is the reported transformation of the Containment Response Class (1 through 10) to the Release Mode (M1 through M12) with the Plant Damage States corresponding to the Containment Response Class. This table has the footnote "Matrix elements with low probabilities and low contribution to overall risk have been deleted. This includes steam explosions (M2B) and early overpressure failures (M2A and M3). Although Table 5.3-1 includes the M4 release category, which corresponds to the containment isolation failure PDS, it was deleted shortly after the IPE was issued due to its low contribution to containment failure. Thus all early containment failures were set to zero for the MP3 SAMA analysis, which is consistent with the IPE methodology.

RAI 2. Please provide the following information concerning important cutsets, basic events, and risk contributors:

a. The loss of SW initiator contributes 7.4% of the CDF. Please describe the modeling of this initiator and the dominant sequences and failures.

b. Please provide additional information concerning the CDF sequences involving RCP seal LOCAs due to either support system failure and SBO including the MPS3 RCP seal design, associated seal injection and cooling systems, dependencies of these systems on other support systems related ECCS or makeup system dependencies and how the RCP seal failure is modeled in the MPS3 PRA.

*c. The transformation of MPS3 IPE PDS frequencies into release category frequencies is provided in Table G.2-4. The information in this table indicates that the total frequency of a number of PDSs allocated to the various release categories exceeds 1.0 times the PDS. For example, the total for PDS AE is 1.80 * AE, the total for AL is 1.76 * AL and the total for AES is 1.1 * AES. It would appear that the total for each PDS should be exactly 1.0 times the PDS. Please explain.*

Dominion Response to RAI 2

Response to 2a.

Unit 3 has four 100% capacity SW pumps, two per train. One pump in each train is normally in operation. Each train is equipped with a ventilation fan, which is required for pump operation. If both pumps in the same train fail, the unit is expected to trip, which is what is currently modeled in the PRA. The capability does exist to cross-tie the system via the turbine building header; however, the system has never been operated in this configuration. The loss of SW initiator models failure combinations of all four pumps via random faults, common cause faults, or loss of support systems (which include power and ventilation) given one of the following events:

- Loss of offsite power
- Transient

- Common cause failure of the two operating SW pumps
- Failure of the operating pump and standby pump in the same train

The dominant contributors to loss of SW sequences include ventilation failures and common cause failures.

Given failure of all four SW pumps, the operators are directed to align fire water to the charging pump cooling pump heat exchangers. If this is unsuccessful, the PRA currently assumes that the charging pumps fail. However, analysis recently completed by Westinghouse concluded that SW cooling to the heat exchangers is only necessary when charging pump room temperature exceeds 91°F. This information has not yet been translated into success criteria and incorporated into the PRA model. However, the expectation is that the contribution from the loss of SW would be significantly reduced given that the charging pump ventilation system is not dependent upon SW.

The Fussell-Vesely value for the operator failing to align fire water to the charging pump cooling pump heat exchangers is 0.0463.

Response to 2b.

Loss of RCP seal cooling, which is modeled as a separate initiating event, occurs when an RCP loses both seal injection and thermal barrier cooling. Seal injection is provided by the charging system that is comprised of two trains, which require power, SW, and auxiliary building ventilation. [Note the discussion provided above regarding the SW dependency.] One charging pump is capable of supplying seal injection to all four RCPs. Thermal barrier cooling is provided by the Reactor Plant Component Cooling Water (RPCCW) system that is comprised of two trains, which also require power, SW, and auxiliary building ventilation. Two RPCCW pumps are normally operating and required to supply thermal barrier cooling to the four RCPs, one RPCCW pump per two RCPs. The capability exists to cross-tie the RPCCW containment supply headers, but the PRA model currently does not credit it.

If RCP seal cooling is lost, a distribution of RCS leak sizes is assumed based on Westinghouse guidance. The operator recovery time for the scenario is calculated based on the assumed RCS leakage rate. Only loss of RCP seal cooling events initiated by a loss of power are currently recovered in the PRA model.

Makeup for RCP seal leak events is provided by either the charging pumps or safety injection pumps. The charging pumps also function as the high head safety injection pumps. The safety injection pumps are intermediate head pumps, which require power, SW, and ESF building ventilation.

The RCP seal LOCA scenario uses WCAP-15603 "WOG 2000 Reactor Coolant Pump Seal Leakage Model for Westinghouse PWRs," Rev. 0.

Response to 2c.

The observation is correct. The formulas used in the Millstone Unit 3 translation into the benefit calculations resulted in a slight overestimate of the benefits, which is conservative for the cost/benefit analyses. The corrected Table G.2-4 is shown below:

Table G.2-4
Transformation of MP3 IPE PDS Frequencies into Containment Release Category Frequencies

Release Category	Formulae
M1A	= V
M1B	= V2E + V2L
M2	= 0
M3	= 0
M4	= 0
M5	= (0.31 * AE) + (0.27 * AL) + (0.03 * SE) + (0.005 * SL)
M6	= (0.31 * AE) + (0.27 * AL) + (0.03 * SE) + (0.005 * SL)
M7	= (0.29 * AE) + (0.35 * AL) + (0.89 * SE) + (0.79 * SL) + (0.90 * TE) + AEQ + ALQ + SEQ + SLQ + TEQ + TLQ
M8	= 0
M9	= (0.03 * AE) + (0.037 * AL) + (0.017 * SE) + (0.067 * SL) + (0.033 * TE) + 0.017 * (AES + ALS + SES + SLS + TES + TLS) + 0.33 * (AER + ALR + SER + SLR + TER + TLR)
M10	= (0.03 * AE) + (0.037 * AL) + (0.017 * SE) + (0.067 * SL) + (0.033 * TE) + 0.017 * (AES + ALS + SES + SLS + TES + TLS) + 0.33 * (AER + ALR + SER + SLR + TER + TLR)
M11	= (0.03 * AE) + (0.037 * AL) + (0.017 * SE) + (0.067 * SL) + (0.033 * TE) + 0.017 * (AES + ALS + SES + SLS + TES + TLS) + 0.33 * (AER + ALR + SER + SLR + TER + TLR)
M12	= 0.95 * (AES + ALS + SES + SLS + TES + TLS) + 0.01 * (AER + ALR + SER + SLR + TER + TLR)

RAI 3. Please provide the following information concerning the MACCS2 analyses:

a. The MACCS2 analysis for both units uses a core inventory scaled by power level from a reference PWR core inventory at end-of-cycle calculated using ORIGIN. The ORIGIN calculations were based on a 3-year fuel cycle (12 month reload), 3.3% enrichment, and three region burnup of 11000, 22000 and 33000 MWD/MTU. Current PWR fuel management practices use higher enrichments and significantly higher fuel burnup (>45000 MWD/MTU discharge burnup). The use of the reference PWR core instead of a plant specific cycle could significantly underestimate the inventory of long-lived radionuclides important to population dose (such as Sr-90, Cs-134 and Cs-137), and thus impact the SAMA evaluation. Evaluate the impact on population dose and the and on the SAMA screening and dispositioning if the SAMA analysis were based on the fission product inventory for the highest burnup and fuel enrichment expected at MPS during the renewal period.

b. Please provide the release time and duration, warning time, release height and release energy used in the MACCS2 analysis for each of the release categories.

c. The assumption of 100% evacuation in the baseline case is overly optimistic. Sensitivity case 3 (95% evacuation) would be a more reasonable baseline. However, the estimated SAMA benefits under case 3 are even lower than the baseline case, which is counterintuitive. Please explain this apparent anomaly.

d. The population is based on projected values for year 2040 for Unit 3, which is 5 years prior to the end of the renewal period. Explain why this date was selected rather than the date for the end of the renewal period.

e. The population distribution and economic data are based on SECPOP90; SECPOP2000 was not considered. State what the impact would be if SECPOP2000 were used. In addition, please explain how resort areas are addressed in the economic model.

Dominion Response to RAI 3

Response to 3a.

The design basis source terms for Millstone Unit 3 represent worst case source term core inventories. Calculated using ORIGEN, each source term was determined by varying critical input variables to yield bounding core inventory values which would encompass plant operating histories and design. Fuel assemblies with three different burnups, representing one, two, and three cycles, were assumed to determine an equilibrium core source term at the end of a fuel cycle. Different combinations of fuel enrichment (up to the maximum licensed enrichment of 5.0%) and low and high region burnups (up to a core-average burnup of 58,000 MWD/MTU) were used in the source term determination. Core inventories for individual nuclides vary differently with fuel enrichment and burnup. Specifically, for a fixed enrichment, some nuclide inventories increase with burnup, while others decrease; for a fixed burnup, some nuclide inventories increase with enrichment while others decrease. For bounding source term calculations, the worst-case core inventory for each nuclide was selected between all the ORIGEN runs to represent a core maximum value over all expected operating conditions.

Even using this very conservative approach, the benefit calculations are still not significantly impacted. Using the offsite dose and dollar results from MACCS, the baseline offsite annual dose increases from 12.8 person-rem/year to 20.3 person-rem/year (compared to more than 35,000 person-rem per year from natural background radiation for the population within 10 miles of the plant, and more than 900,000 person-rem per year from natural background radiation for the population within 50 miles). Counting all contributors to benefit, the Unit 3 baseline benefit (if 100% of the CDF is eliminated, including all external events CDF) increases from $1.83M to $2.35M, or 28%. A best-estimate calculation with mid-cycle burnup and actual expected (instead of worst-case) inventories of each nuclide would yield an even smaller increase in the baseline annual dose and overall benefit. The long-lived isotopes have a dominant impact on dose since they do not reach equilibrium. Therefore, if calculations were performed at actual design end of cycle burnup (approximately 40,000), there would be a much smaller increase from the baseline benefit.

Given that a factor of two margin was used for all cost-benefit analyses to account for such uncertainties, the conclusions of the SAMA cost-benefit analyses would not have changed even if the more conservative nuclide inventories had been used in MACCS2.

Response to 3b.

The release time (PDELAY), duration (PLDUR), warning time (OALARM), release height (PLHITE) and energy (PLHEAT) used in the MACCS2 analysis for each of the release categories are shown below.

Table 7: Plume Characteristic Data

STC	OALARM (S)	PLHEAT (w)	PLHITE (m)	PLDUR (s)	PDELAY (s)
M-1A	14,400	0.6E+6	0.0	2,880	15,840
M-1B	9,000	2.8E+6	21	3,600	10,800
M-2	30,600	2.0E+6	25	10,800	43,200
M-3	61,200	4.5E+6	25	7,200	75,600
M-4	61,200	2.2E+5	25	28,800	64,440
M-5	61,200	3.0E+6	25	10,800	83,160
M-6	63,720	3.0E+6	25	10,800	85,320
M-7	61,200	9.0E+6	25	10,800	140,760
M-8	22,680	8.0E+5	25	10,800	54,720
M-9	22,680	1.8E+6	25	10,800	105,120
M-10	3,240	1.0E+3	0.0	10,800	205,200
M-11	3,240	1.0E+3	0.0	10,800	205,200
M-12	61,920	1.0E+3	25	28,800	64,080

Response to 3c.

The variability noted is an artifact of the random weather sampling used in MACCS2, which is briefly described in the next paragraph. The variation shown between the base case and the 95% evacuation case is not statistically significant and indicates the low sensitivity of the results to small variations in the evacuation effectiveness assumption.

The variability of consequence values in MACCS2 CCDFs (the CCDF is an estimate of the distribution of consequence magnitudes) is due solely to the uncertainty of the weather conditions existing at the time of the accident. A number of weather conditions is sampled from the input meteorological conditions and consequences calculated for each weather trial. Emergency-response scenarios combined using population fractions are a function of the consequence calculated for each meteorological trial/wind direction multiplied by the fraction of people assigned to the scenario. The values utilized in this analysis are the mean values of the sampled distribution trial results. The mean is the average (expected) consequence over all weather trials. This is calculated by taking the sum of all the products [(consequence value) × (associated probability of that value)] for each weather trial.

Response to 3d.

The US Bureau of the Census estimates that the national population of the US will grow about 4% for each five-year period in the interval 2010 to 2050 (see Reference). Applying the national growth rate to the 50-mile radius analysis zone for 2040 to 2045 produces a growth projection of only 4 %. Table G.3-2 shows that all of the SAMAs screened with costs at least twice the benefit, so it is concluded that the cost-benefit results are highly conservative relative to population uncertainties over a five-year period.

Dominion believes that the use of the year 2040, only five years prior to the end of the renewal period, is conservative. It is overly conservative to assume that the accidents occur at the end of the period of extended operation.

Reference:
U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin, available on the website "http://www.census.gov/ipc/www/usinterimproj/", Internet Release Date: March 18, 2004.

Response to 3e.

SECPOP2000 was not used in the analyses as it was not available in the time frame of the submittal preparation; however, actual Census 2000 population data, further projected to 2040, was used to update the SECPOP90 rosette population. Moreover, economic data in the SECPOP90 county data file was adjusted to 2001 dollars using the Consumer Price Index for the SAMA analysis. Consequently, the expected impact of using SECPOP2000 would be negligible.

Resorts are treated in the economic model as other businesses in the region. There is no reason not to expect that resorts are included in the official values for county wealth that have been used in preparing the MACC2 input. As economic enterprises, resorts are indistinguishable from the other contributors to the non-farm wealth. In addition, since many resorts are seasonal, treating them as any other business is considered conservative.

RAI 4. Since the MPS3 PRA does not include a complete external events model, external events were accounted for by increasing the benefit for SAMAs calculated by the internal events by 60%, which is approximately the relative magnitude of the estimated external events CDF. The SAMA identification process does not specifically address the identification of SAMAs for external events. In this regard, the following information is needed:

a. The NRC's SER for the MPS3 IPEEE gives a seismic contribution to CDF of 9.1E-6/year. This value is primarily based on the Millstone 3 PSS conducted in the early1980 and subsequently reviewed extensively by the NRC. Review the contributors to the seismic risk and discuss potential SAMA candidates based on this review including those identified in Section 5.3.1.2.5 of NUREG-1152.

b. Based on the information in the IPEEE SER the fire contribution to MPS3 CDF is 4.9E-06/year. The fire CDF is stated to be dominated by fires in the control room, cable spreading room, and charging and component cooling pump zones. For each zone, explain what measures were taken to further reduce risk, and explain why these CDFs can not be further reduced in a cost effective manner.

c. The approach of increasing the benefit determined from the internal events model by 60% to account for external events is valid only if the contributors affected by the SAMA make the same relative contribution for external events as for internal events. Justify this approach or include in the benefit analysis the extra contribution from external events for those SAMAs which might have a higher relative impact on risk from external events than internal events.

d. The ER indicates that for some SAMAs that relate only to specific internal event initiators, the benefits will not necessarily be multiplied. Please provide a list of those SAMAs that were not multiplied by the external event factor.

Dominion Response to RAI 4

Response to 4a.

The design basis earthquake for Millstone Unit No. 3 is 0.17g for a peak horizontal ground acceleration. The Probabilistic Safety Study (PSS) concluded that the dominant seismic plant damage state is a transient initiated by a loss of offsite power (which has a relatively low median acceleration capacity of 0.20g). Specifically, the PSS calculated the seismic CDF distribution as: loss of offsite power=63.0%; small LOCA=20.9%; large LOCA=7.2%;

ISLOCA=1.1%; and all others=7.8%. The SSCs necessary to mitigate a loss of offsite power event are:

1. Emergency diesel generators
2. Auxiliary feedwater pumps (including the water source, DWST)
3. Service Water pumps
4. Charging pumps
5. AC/DC switchgear

The PSS, published in 1983 and subsequently amended, reported the most limiting safety-related structures and components in terms of fragility to seismic acceleration. SSCs with a median acceleration capacity of greater than 2.5g in the Capacity and Equipment Response Factor screening were screened out, and are not discussed here. The SSCs relevant for the loss of offsite power scenario are:

Structure	Median Acceleration Capacity
EDG Enclosure Building	0.88g
DWST	1.60g
Control Building	1.00g
Intake Structure	1.30g
Auxiliary Building	1.40g
ESF Building	1.70g

Component	Median Acceleration Capacity
EDG	0.91g*
Charging system piping	2.17g (housed in the Aux. Building)
Service water pumps	2.40g (housed in the intake structure)
Motor-driven AFW pumps	3.30g (housed in the ESF building)
4160V switchgear	3.09g (housed in the control building)
125V DC Batteries	1.74g (housed in the control building)
125V DC Switchgear	1.71g (housed in the control building)

*In 1986 a design modification replaced the EDG lube oil cooler anchor bolts with bolts made of more seismically rugged material. As a result, the EDG median peak ground acceleration capacity increased to 1.13g and the high confidence, low frequency failure level increased to 0.38g.

The PSS further breaks down the seismic contribution to CDF as follows:

Ground Acceleration	% Seismic CDF
0.45g and 0.55g	45
0.35g	18
0.65g	13
0.80g	9
0.75g	7
0.25g	7
0.15g	<1

Per the PSS, the limiting SSCs for a seismic scenario and thus, potential SAMA candidates for risk reduction, are the EDG enclosure and the control building. However, both structures already have a median acceleration capacity that is double the ground acceleration of the largest seismic CDF scenario contributor (0.45 and 0.55g). Therefore, based on a large seismic margin with the dominant seismic CDF scenario, and the complexity associated with increasing the seismic capacity of a structure, no cost effective SAMAs were identified.

<u>Review of NUREG-1152 for potential SAMA candidates</u>:

In NUREG-1152, there were six alternatives presented in Section 5.3.1.2.5. These six alternatives were:

1) Improve the anchorage system of the emergency diesel generator lube oil coolers so that it could withstand an earthquake significantly beyond the SSE.
2) Improve the capability of the emergency diesel generator enclosure and the control building to withstand an earthquake significantly beyond the SSE.
3) Add a filtered vent system to the containment capable of withstanding an earthquake significantly beyond the SSE.
4) Add a dedicated AC-independent, RWST-independent containment spray system capable of withstanding an earthquake significantly beyond the SSE.
5) Add an AC-independent, manually operated containment spray system capable of drawing water from a water source that is qualified to a very high g-level.
6) Make no improvements.

In the NUREG-1152 analysis of these alternatives, the following points are noted:

- Alternative 1 has already been implemented at Millstone Unit 3.
- For alternative 2, the estimated cost was $10 Million to $150 Million (cost in 2004 would be even higher). Evaluation on page 5-21 of NUREG-1152 states that "improvement of

the building fragilities is not cost effective". Dominion concurs that because of the high cost, this need not be analyzed further.

- For alternative 3, the estimated cost was $4 Million to $20 Million on page 5-18 of NUREG-1152, and $8 Million to $40 Million on page 5-21 (the cost estimate in 2004 would be even higher; note that in SAMA #35, Dominion estimated the cost of a filtered vent system to be $12 Million to $18 Million). Page 5-21 of NUREG-1152 suggests that the offsite doses calculated in that report are conservative because they did not give the containment enough credit (NUREG-1037, which was in draft form at the time of NUREG-1152, is referenced). In any case, alternative 3, as originally considered, is cost-prohibitive, and need not be considered further. It should be noted that an existing Severe Accident Management Guideline, discussed in the response to RAI 8a, is designed to accomplish the intent of this alternative.
- For alternative 4, the estimated cost was $4 Million to $15 Million on page 5-19 of NUREG-1152, and $8 Million to $30 Million on page 5-22 (cost in 2004 would be even higher). Besides being cost-prohibitive, the analysis on page 5-22 indicates that the NUREG's analysis of person-rem averted was conservative, and also presents three other reasons why such a system is not recommended. Dominion concurs with the assessment, and this high cost alternative need not be analyzed further.

This leaves Alternatives 1 and 5 for consideration. Alternative 1 has already been implemented at Millstone Unit 3.

Alternative 5 is not considered cost-beneficial for several reasons:

- In NUREG-1152, the NRC stated that NUREG was conservative in regard to the strength of the containment (stated in the Recommendations section for Alternatives 3 and 4, but it also applies to the containment spray evaluation in Alternative 5).
- In the Millstone Unit 3 IPEEE, no seismic vulnerabilities were identified associated with the containment spray system. The NRC SER for the Unit 3 IPEEE states the following in the Containment Performance section, "... the weakest component of the quench spray system which is a diverse system for containment heat removal, has a HCLPF value of 0.46g (quench spray piping). Therefore, there is adequate ruggedness for the containment heat removal function. The seismic PRA did not uncover any other seismically unique containment performance vulnerabilities."
- The system (a dedicated fire truck was proposed in NUREG-1152) would require manual operation after a seismic event that was large enough to result in substantial damage to the plant, which limits the actual benefit of this option.
- The system would have to be capable of withstanding a substantial seismic event, which would make the cost at least on the upper end of the $400k to $2M estimate in NUREG-1152. An exact benefit has not been calculated, but a bounding approximation can be made by reviewing the benefit calculation of SAMA 77. In the response to SAMA RAI 7a, the benefit calculation of SAMA 77 is presented in some detail. SAMA 77 was calculated by setting the Loss of Offsite Power (LOP) frequency to zero in the

internal events model, yielding a CDF reduction of approximately 1E-5/year. A seismic CDF profile would be dominated by LOP/SBO sequences (NUREG-1152, page 5-14 estimated 85% of external events CDF to be from SBO). Since the seismic CDF for Millstone Unit 3 is 9.1E-6/year, the benefit calculation for LOP/SBO in SAMA 77 can be used to approximate the maximum benefit. As seen in the response to SAMA 7a, the total benefit from a complete elimination of approximately 1E-5 of LOP/SBO CDF is $396,921 (the 1.6 external events multiplier does not apply to this seismic calculation). The proposed fire truck connection to containment spray would provide no real benefit to the seismic CDF, but would offer some potential for source term reduction. The Level 2/Level 3 benefit shown as "Offsite Dose Savings" and "Offsite Prop Cost Savings", respectively, total a benefit of approximately $153,000. Even if this amount were doubled to account for uncertainties, the bounding benefit from a 100% successful system would be $306,000. As this value is well below the expected cost, and since the benefit calculation here is believed to be conservative because the proposed system would not be 100% effective, this concept is judged not to be cost beneficial.

Response to 4b.

<u>Cable Spreading Area (CB-8) in the PSS (section 2.5.2.1.2)</u>:

The Cable Spreading Area (CSA) has both ion and photo-electric detection systems, which actuate the automatic total flooding CO_2 suppression system (note that currently the CO_2 system is locked out for personnel safety reasons, but the system can be manually initiated). If the automatic CO_2 suppression system fails to actuate, the Fire Brigade would be sent into the CSA to manually suppress and extinguish the fire using the hose stations (1.5" hose stations are available in this area; 2.5" hose connections are available in the Control Building stairwell on this elevation [24'6"], the Tech Support Center Elev. 11' 6", and Service Building Elev. 24' 6") and portable extinguishers. Portable fire extinguishers are provided in the CSA based on NFPA guidelines for location and spacing.

In the PSS, the total contribution to core damage in the CSA is 9.89E-07/yr (PSS Table 2.5.2.3-1). Millstone Unit 3 has since added an Incipient Fire Detection (IFD) system (LAR dated April 15, 2004, serial no. 04-070, docket no. 50-423, license no. NPF-49), which results in a reduction of the total contribution to core damage in the CSA to about 3.75E-07/yr, resulting in a delta-CDF of <u>6.14E-07/yr</u> (this also assumes that the CO_2 system cannot automatically actuate). If the detection systems were further improved until detection was always successful, the contribution to core damage in the CSA would be about 3.00E-07/yr, resulting in a delta-CDF of 6.89E-07/yr from the PSS value, and a delta-CDF of <u>7.5E-08/yr</u> from the current configuration with the IFD installed. Improvements to obtain such a small decrease in risk would not be cost-effective. Another option would be to increase the success of the fixed suppression system. If the system never fails, the contribution to core damage in the CSA would be about 6.21E-07/yr, resulting in a delta-CDF of 3.68E-07/yr. Note that this assumes the original systems for detection are available (i.e., pre-IFD). Improvements to obtain such a small decrease in risk would not be cost-effective. A third option would be to separate the trains in the CSA. This would be a large project, since cables and trays cross over each other or are adjacent to each other in many locations. Cables and trays would have to be wrapped with fire-retardant wrap in all of these locations. The maximum risk benefit would be to reduce the contribution to core damage in the CSA to 0, resulting in a delta-CDF of 9.89E-07/yr. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $2M to $10M depending on the specific details. The low end of the cost estimate range includes design and installation of improvements to the existing Incipient Fire Detection (IFD) system in the Cable Spreading area, additional training for the operators, new and revised procedures, and all Engineering and Construction services related to the design and implementation of Design Change Packages. This would also require ongoing O&M costs to maintain and test the system regularly. If a redundant detection system is necessary to achieve the desired reliability, it would be covered within the cost estimate range. Within the cost range includes design and installation of improvements to the fixed suppression system. This would increase confidence, but probably not achieve assurance of 100% success of the system. This would also require training and procedures support, as well as ongoing O&M costs to maintain and test the system regularly. If a redundant detection system is necessary to achieve the desired reliability, it would be covered within the cost estimate range. The high end of the cost estimate range includes an allowance to design and implement a Design Change Package to separate the trains' cables in the Cable Spreading area by installing fire-retardant wrap on all cables and/or cable trays in the Cable Spreading area. Although expected to be quite large, it is unknown how extensive this effort would actually be, and it may not be feasible. Therefore, there are no apparent cost-effective changes that could be made in the CSA to reduce the risk.

Control Room (CB-9) in the PSS (section 2.5.2.1.3):

The Control Room (CR) has single-zone smoke detectors located on the underside of the concrete ceiling. There are also ceiling-mounted smoke detectors located within the Main Control Board cabinets. Detection transmits to the main fire protection panel located in the CR, which sounds an alarm and indicates where the detector(s) are. The system is designed, installed, and maintained according to NFPA standards, and inspected regularly. In addition to the smoke detectors, there are several personnel in the CR on a continuous basis. Only manual suppression is available for fires in the CR. Hose stations and connections are located outside the CR in two opposite locations (1.5" hose stations and 2.5" hose connections available in Service Building Elev. 49' 6", and Control Building stairwell Elev. 24' 6" and 47' 6"). Portable fire extinguishers are provided in the CR based on NFPA guidelines for location and spacing.

In the PSS, the total contribution to core damage in the CR is 7.28E-07/yr (PSS Table 2.5.2.3-1). If the detection systems were improved until detection was always successful, the contribution to core damage in the CR would be about 7.17E-07/yr, resulting in a delta-CDF of 1.1E-08/yr. Improvements to obtain such a small decrease in risk would not be cost-effective. There is no fixed suppression system in the CR. Improvements to the success of the manual suppression probability are difficult to quantify. The current values are based on generic data. It could be postulated that extensive training may reduce the failure probability of manual suppression. If the probability of failure is reduced by 50%, the contribution to core damage in the CR would be about 3.70E-07/yr, resulting in a delta-CDF of 3.58E-07/yr. Improvements to obtain such a small decrease in risk would not be cost-effective. A third option would be to separate the trains in the CR. This would be a large project, since all of the Main Control Boards that contain cables for safe shutdown equipment contain cables from both trains, and many are adjacent to each other in many locations. Cables would have to be wrapped with fire-retardant wrap in all of these locations. The maximum risk benefit would be to reduce the contribution to core damage in the CR to 0, resulting in a delta-CDF of 7.28E-07/yr. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $0.5M to $12M depending on the specific details. The low end of the cost estimate range includes extensive personnel training to reduce the failure probability of manual suppression. Within the cost estimate range includes design and installation of improvements to the existing fire detection system in the MCR similar to the existing ionization detector system, additional training for the operators, new and revised procedures, and all Engineering and Construction services related to the design and implementation of Design Change Packages. This would increase confidence, but probably not achieve assurance of 100% success of the system. If a redundant detection system is necessary to achieve the desired reliability, it would be covered within the cost estimate range. This would also require ongoing O&M costs to maintain and test the system regularly. The high end of the cost estimate range includes an allowance to design and implement a Design Change Package to separate the trains' cables in the MCR by installing fire-retardant wrap in the Main Control Boards. Although expected to be quite large, it is unknown how extensive this effort would actually be, and it may not be physically feasible. Therefore, there are no apparent cost-effective changes that could be made in the CR to reduce the risk.

Charging Pumps and RPCCW Pumps (AB-1) in the PSS (section 2.5.2.1.8):

The Charging and RPCCW pump area (AB-1) contains single zone smoke detectors located in areas with appreciable combustible loading. The smoke detectors actuate an automatic closed head wet pipe sprinkler system for water curtain protection between the Charging pump cubes and RPCCW pumps, which also helps suppress fires in cable trays, vent ducts, etc. Hose stations and portable fire extinguishers are provided in this area based on NFPA guidelines for location and spacing.

In the PSS, the total contribution to core damage in AB-1 is 1.07E-06/yr (PSS Table 2.5.2.3-1). If the detection systems were improved until detection was always successful, the contribution to core damage in AB-1 would be about 4.47E-08/yr, resulting in a delta-CDF of 1.03E-06/yr. Plant modifications and analyses to obtain the risk reduction would be extensive and costly, and therefore, the improvements would not be cost-effective. Improvements to the success of the manual suppression probability are difficult to quantify, since the current values are based on generic data. If the success of the fixed suppression system was increased, such that the system never fails, the contribution to core damage in AB-1 would be about 1.06E-06/yr, resulting in a delta-CDF of 1.0E-08/yr. Improvements to obtain such a small decrease in risk would not be cost-effective. A third option would be to separate the Charging system from the RPCCW system in AB-1 by building a fire wall, thereby precluding a total loss of RCP seal cooling event due to a fire. This would be a very large project, since many of the cable trays and conduits in the room would have to be moved to accommodate the wall, and to ensure that the systems are truly separated. The maximum risk benefit would be to reduce the contribution to core damage in AB-1 to 0, resulting in a delta-CDF of 1.07E-06/yr. However, the cost of the project would be very high, so as to make the project not cost-effective. Costs for design and implementation of the above referenced solutions could be in the range of $1M to $10M depending on the specific details. The low end of the cost estimate range includes design and installation of improvements to the existing fire detection system in the Charging and RPCCW Pump area to increase reliability. This may involve a redundant system and would increase confidence, but probably not achieve assurance of 100% success of the system. The high end of the cost range includes design and implementation of a Design Change Package to separate the train cables by installing fire barriers in the Charging and RPCCW Pump area and relocating all cables and cable trays to separate the Charging system from the RPCCW system. Therefore, there are no apparent cost-effective changes that could be made in AB-1 to reduce the risk.

Response to 4c.

For the Millstone SAMA analyses, the external events factor was utilized because the external events analyses are not readily quantifiable. Increasing the benefit assessment by a ratio of the (internal CDF + external CDF)/internal CDF makes the implicit assumption that the consequences from the external events sequences are proportional to the consequences of the internal events sequences. In some respects, this assumption is conservative in that the external events sequences are generally dominated by loss of offsite power and SBO, which do not have high offsite consequences relative to other internal events in a large, dry containment such as Millstone. This is demonstrated by reviewing the benefit calculations for SAMAs 77 and 73 from the Environmental Report Table G.3-2. SAMA 77, which calculated benefit by setting all LOOP/SBO frequency to zero, yielded a CDF reduction of 38.4% but an offsite dose reduction of only 30.0%. SAMA 73, which set all diesel failures to zero yielded a CDF reduction of 29.9% but an offsite dose reduction of only 24.2%.

Nonetheless, it is possible that the CDF benefit of SAMAs related to LOOP and particularly SBO may have a higher proportional external events contribution than the internal events contribution. Therefore, to demonstrate the robustness of the analysis, the SAMA cost/benefit analyses were re-examined with the external events factor doubled. For Millstone Unit 3, the factor is doubled from 60% to 120% and doubled again to account for uncertainties. These conservative benefits were compared to the associated cost estimates and almost all SAMAs still had costs greater than the benefit, even after doubling the benefit to account for uncertainties. Only two SAMAs, #112 and #168, had benefits that slightly exceeded the lower bound of the cost estimate range. For these two SAMAs, further evaluation is presented below.

SAMA #112 is to proceduralize local manual operation of turbine driven AFW when control power is lost. This SAMA is primarily of benefit in SBO scenarios. However, for SAMA #112, the SBO benefit in the external events analysis would be less than the proportional internal events SBO benefit. Maintaining AFW during an SBO provides a benefit to the internal events model because it allows greater time to recover offsite power before core damage occurs due to either inventory loss from a seal LOCA or due to loss of heat removal. In external events PRA analyses, offsite power recovery is typically not credited for the first 24 hours, so core damage is assumed to occur anyway due to either a seal LOCA or depletion of the AFW water supply. The external events benefit increase of 60% that was used in the Environmental Report is therefore judged to be acceptable in the analysis of SAMA #112. Additionally, as discussed in the responses to RAIs 7f and 7g, the lower end of the cost range would only pertain to non-SBO scenarios, in which the plant continued to have level indication and a plant modification was not necessary. In the event of an SBO, a modification would be necessary to provide level indication, thus making this SAMA non-cost beneficial, even with the additional conservatism calculated for external events.

It should be noted that the benefit calculated in the ER for this SAMA was derived by using the very conservative assumption that the probability of recovery of offsite power during the first 24 hours is zero. During the preparation of this response, Dominion evaluated this SAMA more closely and determined that it would be more appropriate to set the probability of recovery of offsite power to 0.1. Adding this one realism into the scenario brought the benefit (including adding 120% for external events, followed by doubling) out of the range of the cost ($68,000, versus $100,000-300,000).

Nonetheless, as discussed in the response to 7f, Dominion will evaluate the incorporation of a new Severe Accident Management Guideline that provides guidance on manual control of the TDAFW pump.

SAMA #168 is to automate Feed and Bleed after a loss of secondary heat removal. This SAMA would be of no benefit for SBO scenarios because feed and bleed cannot be achieved without power. As discussed in the response to RAI 4a, NUREG-1152 estimates that 85% of external events CDF is from SBO. Therefore, the external event increase of 60% utilized in the Environmental Report is judged to be acceptable, and perhaps even conservative, in the analysis of SAMA 168. Thus, this is not a SAMA "which might have a higher relative impact on risk from external events than internal events," as requested in the RAI. In addition, the benefit calculation did not take into account the negative impacts that this SAMA would create. Besides creating additional means for a spurious PORV opening or safety injection, automating feed and bleed would take away some of the control that the operator would have over the plant if secondary heat removal were lost.

Response to 4d.

The initiating events for which the external event multiplier does not need to be applied are ISLOCAs and SGTR initiating events. These initiating events bypass the containment as part of the initiating event, and therefore may have relatively high offsite consequences. In the external event initiators (fire, seismic, etc.) the representative initiating events in terms of plant response are generally either: Turbine Trip with or without Main Feedwater and Condensate, Loss of Offsite Power, or RCP Seal LOCA. Since none of these external events initiators involve containment bypass as part of the initiating event, it would not be appropriate to increase the SAMAs dealing with these initiators by the external events factor.

The SAMAs in Table G.3-2 for which the benefits were not increased by the external events multiplier are: 87, 93, 94, and 99. Table G.3-2 shows that the cost/benefits of these four SAMAs are:

SAMA 87: Cost = $175-200M; Benefit = $144,816
SAMA 93: Cost = $9-12M; Benefit = $83,596
SAMA 94: Cost = $2-4M; Benefit = $83,596
SAMA 99: Cost = $4-6M; Benefit = $83,596

Therefore, even if the external events factor had been applied to these, they would still have screened out by more than an order of magnitude.

RAI 5. The discussion of the consideration of uncertainties in the evaluation of the SAMAs is not clear. In this regard, the following information is needed:

a. In the discussion of cost-benefit analysis in Attachment E Section 4.20.2.2 and in the corresponding sections of Appendix G, it is stated that a factor of two is used to account for uncertainties in the cost estimates, while sensitivity analyses were used to account for the uncertainties in the determination of benefits. The impact of uncertainty in CDF and the various release categories apparently has not been considered. Provide an estimate of the uncertainties associated with the calculated core damage frequency (e.g., the mean and median CDF estimates and the 5^{th} and 95^{th} percentile values of the uncertainty distribution). Indicate whether any peer review comments were provided on uncertainty analysis, and if so, what is planned to address the comment(s).

b. Provide an assessment of the impact on the initial and final screening if risk reduction estimates are increased to account for uncertainties in the risk assessment. Please consider the uncertainties due to both the averted cost-risk and the cost of implementation to determine changes in the net value for these SAMAs.

c. Section G.3.3 says that to account for uncertainties, the benefit or each SAMA list in Table G.3-2 are doubled for the purposes of the comparison with its cost, except for the SGTR and ISLOCA SAMAs. The values in the table do not appear to have been doubled. Please clarify if the values in the table have been doubled.

d. Please justify the last phrase of the first full paragraph on page E-G-37

"... except for SGTR and ISLOCA SAMAs."

This is believed to be an error and applicable to the increase by 60% to account for external events.

e. Potential impact of a power uprate was assessed by a sensitivity case in which core inventory scaling factor was increased by 10%. There is no indication that the replacement power costs were also scaled up by 10%, thus this sensitivity study appears incomplete. Provide a reassessment this case based on appropriate scaling of both core inventory and replacement power costs.

Dominion Response to RAI 5

Response to 5a.

CDF uncertainty calculations are not available in the current version of the Millstone PRA models. Some insight can be obtained by reviewing the RAI responses to some other utility License Renewal applications. Reviewing the North Anna Power Station, Surry Power Station and D.C. Cook license renewal RAIs, the 5th percentile CDF in each is approximately 2.3 times less than the mean CDF, while the 95th percentile CDF ranged from a factor of 2.0 to a factor of 6.4 greater than the mean CDF. Consistent with traditional PRA approaches, the Millstone SAMA analyses were performed using the mean (best estimate) CDF. To provide an extra measure of conservatism, Dominion chose to compare twice the benefit calculations to the costs, to provide conservatism in a global manner. Additional conservatism appears in the bounding approach taken in the benefit calculations, in which portions of the PRA model were set to 100% successful to analyze SAMA benefits. In some cases, an entire initiating event was even set to zero. In reality, no SAMA would be 100% successful, and in many cases, the benefit estimates in the Environmental Report would be substantially less if a detailed PRA analysis were performed for each SAMA. However, in most cases, the cost of the SAMA far outweighed even the conservative benefit calculations, so refined analysis was not needed.

To provide insight into some of the uncertain areas of the analysis, the Environmental Report also presented several sensitivity calculations. These sensitivities showed that the conclusions of the SAMA analyses did not change even when some of the uncertainties are considered.

Because the uncertainties are accounted for through conservatisms in the bounding benefit calculations and in the "factor of two" criterion applied when comparing benefits with costs, the conclusions of the SAMA analysis are not expected to change as a result of a quantitative uncertainty analysis.

In the response to RAI 1c, the peer review comments are presented. Comment B37 notes that no uncertainty analysis was performed for the PRA. This is intended to be addressed in a future update.

Response to 5b.

The uncertainties in the cost of implementation are estimated in Table G.3-2 by presenting a range of anticipated costs. To account for uncertainties in the SAMA benefit calculations, Table G.3-2 presented that the low end of the cost range of each SAMA was more than twice the calculated benefit. A factor of two to account for uncertainties has been used in other license renewal Environmental Reports, and is considered by Dominion to adequately address uncertainties in the Millstone Unit 3 SAMA submittal. Although many of the benefit calculations in Table G.3-2 are very conservative in their bounding approach, the Millstone submittal still chose the criterion of a factor of two increase in benefit to provide strong confidence that benefits were not underestimated. This factor was intended to cover uncertainties in the Level 1, 2 and 3 PRA analyses.

In addition to Dominion's position that the factor of two is sufficient to account for uncertainties, there is substantial margin between the mean benefit calculations and the estimated range of costs. All of the SAMAs in Table G.3-2 show a cost that is at least 10 times the mean benefit, except the following: SAMA #21 has a cost estimate that is 3.5 to 7 times the mean benefit. SAMA #77 has a cost estimate that is 9-16 times the mean benefit. SAMA #112 has a cost estimate that is 2.3 to 7 times the mean benefit. SAMA #168 has a cost estimate that is 2.1 to 6 times the mean benefit.

Response to 5c.

The statement in RAI 5c is correct - the numbers appearing in Table G.3-2 are not doubled. During the cost/benefit analysis, the cost was compared to twice the benefit, to ensure conservatism in the conclusions. This fact is stated in the last column of Table G.3-2, where all SAMAs are stated to have a cost that is "> 2 x Benefit".

Response to 5d.

The phrase "except for SGTR and ISLOCA SAMAs" should not appear in that sentence, because the sentence is referring to the doubling (or cost > 2 x Benefit) that was used as the screening criterion for all the SAMAs in Table G.3-2.

Response to 5e.

The replacement power costs were not increased by 10% in Sensitivity Case 6. The following shows a reassessment of the sensitivity with the replacement power costs increased by 10%:

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table G.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
9	Provide additional SW pump that can be connected to either SW header.	$164,796	$170,579	$174,523
10	Create an independent RCP seal cooling system, with dedicated diesel.	$419,846	$433,250	$443,788

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table G.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
11	Create an independent RCP seal cooling system, without dedicated diesel.	$419,846	$433,250	$443,788
20	Procedural guidance for use of cross-tied CCW or SW pumps.	$14,099	$13,923	$14,695
21	Loss of CCW or SW procedural enhancements.	$14,099	$13,923	$14,695
34	Install a containment vent large enough to remove ATWS decay heat.	$103,371	$104,112	$108,393
35	Install a filtered containment vent to remove decay heat.	$110,796	$114,672	$117,367
36	Install an unfiltered hardened containment vent.	$110,796	$114,672	$117,367
43	Create a reactor cavity flooding system.	$344,756	$370,811	$370,821
44	Creating other options for reactor cavity flooding.	$344,756	$370,811	$370,821
60	Provide additional DC battery capability.	$42,753	$44,328	$45,323
61	Use fuel cells instead of lead-acid batteries.	$42,753	$44,328	$45,323
63	Improved bus cross tie ability.	$429,606	$440,439	$453,294
64	Alternate battery charging capability.	$42,753	$44,328	$45,323
67	Create AC power cross tie capability across units.	$170,796	$177,111	$181,081
73	Install gas turbine generators.	$500,060	$514,687	$528,482
75	Create a river water backup for diesel cooling.	$11,116	$11,390	$11,730
76	Use firewater as a backup for diesel cooling.	$11,116	$11,390	$11,730
77	Provide a connection to alternate offsite power source (the nearest dam).	$635,074	$653,263	$671,014
80	Create an auto-loading of the SBO diesel.	$47,432	$49,179	$50,285
87	Replace steam generators with new design.	$144,816	$151,059	$152,061
93	Additional instrumentation and inspection to prevent ISLOCA sequences.	$83,596	$85,023	$85,245

SAMA No.	Potential Improvement	Baseline	Case 6, as shown In ER Table G.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
94	Increase frequency of valve leak testing.	$83,596	$85,023	$85,245
99	Ensure all ISLOCA releases are scrubbed.	$83,596	$85,023	$85,245
100	Add redundant and diverse limit switch to each containment isolation valve.	$133,754	$136,038	$136,392
112	Proceduralize local manual operation of AFW when control power is lost.	$42,753	$44,328	$45,323
113	Provide portable generators to be hooked in to the turbine driven AFW train, after battery depletion.	$38,403	$39,819	$40,714
120	Create passive secondary side coolers.	$532,887	$542,291	$561,053
123	Provide capability for diesel driven, low pressure vessel makeup.	$396,036	$409,411	$418,506
124_125	Provide an additional high pressure injection pump with independent diesel.	$42,800	$43,328	$44,923
138	Create automatic swapover to recirculation on RWST depletion.	$19,802	$19,984	$20,773
156	Secondary side guard pipes up to the MSIVs.	$335,690	$346,699	$352,877
160	Install turbine driven AFW pump.	$712,156	$729,875	$749,273
161	Install SBO diesel.	$105,417	$109,304	$111,760
162	Install Charging system train.	$103,348	$105,498	$108,831
164	Install Safety Injection train.	$42,800	$43,328	$44,923
168	Automate Feed and Bleed.	$480,825	$491,278	$504,598
169	Improve boron injection reliability with new procedure and hardware.	$0	$0	$0
170	Add another AOV to isolate SW.	$143,769	$149,203	$152,481
171	Install another RSS parallel flow path.	$28,804	$29,704	$30,480
172	Add a redundant train of RSS.	$28,804	$29,704	$30,480
173	Add additional SW AOVs (ATC/ATO).	$143,769	$149,203	$152,481
175	Add a redundant DC bus.	$6,967	$7,241	$7,380
176	Add a redundant charging pump.	$103,348	$105,498	$108,831
177	Add a redundant block valve for the PORV.	$55,118	$56,664	$58,248

SAMA No.	Potential Improvement	Baseline	Case 6, as shown in ER Table G.3-3	Case 6, with CORSCA = x 1.1 and replacement power costs x 1.1
178	Add redundant MSIVs.	$10,010	$10,120	$10,497
179	Add a redundant SW pump ventilation train.	$34,651	$35,552	$36,499
180	Add a redundant valve in series to isolate the steam line dumps to condenser.	$44,258	$44,556	$46,400
182	Add redundant AC bus.	$429,606	$440,439	$453,294
183	Add redundant AFW flow path.	$11,234	$11,396	$11,792
184	Add redundant demineralized water storage tank (DWST).	$9,844	$9,946	$10,332

Increasing the replacement power costs by 10% in this sensitivity case increases the benefit by a few percent, but the conclusion of the sensitivity is unchanged - that a 10% increase in power would not have a significant impact on the SAMA analyses.

RAI 6. Please provide the following information regarding the initial list (Table G.3-1) of candidate improvements:

a. For each dominant contributor (in Table G.3-4), provide a cross-reference to the SAMA(s) evaluated in the ER (Table G.3-1) that address that contributor. If a SAMA was not evaluated for a dominant risk contributor, justify why SAMAs to further reduce these contributors would not be cost-beneficial.

b. The use of Criterion B (already implemented at MPS2) to screen out SAMAs identified from review of the PRA is misleading. The proposed SAMAs from the review of the PRA should address the cause of the CDF contributor in the PRA. If the importance of the item after implementation, as indicated by the PRA, is high enough to suggest a potential SAMA, a further quantitative evaluation would appear warranted. For example, the evaluation of SAMA 166 is subsumed by SAMA 32 which in turn was screened out on the basis that the risk significance of adding an AC-independent containment spray has been previously evaluated and found to be not cost effective by a significant margin. The relevance of this to the MPS3 SAMA which does not mention AC-independence is not clear. SAMA 166 is presumably in the list because a related basic event is in the FV importance list for MPS3. SAMA 159, concerning a redundant RSS logic train, is screened out as not needed. Please provide a further quantitative evaluation of those SAMAs identified from the PRA that were screened out using Criterion B.

c. ER indicates 52 SAMAs remained for after initial screening. If 124/125 count as one SAMA, 51 SAMAs remain. Briefly explain.

d. The third item in the FV importance (Table G.3-4) is operator failure to establish direct recirculation with an event probability of 0.5. Please describe the operator error and discuss the benefit of SAMAs for either automating this action or improving the procedures and/or training for this action which contributes to 17.8% of the CDF.

e. The MPS3 specific SAMAs related to the SW system address only SW AOVs (SAMA 170 and 173) and SW pump ventilation (SAMA 179). Please review the contributors to SW failure and further consider additional SAMA candidates, e.g., operator actions to cope with or recover from AOV failures.

f. ***Please discuss the disposition of the various recommendations made in Sections 5.3.1 and 5.3.2 of NUREG-1152. Indicate whether they have been implemented. If not, please explain why within the context of this SAMA study.***

Dominion Response to RAI 6

Response to 6a.

As shown in RAI 1a, the latest version of the model available at the time was used to determine the plant specific SAMAs which was different from the latest version available at the time for quantification. Below is a comparison between the two versions of the model to demonstrate that the plant specific SAMAs chosen by the previous model were overly conservative compared to those that would have been chosen with the latest model.

Notice that only those Basic Events that were considered as a system, structure, component, or human action were considered as a potential SAMA. The Basic Events that were not considered as a potential risk contributor include some Initiating Events, Flag Events, or Fraction/Factor Events identified as N/A in the table below. Such basic events do not have a significant meaning in an importance list, and do not translate well into specific alternatives for the plant.

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
%SMLOCA	%SLOCA	SMALL BREAK LOCA	2.52E-01	8.81E-02	N/A
%GPT	%GPT	GENERAL PLANT TRANSIENT	2.33E-01	2.71E-01	N/A
OADIRREC	OAPDIRECTINJ	OPERATORS FAIL TO ESTABLISH DIRECT RECIRCULATION	2.12E-01	2.11E-05	N/A
%LOOPPC	%LOOPPC	LOSS OF OFFSITE POWER (PLANT-CENTERED EVENTS)	1.78E-01	2.35E-01	N/A
FWMODX4	FWXP5FWAP2FN	TURBINE DRIVEN AFW PUMP 3FWA*P2 FAILS	1.48E-01	3.02E-01	160
OARECS	OAPRECS	OPERATORS FAIL TO ESTABLISH SUMP RECIRCULATION FOLLOWING A SMALL LOCA	1.41E-01	7.52E-03	138
%ITLOCA	%ITLOCA	INCORE INSTRUMENT LOCA	1.01E-01	2.06E-03	N/A
OABAF	OAPBAF	OPERATORS FAIL TO ESTABLISH BLEED AND FEED	9.33E-02	2.78E-01	168
ACBDG3EGSBFN	ACBDG3EGSBFN	DIESEL GENERATOR 'B' FAILS AFTER FIRST HOUR	9.22E-02	1.47E-01	161
ACADG3EGSAFN	ACADG3EGSAFN	DIESEL GENERATOR 'A' FAILS AFTER FIRST HOUR	8.25E-02	1.18E-01	161
RSMODC2	CHCMH8511XF2	CCF TO CLOSE OF *8511A(B) OR *8512A(B) (FAILS TO SATISFY *8804 OPENING LOGIC)	7.29E-02	2.63E-03	162
	CHCMH8512XF2			2.63E-03	
RTELEC	RPSFAILURE	REACTOR TRIP FAILURE (SIGNAL, COILS, BREAKER)	6.48E-02	5.48E-02	144
%LOOPWR	%LOOPWR	LOSS OF OFFSITE POWER (WEATHER RELATED EVENTS)	6.34E-02	9.50E-02	N/A
RSMODA8	RHAMV8812AFF	MV8812A FAILS TO CLOSE (PERMITS MV8837/8A TO OPEN)	5.28E-02	1.47E-02	162
RSMODB12	RHAMV8812BFF	MV8812B FAILS TO CLOSE (PERMIT 3RSS*MV8837/8B TO OPEN)	5.21E-02	1.52E-02	162
RTMECH	STUCKROD35	REACTOR TRIP FAILS DUE TO MECHANICAL ROD BINDING	4.40E-02	3.73E-02	169
FWCP0FWAP1NN	FWCP0FWAP1N2	CCF TO START OF MD AUX FEEDWATER PUMPS FW*P1A AND FW*P1B (SCREENING FACTOR)	3.35E-02	9.24E-02	160
RSMODA9	SIAMVR8814FF	3SIH*MV8920 OR 3SIH*MV8814 FAIL TO CLOSE	3.27E-02	4.97E-03	164
OATRIP	OAPTRIPLC	OPERATORS FAIL TO OPEN SUPPLY BREAKERS TO MG SETS	3.24E-02	3.04E-04	144
RSMODA11	SWACPCDA78FF	3SWP*MOV71A FAILS TO CLOSE	3.18E-02	1.81E-02	170
RSMODB17	SWBCPCDA78FF	3SWP*MOV71B FAILS TO CLOSE	3.14E-02	1.88E-02	170
%RT	%RT	REACTOR TRIP	3.03E-02	0.00E+00	N/A
RSMODA7	RSAMV8837ANN	MOTOR OPERATED VALVE 3RSS*MV8837A FAILS TO OPEN	2.88E-02	6.66E-03	171
RSMODB11	RSBMV8837BNN	MOTOR OPERATED VALVE 3RSS*MV8837B FAILS TO OPEN	2.85E-02	6.90E-03	171
RSMODCRSS	HVCACAC2ABN2	CCF OF ALL RSS TRAINS FOR CORE COOLING	2.65E-02	5.55E-03	172
RSMODC6	SWCMSV50ABF1	CCFs OF SW VALVES 3SWP*MOV50A,B & 3SWP*MOV71A,B	2.38E-02	1.14E-02	173
	SWCMSV71ABF1			1.14E-02	
RCPSL400	RCPSEALLOCA	PROBABILITY OF RCP SEAL LEAK (0-400 GPM)	2.37E-02	1.96E-01	10
RHXVMRHV43NX	RHXVMRHV43NX	MANUAL VALVE 3RHS*V43 MISALIGNED OPEN	2.32E-02	3.78E-03	N/A
RSMODB10	SIBMVR8813FF	MOTOR OPERATED VALVE 3SIH*MV8813 FAILS TO CLOSE	2.27E-02	7.30E-03	164
RSMODA5	CHAMV8512AFF	MOTOR OPERATED VALVE 3CHS*MV8512A FAILS TO CLOSE	2.24E-02	6.83E-03	162
RSMODA16	CHAMV8511AFF	MOTOR OPERATED VALVE 3CHS*MV8511A FAILS TO CLOSE	2.24E-02	6.83E-03	162
RSMODB16	CHBMV8511BFF	MOTOR OPERATED VALVE 3CHS*MV8511B FAILS TO CLOSE	2.23E-02	7.39E-03	162

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
RSMODB7	CHBMV8512BFF	MOTOR OPERATED VALVE 3CHS*MV8512B FAILS TO CLOSE	2.23E-02	7.39E-03	162
FWBP0FWP1BBQ	FWBP0FWP1BBQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B OOS FOR MAINTENANCE	2.22E-02	9.27E-02	160
RSMODC4	SIBCPCCP1BFF	COMMON CAUSE FAILURES OF RSS FOR HIGH PRESSURE RECIRC USING SI OR CHG	2.15E-02	2.10E-02	172
	SIACPCCP1AFF			2.05E-02	
%LOOPGR	%LOOPGR	LOSS OF OFFSITE POWER (GRID RELATED EVENTS)	2.12E-02	2.90E-02	N/A
OSPRN1WR	OSPRN1WR	FAILURE TO RECOVER WEATHER-RELATED LOOP - PORVs,AFW AVAIL (0-400 GPM)	2.06E-02	3.19E-02	161
RSMODA6	RHAMV8804ANN	MOTOR OPERATED VALVE 3RHS*MV8804A FAILS TO OPEN	2.05E-02	6.66E-03	164
RSMODB8	RHBMV8804BNN	MOTOR OPERATED VALVE 3SIL*MV8804B FAILS TO OPEN	2.02E-02	6.90E-03	164
QSMODC1	QSCP4QSSP3N2	COMMON CAUSE FAILURES	1.85E-02	0.00E+00	166
ESBBIP456ENF	ESBBIP456ENF	BISTABLE P456E FAILS HIGH OUTPUT	1.69E-02	1.00E-02	177
ESABIP455ENF	ESABIP455ENF	BISTABLE P455E FAILS HIGH OUTPUT	1.69E-02	9.77E-03	177
%DCBSI301AFN	%DCBSI301AFN	METAL ENCLOSED DC BUS 301A1 BUS-TO-GROUND SHORT	1.49E-02	3.89E-02	175
CHAP9CHP3AFN	CHAP9CHP3AFN	CHARGING PUMP 3CHS*P3A FAILS TO RUN	1.47E-02	1.18E-02	176
RSMODA3	SWAMVMV50AFF	3SWP*MOV50A FAILS TO CLOSE	1.46E-02	1.47E-02	170
CHBP9CHP3BFN	CHBP9CHP3BFN	CHARGING PUMP 3CHS*P3B FAILS TO RUN	1.44E-02	1.13E-02	176
%DCBSI301BFN	%DCBSI301BFN	METAL ENCLOSED DC BUS 301B1 BUS-TO-GROUND SHORT	1.44E-02	3.73E-02	175
RSMODB3	SWBMVMV50BFF	3SWP*MOV50B FAILS TO CLOSE	1.44E-02	1.52E-02	170
RSBP6BTRAINQ	RSBP6TRAIN2Q	RSS TRAIN 'B' OOS FOR TEST/MAINTENANCE	1.43E-02	3.72E-03	170
%SWMODA23	%SWP3ISW1AFN	SERVICE WATER PUMP TRAIN 'A' FAILS TO RUN	1.26E-02	1.06E-02	9
CHMODB01	CHBP9CHP3BNN	CHS PUMP 3CHS*P3B FAILS TO START	1.25E-02	1.61E-02	176
%LMFW	%LMFW	LOSS OF MAIN FEEDWATER	1.22E-02	1.47E-02	N/A
%SWMODB24	%SWP3ISW1DFN	SERVICE WATER PUMP TRAIN 'D' FAILS TO RUN	1.17E-02	9.98E-03	9
FWCP0FWAP1FN	FWCP0FWAP1N2	CCF TO RUN OF MD AUX FEEDWATER PUMPS FW*P1A AND FW*P1B (SCREENING FACTOR)	1.17E-02	9.24E-02	160
RCMODA2	RCAPVV455AFF	PORV 455A AUTOMATIC RESEAT CIRCUITRY FAILURE	1.14E-02	5.75E-03	177
RCMODB12	RCBPVPV456FF	PORV 456 AUTOMATIC RESEAT CIRCUITRY FAILURE	1.14E-02	5.89E-03	177
ACMODB15	ACBDMDM26BFF	ENCLOSURE 'B' VENTILATION DAMPERS FAIL TO REPOSITION	1.06E-02	1.05E-02	167
RSAP6ATRAINQ	RSAP6TRAIN1Q	RSS TRAIN 'A' OOS FOR TEST/MAINTENANCE	1.01E-02	1.53E-03	172
ACMODSBO	ACXBGSBODGNN	SBO DIESEL FAILS	1.01E-02	1.53E-02	161
%SWMODB23	%SWP3ISW1BFN	SERVICE WATER PUMP TRAIN 'B' FAILS TO RUN	1.00E-02	1.01E-02	9
%SWMODA24	%SWP3ISW1CFN	SERVICE WATER PUMP TRAIN 'C' FAILS TO RUN	9.97E-03	9.46E-03	9
ACBDG3EGSBBQ	ACBDG3EGSBBQ	DIESEL GENERATOR 'B' UNAVAILABLE DUE TO TEST OR MAINTENANCE	9.73E-03	1.12E-02	161
ACMODA15	ACADMDM26AFF	ENCLOSURE 'A' VENTILATION DAMPERS FAIL TO REPOSITION	9.48E-03	8.56E-03	N/A
SWAP3SWP1CCQ	SWAP3SWP1CCQ	SERVICE WATER PUMP SWP1C OOS FOR MAINTENANCE	9.33E-03	6.52E-03	9
SWBP3SWP1BBQ	SWBP3SWP1BBQ	SERVICE WATER PUMP SWP1B OOS FOR MAINTENANCE	8.53E-03	4.87E-03	9

Previous Basic Event	Present Basic Event	Description	Previous FV	Present FV	SAMA #
FWAP0FWP1AAQ	FWAP0FWP1AAQ	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1A OOS FOR MAINTENANCE	8.46E-03	4.44E-02	160
ACXBGSBODGFN	ACXBGSBODGFN	SBO DIESEL FAILS TO RUN	8.44E-03	2.44E-02	161
NOTSUMMER	NOTSUMMER	NOT SUMMER OPERATION	8.40E-03	2.74E-02	N/A
FWBP0FWP1BNN	FWBP0FWP1BNN	MOTOR DRIVEN AUXILIARY FEEDWATER PUMP FWP1B FAILS TO START	8.07E-03	3.16E-02	160
ACADG3EGSAAQ	ACADG3EGSAAQ	DIESEL GENERATOR 'A' UNAVAILABLE DUE TO TEST OR MAINTENANCE	7.51E-03	1.18E-02	161
MSCMIC20F4FF	MSCMIC20F424	COMMON CAUSE FAILURE TO CLOSE ANY 2 OF 4 MSIVs	7.22E-03	5.58E-03	178
ACCDG3EGSXFN	ACCDG3EGSXF2	CCF OF DIESEL GENERATORS AFTER FIRST HOUR	7.17E-03	1.08E-02	161
OASBODG	OAPSBODG	OPERATORS FAIL TO MANUALLY START THE SBO DIESEL	7.17E-03	1.96E-02	161
FWXP5FWAP2NQ	FWXP5FWAP2NQ	AFW TURBINE DRIVEN PUMP FW*P2 OOS FOR MAINTENANCE	7.16E-03	3.72E-02	160
HVCSWMOD1	HVCFNFN2ABN2	CCF OF SW PUMP VENTILATION	6.89E-03	4.78E-03	179
SWBP3SWP1DDQ	SWBP3SWP1DDQ	SERVICE WATER PUMP SWP1D OOS FOR MAINTENANCE	6.87E-03	5.25E-03	9
%SLBO	%SLBO	STEAMLINE BREAK OUTSIDE CONTAINMENT	6.71E-03	1.29E-02	N/A
SWAP3SWP1AAQ	SWAP3SWP1AAQ	SERVICE WATER PUMP SWP1A OOS FOR MAINTENANCE	6.63E-03	3.97E-03	9
%LLOCA	%LLOCA	LARGE BREAK LOCA	6.15E-03	2.64E-03	N/A
DCMODA2	DCABK31A1ANF	FAILURE OF DC PANEL 301A-1A	6.11E-03	5.96E-03	175
DCMODB2	DCBBK31B1ANF	FAILURE OF DC PANEL 301B-1A	6.10E-03	6.10E-03	175
ACMODA18	ACABK32R12NF	FAILURE TO SUPPLY BUS 32R VIA BUS 34C	5.76E-03	5.55E-03	67
%MLOCA	%MLOCA	MEDIUM LOCA	5.73E-03	2.14E-02	N/A
%ISLOCA	%RHRSUCTION	PROBABILITY OF INCURRING AN INTERFACING SYSTEMS LOCA	5.71E-03	7.80E-03	N/A
ESBESESFTBBQ	ESBESESFTBBQ	ESFAS TRAIN 'B' CIRCUIT OOS FOR TEST OR MAINTENANCE	5.43E-03	2.86E-03	159, 165
RHACV8969ANN	RHACV8969ANN	CHECK VALVE 3SIL*8969A FAILS TO OPEN ON DEMAND	5.29E-03	1.85E-03	162
RHBCV8969BNN	RHBCV8969BNN	CHECK VALVE 3SIL*V8969B FAILS TO OPEN ON DEMAND	5.21E-03	1.92E-03	162
ACMODB4	ACBBKG15U2FF	DIESEL 'B' OUTPUT BREAKER FAILS TO CLOSE	4.99E-03	3.69E-04	161
ESAESESFTAAQ	ESAESESFTAAQ	ESFAS TRAIN 'A' CIRCUIT OOS FOR TEST OR MAINTENANCE	4.61E-03	2.12E-03	159, 165
%ACMODA28	%ACBSIVAC1FN	FAILURE ASSOCIATED WITH VIAC-1	4.53E-03	1.19E-03	143_144
ACMODA3	ACABKG14U2FF	DIESEL 'A' OUTPUT BREAKER FAILS TO CLOSE	4.52E-03	2.89E-04	161
OAREC	OAPREC	OPERATORS FAIL TO ESTABLISH SUMP RECIRCULATION	4.49E-03	1.09E-02	138
MSXAVPV47AFF	MSXAVPV47AFF	AIR OPERATED VALVE PV47A FAILS TO CLOSE ON DEMAND	4.34E-03	4.51E-03	180
ACBININV2BFN	ACBININV2BFN	DC TO AC POWER INVERTER-2 FAILS DURING OPERATION	3.88E-03	4.84E-03	181
ACBBSBS32UFN	ACBBSBS32UFN	METAL ENCLOSED AC BUS-TO-GROUND SHORT (BUS 32U)	3.66E-03	1.95E-04	182
FWXCVCOMBINN	FWXCVCOMBI24	CCF TO OPEN OF 2 OF 4 INJECTION CV AND RANDOM FAILURE OF THE UNAFFECTED CV	3.60E-03	3.32E-05	183
FWXTKFDWSTTN	FWXTKFDWSTTN	DWST RUPTURES	2.30E-03	9.25E-03	184
QSXTKQRWSTTN	QSXTKQRWSTTN	RWST RUPTURES	7.40E-03	1.71E-03	185

Response to 6b.

The plant-specific SAMAs that were screened using Criterion B were: 159, 163, 165, 166, 167, 174, 181, and 185. Criterion B was defined as a SAMA already being implemented at MPS3. Each of the aforementioned SAMAs is examined in more detail below:

SAMA 159 - This SAMA is bounded by SAMA 165. RSS is actuated by ESFAS, an additional ESFAS logic train is presumed to include the ability to actuate RSS. The importance measures for basic events related to ESFAS being out of service for maintenance marginally exceeded the criteria for SAMA consideration. However, following the latest model update, these values now fall well below the threshold.

SAMA 163 - Basic event RHXVMRHV43NX models the latent error to inadvertently leave manual valve 3RHS*V43 open following refueling outage maintenance. If left open, the sump recirculation function of RSS is assumed to fail due to flow diversion via *V43 to the RWST. The importance measure for this event originally exceeded the criteria for SAMA consideration. Plant-specific thermal hydraulic analysis performed for the latest model update determined that, for ≤1" break LOCA scenarios, the RWST has sufficient inventory such that switchover to sump recirculation via RSS is not required within the 24 hour mission time. This model modification caused a decrease in RSS system importance and thus, a reduction in the importance measure for this latent error resulting in the value falling below the threshold.

SAMA 165 - The importance measures for basic events related to ESFAS being out of service for maintenance marginally exceeded the criteria for SAMA consideration. However, following the latest model update, these values now fall well below the threshold.

SAMA 166 - An evaluation of an AC-Independent Containment Spray System was performed in Feb. 1987 in which the analyzed risk reduction of a 100% effective and 100% available containment spray design was not cost effective (SAMA 32). That is why SAMA #32 was considered a bounding case for SAMA #166, which considered an additional Quench Spray train to assure the containment spray function.

SAMA 167 - The SLCRS system is not credited in the LERF model. The Maintenance Rule expert panel has categorized the system as not a significant contributor to risk in the Maintenance Rule. Therefore, its significance is also adjusted to not risk significant in determining new SAMAs.

SAMA 174 – Basic events ESABIP455ENF and ESBBIP456ENF were incorrectly assigned to this screened SAMA. They are actually related to the RCS PORVs sticking open, which is bounded by SAMA 177 as the addition of a redundant PORV block valve would compensate for this failure mechanism.

SAMA 181 - A parallel strainer used for seal cooling already exists and is not credited because failure of the in-service RCP seal injection strainer was not considered risk significant in the PRA. However, the strainer could be credited and no new SAMA is needed.

SAMA 185 - The RWST at MP3 is atypical of those at other nuclear units in that it is much larger with a barricaded water inventory of approximately 1.2 million gallons, which effectively is the same as adding an additional tank. Plant-specific thermal hydraulic analysis performed for the latest model update determined that, for <1" break LOCA scenarios, the RWST has sufficient inventory such that switchover to sump recirculation via RSS is not required within the 24 hour mission time. This model modification caused the RWST importance measure to fall below the criteria for SAMA consideration.

Response to 6c.

The observation noted in the RAI is correct. The number 52 was arrived at by counting 124/125 as two SAMAs. If the two are counted as only one combined SAMA, then 51 SAMAs remained after initial screening.

Response to 6d.

The 17.8% CDF contribution for the operator failure to establish direct injection was calculated based on the Rev. 4, 10/99 model. The importance of this operator action was significantly reduced (i.e., FV of 2.11E-05) in the Rev. 5, 10/02 model after:

- plant-specific thermal hydraulic analysis determined that, for ≤1" break LOCA scenarios, the RWST has sufficient inventory such that switchover to sump recirculation via RSS is not required within the 24 hour mission time,
- the 0.5 event probability originally assigned was a screening value that was replaced with a rigorously calculated HRA value of 3.9E-02.

Response to 6e.

The basic events in the Fussell-Vesely importance analysis that resulted in SAMAs 170, 173 and 179 are:

RSMODA11	1.98E-02	3SWP*MOV71A FAILS TO CLOSE
RSMODB17	1.98E-02	3SWP*MOV71B FAILS TO CLOSE
RSMODC6	1.19E-03	CCFs OF SW VALVES 3SWP*MOV50A,B & 3SWP*MOV71A,B
HVCSWMOD1	1.14E-04	CCF OF SW PUMP VENTILATION
RSMODA3	9.21E-03	3SWP*MOV50A FAILS TO CLOSE
RSMODB3	9.21E-03	3SWP*MOV50B FAILS TO CLOSE

These SW SAMAs were specifically selected because they correspond to the basic events that were shown as risk significant in Fussell-Vesely importance analysis. Developing SAMAs that deal specifically with the important basic events - and not the entire system - is consistent with the SAMA development for all the other risk-significant basic events in the importance analysis.

SW related SAMA candidates are deemed less significant due to recently completed Westinghouse analysis concluding that SW cooling to the charging pump cooling pump heat exchangers is only necessary when charging pump room temperature exceeds 91°F. This information has not yet been translated into success criteria and incorporated into the PRA model. However, the expectation is that the contribution from the loss of SW would be significantly reduced given that the charging pump ventilation system is not dependent upon SW.

Response to 6f.

The disposition of the seismic SBO alternatives (NUREG-1152, section 5.3.1.1.5) is presented in the response to RAI 4a. The other recommendations from sections 5.3.1 and 5.3.2 of NUREG-1152 are discussed subsequently.

Section 5.3.1.1.5 of NUREG-1152 - Alternatives for SBO due to non-seismic events

1)The first alternative proposed in NUREG-1152 was to add a gas turbine generator. This was postulated as SAMA #73 in the Environmental Report.

2)The second alternative was to add a redundant diesel generator. This was postulated as SAMA #59, but was screened out because Millstone Unit 3 now has an SBO diesel. In other words, the intent of the alternative in NUREG-1152 was implemented.

3)The third alternative was to upgrade emergency battery, instrument air and auxiliary feedwater supply capacity to last at least 8 hours following an SBO. This is considered bounded by SAMAs 60, 61, 64, 110, 115 and 116.

4)The fourth alternative was to add a steam-driven turbine generator to charge emergency batteries and power an added electric pump (self cooled) to supply coolant to the RCP seals. The estimated cost on page 5-12 of NUREG-1152 was $1.2M to $1.7M, which would be about 50% higher today after adjusting for inflation. Considering that the benefit calculated in SAMA #77, which eliminated 100% of all loss of offsite power and SBO only calculated a benefit of $635k, the cost of this alternative is more than twice even the very conservative benefit calculation, and this alternative need not be considered further.

Section 5.3.1.3.5 of NUREG-1152 - Alternatives for dealing with relay chatter

There are two alternatives proposed in NUREG-1152 to address the uncertainties associated with relay chatter during a seismic event.

1)The first alternative proposed was to perform qualification tests to determine at what acceleration relays chatter. If relays in safety-related systems showed to be too fragile in such tests, then they would be replaced with better qualified relays or qualified solid-state equipment.

2)The second alternative proposed was to develop emergency procedures for dealing with earthquake-induced relay chatter.

In NUREG-1152, the NRC stated that the staff's assessment of CDF due to relay chatter was performed in a "highly simplistic manner." NUREG-1152 recognized the high degree of uncertainty associated with relay chatter. The approach presented in section 5.3.1.3.2 of NUREG-1152 assumed that once relay chatter begins during a seismic event, it is widespread and will lead to a core melt unless there is operator intervention. This assumption is very conservative, and could easily skew the results of the analysis.

Because the issue of relay chatter has such a great deal of uncertainty involved, Millstone Unit 3 chose to address the seismic effect on relays in an Abnormal Operating Procedure for Earthquakes. An attachment to the procedure lists the set of relays for which the relay status is to be systematically checked after a seismic event. If any of the relays examined is found to be in the tripped position erroneously, then the relay is reset to its proper position.

Section 5.3.1.4.5 of NUREG-1152 - Alternatives to cope with a loss of room cooling

1)The first alternative proposed is to create and implement emergency procedures to deal with loss of room cooling to heat-sensitive, vital areas.

Room heatup calculations have been performed for such areas at Millstone Unit 3. The ventilation dependencies have been modeled in the PRA for those areas that the calculations showed require HVAC to maintain temperature for the mission time. Because the SAMA list compilation included reviewing the Fussell-Vesely importance analysis to identify those portions of the PRA that dominate risk, any ventilation system that is modeled but did not show as risk significant need not be analyzed further, as its benefit would be very small.

2)The second alternative is to perform engineering calculations for room heatup, and then to develop plant modifications for areas that show significant risk.

As in the previous discussion for the first alternative, such calculations have been performed, and ventilation SAMAs are only evaluated if the Fussell-Vesely importance is high.

Section 5.3.2 of NUREG-1152 - Improvements in procedures

This section of NUREG-1152 lists 10 elements of the probabilistic safety study for which procedures are suggested to be reviewed for possible risk reductions.

Several of the items in this list (e.g., procedures to refill the RWST, increased testing of ISLOCA valves, and actions taken after a SGTR) were considered as SAMAs in the Environmental Report, and others are discussed in the response to other RAIs (e.g., fire area SAMAs are discussed in the response to RAI 4b, and relay chatter was discussed previously in the response to this RAI). For the remaining systems presented in this list, Dominion relied on the Fussell-Vesely importance analysis to identify any operator actions considered significant in the PRA. Non risk-significant actions do not require detailed SAMA analysis.

RAI 7. For the SAMAs considered in the cost-benefit analysis (Table G.3-2), the following information is needed to better understand the modification and/or the modeling assumptions:

a. Describe in more detail the general process used for determining the impact of the various SAMAs on the CDF, person-rem, and offsite economic impact. Discuss such things as: was the complete model run for each case; in general, what changes were made to the model and what assumptions were made concerning the effectiveness of the modifications. Provide specific details on the evaluations for three example benefit calculations including SAMA 9.

b. It would appear that the benefit for SAMA 10 would be greater than that for SAMA 11 since the former includes a diesel, and thus does not depend on offsite or onsite emergency power. Please describe how these SAMAs are different and how the reduction in CDF was determined for each.

c. The benefits of SAMA 36 (unfiltered hardened vent) appear unrealistically high (e.g., a 6% reduction in both CDF and person-rem for Unit 3). The estimated costs also seem very high compared to the costs to implement similar modifications in Mark I containments. Please provide the basis for the benefit estimates. Also, justify why the containment cannot be vented via an existing penetration in accordance with severe accident management guidelines, and why the development of such a procedure would not be cost-beneficial.

d. For SAMA 93, provide a description of which penetrations constitute the dominant contributors to ISLOCA risk, and whether some subset of these lines can be tested at an increased frequency without the need for significant hardware modifications, thereby deriving some of the benefit without the large cost of adding or modifying test lines and instrumentation.

e. SAMA 76 (use firewater as a backup for diesel cooling) was screened out for Unit 2 because a backup is already in place. The same SAMA was initially screened in for Unit 3 and subsequently screened out based on a cost of $750K to 1.5M. Explain why the costs are so high for Unit 3, when the same alternative is already in place at Unit 2.

f. SAMA 112 (proceduralize local manual operation of TD-AFW when control power is lost) cost estimates include considerable engineering as well as construction costs. Please discuss this SAMA and the need for construction costs. Provide additional information regarding the Unit 2 procedure. Explain why a procedure similar to that in place at Unit 2 cannot be developed at a much lower cost given that a similar procedure has already been developed for Unit 2.

g. SAMA 113 (portable generators for TD-AFW after battery depletion) was screened out for Unit 2 on basis of an existing procedure to perform this task manually. The same SAMA was initially screened in for Unit 3 and subsequently screened out based on a cost of $5M to 8M. Provide additional information regarding the Unit 2 procedure (EOP-2530). Explain why a procedure similar to that in place at Unit 2 cannot be developed in lieu of a hardware modification.

h. SAMA 112 and SAMA 113 only provide about a 2% reduction in CDF, whereas SAMA 160 (install TD-AFW pump) provides a 42% reduction. Please explain why the risk reduction for SAMA 112 and 113 is so low given that an additional AFW pump has a very substantial benefit.

i. SAMA 116 (use firewater as a backup for SG inventory) was screened out for Unit 2 because firewater is already a backup for SG inventory for Unit 2. The same SAMA was screened out for Unit 3 because no firewater backup is available. Explain why firewater backup is available at Unit 2 but not at Unit 3.

Dominion Response to RAI 7

Response to 7a.

The general process for the SAMA evaluations was to run the complete Millstone Unit 3 CAFTA model using the CAFTA computer code at a truncation value of 1.0E-11, or when a complete model resolution was not necessary, the plant damage cutsets could be directly modified. In general, the changes to the model were made with a conservative change to the model (one that would maximize benefit by assuming complete effectiveness), and if the conservative benefit was large, the SAMA was reassessed with more realistic and detailed changes to the model. The CAFTA code produced new PDS frequencies, which were then translated to new STC frequencies as described in the Environmental Report section G.2.3.

Example Benefit Calculations:

SAMA 9 - Provide additional SW pump that can be connected to either SW header. A conservative, bounding estimate of the benefit was provided by setting basic events SW?P* (SW pump basic events) in plant damage class cutsets to be successful. The new PDS frequencies are as follows:

SAMA No.	AE	AEQ	AER	AES	AL	ALQ	ALR	ALS	SE	SEQ	SER
9	1.82E-10	1.44E-08	4.74E-11	7.55E-08	8.21E-11	1.21E-07	5.09E-10	3.83E-07	2.31E-06	6.92E-08	1.13E-08

SES	SL	SLQ	SLR	SLS	TE	TEQ	TER	TES	TL	TLQ	TLR
2.53E-06	2.22E-06	1.14E-06	1.80E-09	1.65E-06	1.83E-07	7.60E-08	1.55E-09	8.51E-06	4.92E-07	1.16E-06	6.78E-09

TLS	V	V2E	V2L	TOTAL	ΔCDF
1.80E-06	2.21E-07	9.26E-07	7.37E-08	2.40E-05	1.91E-06

The Source term categories for SAMA 9 are:

CET E.S (Source Term Category)	Base	SAMA 9
M1A	2.21E-07	2.21E-07
M1B	1.00E-06	1.00E-06
M2	0.00E+00	0.00E+00
M3	0.00E+00	0.00E+00
M4	0.00E+00	0.00E+00
M5	1.96E-07	1.61E-07
M6	1.96E-07	1.61E-07
M7	7.79E-06	6.55E-06
M8	0.00E+00	0.00E+00
M9	1.60E-06	1.35E-06
M10	1.60E-06	1.35E-06
M11	1.60E-06	1.35E-06
M12	1.46E-05	1.42E-05

The benefit calculation for SAMA 9 is:

Case->	SAMA 9
Offsite Annual Dose (Rems)	11.5910
Offsite Annual Property Loss ($)	$19,720
Comparison CDF	2.88E-05
Comparison Dose	12.8165
Comparison Cost	$21,807
Reduction in CDF	8.54%
Reduction in Offsite Dose	9.56%
Onsite Short Term Dose Savings (Best Est)	$175
Onsite Long Term Dose Savings (Best Est)	$762
Onsite Prop Cost Savings	$28,562
Total Onsite Benefit (without Replacement Power)	$29,498

Replacement Power Cost	$24,651
Total Onsite Benefit (with Replacement Power)	$54,149
Offsite Dose Savings	$26,379
Offsite Prop Cost Savings	$22,469
Total Offsite Benefit	$48,849
Total Benefit (Onsite + Repl Pwr + Offsite)	$102,998
Total Benefit without Replacement Power	$78,347
Total Benefit (Onsite + Repl Pwr + Offsite)*1.6	$164,796

SAMA 10 - Create an independent RCP seal cooling system, with dedicated diesel. A conservative, bounding estimate of the benefit was provided by setting gate LOSC in master fault tree to be successful. The new PDS frequencies are as follows:

SAMA No.	AE	AEQ	AER	AES	AL	ALQ	ALR	ALS	SE	SEQ	SER
10	1.82E-10	1.44E-08	4.74E-11	7.55E-08	8.21E-11	1.21E-07	5.09E-10	3.83E-07	6.48E-08	4.21E-11	0.00E+00

SES	SL	SLQ	SLR	SLS	TE	TEQ	TER	TES	TL	TLQ
1.36E-07	3.06E-06	1.09E-06	1.20E-09	1.60E-06	1.83E-07	7.63E-08	1.55E-09	8.59E-06	4.93E-07	1.18E-06

TLR	TLS	V	V2E	V2L	TOTAL	ΔCDF
6.78E-09	1.81E-06	2.21E-07	9.26E-07	7.37E-08	2.01E-05	5.77E-06

The Source term categories for SAMA 10 are:

CET E.S (Source Term Category)	Base	SAMA 10
M1A	2.21E-07	2.21E-07
M1B	1.00E-06	1.00E-06
M2	0.00E+00	0.00E+00
M3	0.00E+00	0.00E+00
M4	0.00E+00	0.00E+00
M5	1.96E-07	3.47E-08
M6	1.96E-07	3.47E-08
M7	7.79E-06	5.13E-06
M8	0.00E+00	0.00E+00
M9	1.60E-06	1.27E-06
M10	1.60E-06	1.27E-06
M11	1.60E-06	1.27E-06
M12	1.46E-05	1.20E-05

The benefit calculation for SAMA 10 is:

Case->	SAMA 10
Offsite Annual Dose (Rems)	9.9543
Offsite Annual Property Loss ($)	$16,593
Comparison CDF	2.88E-05
Comparison Dose	12.8165
Comparison Cost	$21,807
Reduction in CDF	22.82%
Reduction in Offsite Dose	22.33%
Onsite Short Term Dose Savings (Best Est)	$467
Onsite Long Term Dose Savings (Best Est)	$2,035
Onsite Prop Cost Savings	$76,311
Total Onsite Benefit (without Replacement Power)	$78,813
Replacement Power Cost	$65,862
Total Onsite Benefit (with Replacement Power)	$144,675
Offsite Dose Savings	$61,612
Offsite Prop Cost Savings	$56,118
Total Offsite Benefit	$117,729
Total Benefit (Onsite + Repl Pwr + Offsite)	$262,404
Total Benefit without Replacement Power	$196,542
Total Benefit (Onsite + Repl Pwr + Offsite)*1.6	$419,846

SAMA 77 - Provide a connection to alternate offsite power source (the nearest dam) A conservative, bounding estimate of the benefit was provided by adding to mutually exclusive logic, a LOOP gate which is an OR of the LOOP initiators %LOOPGR, %LOOPPC, and %LOOPWR (eliminates all LOOP events). The new PDS frequencies are as follows:

SAMA No.	AE	AEQ	AER	AES	AL	ALQ	ALR	ALS	SE	SEQ	SER
77	1.82E-10	1.44E-08	4.74E-11	7.55E-08	8.21E-11	1.21E-07	5.09E-10	3.83E-07	1.19E-06	1.63E-08	0.00E+00

SES	SL	SLQ	SLR	SLS	TE	TEQ	TER	TES	TL	TLQ	TLR
6.80E-07	1.27E-06	1.00E-06	3.18E-10	1.37E-06	7.47E-08	4.98E-08	1.55E-09	7.39E-06	6.30E-08	6.12E-07	1.49E-09

TLS	V	V2E	V2L	TOTAL	ΔCDF
4.86E-07	2.21E-07	9.26E-07	7.37E-08	1.60E-05	9.86E-06

The Source term categories for SAMA 77 are:

CET E.S (Source Term Category)	Base	SAMA 77
M1A	2.21E-07	2.21E-07
M1B	1.00E-06	1.00E-06
M2	0.00E+00	0.00E+00
M3	0.00E+00	0.00E+00
M4	0.00E+00	0.00E+00
M5	1.96E-07	8.44E-08
M6	1.96E-07	8.44E-08
M7	7.79E-06	3.95E-06
M8	0.00E+00	0.00E+00
M9	1.60E-06	8.44E-07
M10	1.60E-06	8.44E-07
M11	1.60E-06	8.44E-07
M12	1.46E-05	9.86E-06

The benefit calculation for SAMA 77 is:

Case->	SAMA 77
Offsite Annual Dose (Rems)	8.9664
Offsite Annual Property Loss ($)	$15,271
Comparison CDF	2.88E-05
Comparison Dose	12.8165
Comparison Cost	$21,807
Reduction in CDF	38.44%
Reduction in Offsite Dose	30.04%
Onsite Short Term Dose Savings (Best Est)	$786
Onsite Long Term Dose Savings (Best Est)	$3,428
Onsite Prop Cost Savings	$128,541
Total Onsite Benefit (without Replacement Power)	$132,756
Replacement Power Cost	$110,941
Total Onsite Benefit (with Replacement Power)	$243,697
Offsite Dose Savings	$82,877
Offsite Prop Cost Savings	$70,347
Total Offsite Benefit	$153,225
Total Benefit (Onsite + Repl Pwr + Offsite)	$396,921
Total Benefit without Replacement Power	$285,980
Total Benefit (Onsite + Repl Pwr + Offsite)*1.6	$635,074

The complete list of changes to the PRA model for the SAMA benefit calculations in Table G.3-2 follows:

SAMA No.	Potential Improvement	PRA Model Modification
9	Provide additional SW pump that can be connected to either SW header.	Set basic events SW?P* in plant damage class cutsets to be successful.
10	Create an independent RCP seal cooling system, with dedicated diesel.	Set gate LOSC in master fault tree to be successful.
11	Create an independent RCP seal cooling system, without dedicated diesel.	Bounded by SAMA #10.
20	Procedural guidance for use of cross-tied CCW or SW pumps.	Substitute for gate SWA100 gate SWL100A which is an AND gate of SWA100 and SWB100A which is an OR gate of SWB100 and OASWXTIE (prob. 0.10). Substitute for gate SWB100 gate SWL100B which is an AND gate of SWB100 and SWA100B which is an OR gate of SWA100 and OASWXTIE (prob. 0.10).
21	Loss of CCW or SW procedural enhancements.	Substitute for gate SWA100 gate SWL100A which is an AND gate of SWA100 and SWB100A which is an OR gate of SWB100 and OASWXTIE (prob. 0.10). Substitute for gate SWB100 gate SWL100B which is an AND gate of SWB100 and SWA100B which is an OR gate of SWA100 and OASWXTIE (prob. 0.10).
34	Install a containment vent large enough to remove ATWS decay heat.	Set basic events RPSFAILURE, RXTRIPBKRCCF, STUCKROD10, and STUCKROD35 in master fault tree to be successful.
35	Install a filtered containment vent to remove decay heat.	Set basic events HVCACAC2AB?2, RHXVMRHV43NX, RS*, SWCMSV50ABF1, and SWCMSV71ABF1 in plant damage cutsets to be successful.
36	Install an unfiltered hardened containment vent.	Bounded by SAMA #35.
43	Create a reactor cavity flooding system.	Add containment release frequencies M5, M7, M10, and M11 to containment release frequency M12 and then set containment release frequencies M5, M7, M10, and M11 to zero.
44	Creating other options for reactor cavity flooding.	Bounded by SAMA #43.
60	Provide additional DC battery capability.	Set basic events OSPRN1PC, OSPRN1GR, OSPRN2PC, and OSPRN2GR in plant damage class cutsets to be successful. Set basic events OSPRN1WR to 7.55E-02 and basic events OSPRN2WR to 1.19E-01.
61	Use fuel cells instead of lead-acid batteries.	Bounded by SAMA #60.

SAMA No.	Potential Improvement	PRA Model Modification
63	Improved bus cross tie ability.	Substitute for gate ACA34C gate ACX34C which is an AND gate of ACA34C and ACB34DC which is an OR gate of ACB34D and OAACXTIE (prob. 0.01). Substitute for gate ACB34D gate ACX34D which is an AND gate of ACB34D and ACA34CD which is an OR gate of ACA34C and OAACXTIE (prob. 0.01).
64	Alternate battery charging capability.	Bounded by SAMA #60.
67	Create AC power cross tie capability across units.	Add basic event ALIGN_MP2 (prob. 0.02) under gate SBO1 which represents failure of the MP2 EDGs 'A' and 'B' or failure of the operator to correctly perform the AC cross-tie between Unit 2 and Unit 3.
73	Install gas turbine generators.	Set basic events AC?DG* in plant damage class cutsets to be successful.
75	Create a river water backup for diesel cooling.	Bounded by SAMA #76.
76	Use firewater as a backup for diesel cooling.	Add to mutually exclusive logic a MUT5 gate which is an AND gate of LOOP and SWAB100 which is an OR gate of SWA100 and SWB100.
77	Provide a connection to alternate offsite power source (the nearest dam).	Add to mutually exclusive logic a LOOP gate which is an OR of the LOOP initiators %LOOPGR, %LOOPPC, and %LOOPWR.
80	Create an auto-loading of the SBO diesel.	Set basic event OAPSBODG in plant damage class cutsets to be successful.
87	Replace steam generators with new design.	Set gate SGTR in master fault tree to be successful.
93	Additional instrumentation and inspection to prevent ISLOCA sequences.	Set the containment release category frequency M1A to zero and set the rest of the containment release category frequencies equal to those in the base case.
94	Increase frequency of valve leak testing.	Bounded by SAMA #93.
99	Ensure all ISLOCA releases are scrubbed.	Bounded by SAMA #93.
100	Add redundant and diverse limit switch to each containment isolation valve.	Bounded by SAMA #93.
112	Proceduralize local manual operation of AFW when control power is lost.	Set basic events OSPRN1PC, OSPRN1GR, OSPRN2PC, and OSPRN2GR in plant damage class cutsets to be successful. Set basic events OSPRN1WR to 7.55E-02 and basic events OSPRN2WR to 1.19E-01.
113	Provide portable generators to be hooked in to the turbine driven AFW train, after battery depletion.	Bounded by SAMA #112.
120	Create passive secondary side coolers.	Set gate AFW in master fault tree to be successful.
123	Provide capability for diesel driven, low pressure vessel makeup.	Set gates ECCS, ACC, and HPINJ in master fault tree to be successful.

SAMA No.	Potential Improvement	PRA Model Modification
124_ 125	Provide an additional high pressure injection pump with independent diesel.	Set basic events SI?P* in plant damage class cutsets to be successful.
138	Create automatic swapover to recirculation on RWST depletion.	Set basic events OAPREC* in plant damage class cutsets to be successful.
156	Secondary side guard pipes up to the MSIVs.	Substitute gate SLBI for %SGTR and set gates SLBIA, SLBIB, SLBIC, and SLBID in master fault tree to be successful.
160	Install turbine driven AFW pump.	Set basic events FWXP* in plant damage class cutsets to be successful.
161	Install SBO diesel.	Set basic events AC?BG* in plant damage class cutsets to be successful.
162	Install Charging system train.	Set basic events CH?P* in plant damage class cutsets to be successful.
164	Install Safety Injection train.	Set basic events SI?P* in plant damage class cutsets to be successful.
168	Automate Feed and Bleed.	Set basic events OAPBAF in plant damage class cutsets to be successful.
169	Improve boron injection reliability with new procedure and hardware.	Set gate EB in master fault tree to be successful.
170	Add another AOV to isolate SW.	Set basic events SW?MV*50*, SW?MV*71*, SWCMS*50*, and SWCMS*71* in plant damage class cutsets to be successful.
171	Install another RSS parallel flow path.	Bounded by SAMA #172.
172	Add a redundant train of RSS.	Set basic events RS?P* in plant damage class cutsets to be successful.
173	Add additional SW AOVs (ATC/ATO).	Set basic events SW?MV*50*, SW?MV*71*, SWCMS*50*, and SWCMS*71* in plant damage class cutsets to be successful.
175	Add a redundant DC bus.	Set basic events LVDCA, LVDCB, LVDC, and DC?BS* in plant damage class cutsets to be successful.
176	Add a redundant charging pump.	Set basic events CH?P* in plant damage class cutsets to be successful.
177	Add a redundant block valve for the PORV.	Set gate STUCKPORV in master fault tree to be successful.
178	Add redundant MSIVs.	Set gates MSI1 and MSLIO in master fault tree to be successful.
179	Add a redundant SW pump ventilation train.	Set gates HVASW10 and HVBSW10 in master fault tree to be successful.
180	Add a redundant valve in series to isolate the steam line dumps to condenser.	Set gate MSX200 in master fault tree to be successful.
182	Add redundant AC bus.	Substitute for gate ACA34C gate ACX34C which is an AND gate of ACA34C and ACB34DC which is an OR gate of ACB34D and OAACXTIE (prob. 0.01). Substitute for gate ACB34D gate ACX34D which is an AND gate of ACB34D and ACA34CD which is an OR gate of ACA34C and OAACXTIE (prob. 0.01).

SAMA No.	Potential Improvement	PRA Model Modification
183	Add redundant AFW flow path.	Set basic events FWCCV* in plant damage class cutsets to be successful.
184	Add redundant demineralized water storage tank (DWST).	Set basic events FW?TK* in plant damage class cutsets to be successful.

Response to 7b.

The benefit calculation for SAMA 11 conservatively used the benefit calculation from SAMA 10 ($419,846). This is conservative, because as the RAI stated, SAMA 11 does not have an independent power source. Since the cost of SAMA 11 was $5-8M, which is more than a factor of 10 larger than the conservative benefit, the benefit calculation was not refined further and the SAMA was screened out.

Response to 7c.

Dominion agrees that the benefit calculated for SAMA 36 is unrealistically high, which is very conservative in terms of a SAMA analysis. Because the cost estimate of SAMA 36 was $10M to $15M, no benefit calculation was performed. Rather, the benefit calculation for SAMA 35 was utilized, as it would be bounding. SAMA 35 is identical to 36 except that the vent would filter any fission products released.

Comparing the cost of an unfiltered vent at Unit 3, or any PWR, with that of a BWR is something that Dominion would not typically do since the designs of the BWR NSSS and containment are so different. The comparison does not seem appropriate. The costs were based on providing a new containment penetration, not using an existing one. This penetration would be high in containment, which would add to construction costs both inside and outside containment for scaffolding, cranes, etc. There would have to be isolation valves both inside and outside containment, two sets for train related redundancy. Valves would have to be electrically operated for increased reliability, which means running cabling from the valves to a control station in the Control Room. A hardened vent would require a missile shield constructed on the outside of the containment structure and the discharge of the vent would have to penetrate the enclosure building outside.

It should also be noted that, as discussed in the response to Millstone 3 RAI 4a, Dominion's cost estimate for a filtered hardened vent is consistent with that of NUREG-1152.

As for using an existing vent path, Unit 3 already has such a means, which is covered by an existing SAMG. This was not originally identified in the License Renewal Application. The SAMG, "Depressurize Containment," has a method to vent containment into the Aux Building by removing both Containment Vacuum system pumps. This requires removing all people from the Auxiliary Building as the containment atmosphere is now going into the Auxiliary

Building. It also requires setting up a fire hose with spray over the end of the pipe where the release is occurring (to entrain fission product gases), running the building sump pumps (to get rid of the fire water) and running either a SLCRS or Aux Building Filter.

Response to 7d.

The dominant ISLOCA scenarios are: Failure of RCS to RHR suction line; failure of RHR cold injection valves; and failure of RHR hot leg injection valves. The RHR suction valves are tested every refueling outage; one train of each of the injection valves is also tested each refueling outage. This test frequency is based on safety train outages during refuelings, and is sufficient to verify their operability. To test more frequently would require an additional safety train outage each refueling, which would far exceed the benefit.

The bounding benefit from SAMA 93, which was applied to all ISLOCA sequences, is $83,596 ($167k after doubling to account for uncertainties), and the cost is $9-12M. A subset of the ISLOCA sequences would yield an even smaller benefit; however, even if the benefit stayed the same, it would still be much less than the cost. It should be noted that, as discussed in the response to RAI 9, further evaluation has determined that the instrumentation necessary to detect ISLOCAs is already available.

Response to 7e.

Rather than provide an alternate cooling supply for the EDGs, Unit 3 installed an alternate AC source, air-cooled station blackout diesel generator. Providing firewater to Unit 3 diesels is not cost beneficial for the following reasons.

The fire water system has a 4-inch line in each diesel room. The normal cooling to the diesels is an 8-inch service water line. There is normally > 2200 gpm of service water going through the diesel when it is running. The current fire water system would be challenged to provide that much flow and remain available for fire protection requirements. The nominal fire water supply makeup flow is 1600 gpm which means diesel run times would be limited by fire water tank inventory requirements unless an increased supply flow was developed.

There are no installed methods to supply firewater to the diesels. To accomplish this would require a larger supply line be run underground from the outside ring header into each diesel enclosure and heat exchanger end bells would have to be modified to provide an input connection for this alternate cooling supply. Piping and isolation valves from the fire water system to the diesel heat exchangers would also have to be installed. All of this would result in the cost far outweighing any benefit.

Response to 7f.

Unit 3 was designed with the ability to operate the TDAFW pump locally at the pump, assuming power is available. Unit 2 did not have this local operation capability so they developed a means to operate locally by manually controlling the TDAFW pump by local operation of the governor. Although that method was not designed specifically for a loss of control power situation, it can be used in that situation.

Unit 3 currently has not developed the ability to locally manually operate the TDAFW pump. The TDAFW pump controls are different between the two units. Therefore, simply applying Unit 2's procedure to Unit 3 is not practical.

Physical modifications were contemplated in the original estimate in order to provide the level indication that would be necessary for the SBO scenario. In the event of an SBO, it would be necessary to provide power, so that steam generator water level and other indications would remain available. Discussion of this scenario is provided in the response to RAI 7g, below.

This modification would not be required for non-SBO scenarios in which AFW control power is lost, but indications (i.e., SG level indication) are not. In that case, it is possible that this capability could be developed within the context of a Severe Accident Management Guideline. The costs associated with this effort would depend on whether or not the event included an SBO, or just loss of control power for the AFW system.

Assuming the necessary indications have not been lost, a SAMG would need to be developed for the manual control of the pump. This would require:

- Engineering to determine the feasibility, and establish the proper methods and parameters for manual operation;
- Creation of a new SAMG, including review, and verification;
- Field verification of the actual operation. This would have to be performed during a plant outage, most likely during Mode 3 Operation, and would require operations and engineering support. It may also require Instrumentation and Controls support;
- Final SAMG production;

Assuming this operation is determined to be achievable without a plant modification, the cost of this SAMA could be expected to be in the range of $50K to $60K. Because the benefit before doubling is $42,753, this SAMA, without any plant modification, would be cost beneficial. Following determination of feasibility without plant modification, this will be incorporated into the Unit 3 SAMGs during a future update.

Response to 7g.

The initial evaluation of this SAMA investigated using a portable diesel to drive an installed AFW pump that would replace the turbine driven pump, not a portable generator to supply DC power to the installed TDAFW pump. The costs assumed constructing a new building to house the pump, routing all the supply piping from the 2 different supply tanks, routing the discharge piping into the present building and connecting to the Auxiliary feedwater system.

Assuming a new SAMG is created for the manual operation of the AFW pump (see response to 7f, above), a more practical alternative to providing power to the AFW pump itself would be to establish a means of supplying power, to provide steam generator level indication. With manual control of the pump, SG level indication would enable feedwater operation without overfilling the SGs. This would require:

- An Engineering feasibility study;
- Engineering to determine the best way to provide power to the panels;
- Installing connections that would accept generator leads;
- Creation of a new SAMG, including engineering and safety review, and verification;
- Field verification of the actual operation. This would require operations, maintenance, I&C and engineering support.
- Final SAMG production;
- Incorporation into training;
- Periodic training.

The total cost estimate for this alternative would be in excess of $130,000. Because the benefit for this SAMA is less than $39,000, no further analysis or action is justified.

Response to 7h.

SAMA 160 was calculated by setting the turbine driven AFW pump failure rate to zero, which is stating that installing a separate pump will reduce the failure contribution from the turbine-driven pump to effectively zero.

SAMA 112 and 113 were calculated by setting the offsite power non-recovery probability to zero which is stating that the failure probability of the turbine driven AFW pump remains constant, but that offsite power would be recovered when control power is lost.

Response to 7i.

Unit 3 currently has three sources of water to supply Steam Generator inventory. The Demineralized Water Storage Tank (DWST) is the 10 hour credited source, the Condensate Storage Tank (CST) is the preferred backup water supply and service water is the final supply. All 3 of these supplies go to both MDAFW Pumps and the TDAFW pump. Unit 2 has only two sources of water, the CST and firewater. Since Unit 3 has backup supply from service water, firewater was not used for a backup source.

It should be noted that Unit 3 does not have direct piping connections from fire water to the steam generators; however, there is an existing Severe Accident Management Guideline which provides for using fire hoses to feed the steam generators via indirect means. These means are discussed in further detail in the response to RAI 8a, under SAMA 183.

RAI 8. For certain SAMAs considered in the ER, there may be lower-cost alternatives that could achieve much of the risk reduction at a lower cost. In this regard, please provide the following:

- ***a.*** ***For the subset of plant-specific SAMAs identified in Table G.3-1 and for the Phase 2 SAMAs, discuss whether any lower-cost alternatives to those considered in the ER would be viable and potentially cost-beneficial.***

- ***b.*** ***A plant has recently installed a direct-drive diesel to power an auxiliary feed water (AFW) pump for under $200K. Please provide the averted-risk benefit of supplemental AFW capability at MPS3, and an assessment of whether such a SAMA could be a cost-beneficial alternative to an additional turbine-driven pump (SAMA 159).***

Dominion Response to RAI 8

Response to 8a.

After reviewing the plant-specific SAMAs from Table G.3-1, and the Phase 2 SAMAs from Table G.3-2, several lower-cost alternatives have been identified. Some are covered in the existing plant Severe Accident Management Guidelines (SAMGs), and others may be candidates for use in an extreme emergency, provided the Technical Support Center of the Station Emergency Response Organization (SERO) evaluates their viability versus plant conditions at the time. Others may be lower-cost, but could not be considered without a comprehensive safety evaluation and installation of equipment that would prevent additional risk to the plant. The following are the alternatives considered:

- **Alternative to SAMA 35 (36): Install a filtered (unfiltered) containment vent to remove decay heat.** Under severe accident conditions, a method exists for venting containment to the Auxiliary Building through the containment vacuum system and then using one of two filtered release paths to discharge the air from the Auxiliary Building to the outside. This would be performed under an existing SAMG, under the direction of the Technical Support Center of SERO.

- **Alternative to SAMA 43 and 44: Use of existing systems to flood reactor cavity.** Under severe accident conditions, existing plant systems could be used to flood the cavity, up to 39 feet above the containment floor. This would be performed under an existing SAMG, under the direction of the Technical Support Center of SERO. Systems that might be used under various conditions could include Quench Spray, Recirculation Spray, Fire System, or off-site pumper trucks.

- **Alternative to SAMA 112: Create a new SAMG to direct the manual control of AFW.** As detailed in the response to RAI 7f, if manual control of the TDAFW pump could be accomplished without a plant modification, a SAMG could be developed in lieu of an EOP and modification that would direct the manual control of the TDAFW pump. This would be useful in the event of loss of AFW control power in non-SBO scenarios.

- **Alternative to SAMA 183: Using Fire Water System to fill steam generators.** The Fire Water System could provide a backup means of providing water for the steam generators. Success options include: filling the Demineralized Water Storage Tank using fire hoses, then using the TDAFW to pump this water to the generators; filling the Condenser Hotwell with fire water and using the Motor Driven Feedwater Pump to pump to the generators; under low pressure conditions, using the fire water pumps (either diesel or electric) to fill the generators via either the auxiliary feedwater lines or feedwater lines. This is covered by an existing SAMG.

Response to 8b.

It is Dominion's understanding that the plant being referred to had purchased a diesel pump "for scrap" more than ten years ago, and that it had been installed at that time to address an AFW redundancy issue that Millstone does not have. It is also Dominion's understanding that it was installed as non-safety grade, and that the $200K figure may have included the installation of the pump, but many of the actual costs of connecting to the system, including the engineering, were not included in that figure.

Millstone 3 does not have the room or proper ventilation capability to place a diesel engine in the present location of the Aux Feedwater pumps. In order to install a new diesel pump as a backup (assuming that the pump itself is not required to be Category 1), the following equipment would be required:

1. The pump itself, including either a self-enclosed fuel storage tank or a separate fuel tank;
2. A separate building or enclosure;
3. A significant run of piping from pump to feedwater piping, some of which would have to be Category 1;
4. A new run of piping from the water source to the new pump;
5. Redundant isolation valves between the seismic and non-seismic portions of the piping.

In addition to the above equipment, the following would also be required:

1. Extensive engineering for the installation and operation of the pump and support equipment;
2. A new Emergency Operations Procedure (EOP)
3. Incorporation into training
4. Regular surveillance and maintenance of the new diesel and other equipment.

While it is possible that several of the above items were not included in the $200,000 cost at the other plant, they are, in fact, a part of the cost of installing such equipment at Millstone. The cost of this option at Millstone, if done in accordance with station practices, would exceed several million dollars.

It should be noted that, as described above in the response to RAI 8a, Millstone 3 currently has a Severe Accident Management Guideline for using the Diesel Fire Pump to send water to the steam generators via a number of potential pathways. This pump provides the backup that would be accomplished by an additional diesel driven AFW pump.

RAI 9. The costs of many SAMAs appear to be over estimated. Provide an explanation/justification for some of the high costs for those SAMAs that have significant benefits, e.g.:

- ***SAMA 36 unfiltered hardened vent @ $10M - $15M***
- ***SAMA 44 options for flooding reactor cavity @ $18M - $24M***
- ***SAMA 63 improved bus cross tie ability @ $2M - $5M***
- ***SAMA 64 alternate battery charging capability @ $5M - $8M***
- ***SAMA 67 create ac power cross tie capability across units @ $4M - $6M***
- ***SAMA 113 portable generators for TD-AFW @ $5M - $8M***

Dominion Response to RAI 9

The following table provides more detailed discussion of the components and activities that were considered in estimating costs of those Table G.3-2 SAMAs for which the benefit was determined to be $50,000 or more.

These cost estimates were based on known costs of similar or other existing projects, and were made with the collaborative input of:

- Two operations shift managers with more than 50 years of collective operations experience;
- Two senior engineering professionals with more than 50 years of engineering experience, including extensive project management expertise;
- A senior nuclear project controls specialist with more than 20 years of experience in cost estimating.

In cases involving actual equipment installation, the elements involved were determined using the intent of the SAMA analysis. For example, in instances involving the creation of a new penetration through containment, or new equipment or components installed in containment or other Category 1 areas, the system was designed in a manner to minimize the introduction of new risk to the plant. For many SAMAs, it would be counterproductive to contemplate less robust alternatives, and would introduce additional risk that would affect the very benefit the SAMA is attempting to achieve.

In those instances where less robust alternatives would not violate the intent of the SAMA, those alternatives are discussed. If the alternative substantially changed the cost estimate, it is discussed above, in the response to RAI 8a.

It is worth noting that Dominion's cost estimate for SAMA 35, installing a filtered hardened vent, is entirely consistent with the estimate provided in NUREG-1152 for the same modification, as detailed in the response to RAI 4a.

It is also important to note that the actual installation of new equipment does not end the cost associated with a particular SAMA. The new equipment often generates a need for procedure changes and operator training. It also creates new surveillance, calibration and maintenance requirements for the duration of plant operations, all of which are part of the cost of instituting the SAMA. Dominion believes that these all are appropriately considered in the cost/benefit analysis.

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
9	Provide additional SW pump that can be connected to either SW header	Providing another pump would decrease core damage frequency due to a loss of SW.	$164,796	Estimate Range: $10M - $15M. Not cost beneficial: since cost is greater than twice the benefit.
Because there is no room to install an additional Service Water pump in the existing intake, an "adjunct" building would have to be built. This would require construction of a new coffer dam during construction, design, engineering and construction of a seismic building, installation of the pump, associated piping and cross-ties, new power and underground pipe chases, safety analysis, instrumentation, control room modifications, procedure modifications for several procedures, and incorporation into training. Note: Unit 3 already has four service water pumps, two per train, with one per train normally operating.				
10	Create an independent RCP seal cooling system, with dedicated diesel	Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling or SBO.	$419,846	Estimate Range: $10M - $15M. Not cost beneficial: since cost is greater than twice the benefit.
Such a system would entail piping, heat exchanger, cooling source (e.g., new tie-in to service water), redundant isolation valves, new wiring, instrumentation and controls. System inside containment (at a minimum) would be required to be seismic, Category 1. New diesel would require piping runs from diesel to new system, plus diesel housing. Would also include new requirements for regular surveillances, instrument calibration, safety analysis, and incorporation into training.				
11	Create an independent RCP seal cooling system, without dedicated diesel	Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling, but not SBO.	$419,846	Estimate Range: $5M - $8M. Not cost beneficial: since cost is greater than twice the benefit.
Such a system would entail piping, heat exchanger, cooling source (e.g., new tie-in to service water), redundant isolation valves, new wiring, instrumentation and controls. System inside containment (at a minimum) would be required to be seismic, Category 1. Would also include new requirements for regular surveillances, instrument calibration, safety analysis, and incorporation into training.				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
34	Install a containment vent large enough to remove ATWS decay heat	Assuming injection is available, would provide alternative decay heat removal in an ATWS.	$103,371	Estimate Range: $10M - $15M. Not cost beneficial: since cost is greater than twice the benefit.
Because of the magnitude of ATWS decay heat, this would require engineering, design and installation of a large piping system through containment. New containment penetration would require redundant isolation valves, entire system would require seismic design, safety analysis. New wiring to control room, which requires cable tray analysis. New instrumentation, which requires periodic maintenance. New or modified procedures, and incorporation into training.				
35	Install a filtered containment vent to remove decay heat	Assuming injection is available (non-ATWS sequences), would provide alternate decay heat removal with the released fission products being scrubbed.	$110,796	Estimate Range: $12M - $18M. Not cost beneficial: since cost is greater than twice the benefit.
Although the magnitude would be less than for SAMA 34, this would still require engineering, design and installation of a piping system through containment. New containment penetration would require redundant isolation valves, entire system would require seismic design, safety analysis. New filter system. New wiring to control room, which requires cable tray analysis. New instrumentation, which requires periodic maintenance. New or modified procedures, and incorporation into training. **Upon further review, an alternate strategy currently exists via the auxiliary building, and is covered under the plant's Severe Accident Management Guidelines (SAMG). This alternative is detailed above in the response to RAI #8a. This would not involve any additional cost, and constitutes "already implemented" status.**				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
36	Install an unfiltered hardened containment vent	Provides an alternate decay heat removal method (non-ATWS), which is not filtered.	$110,796	Estimate Range: $10M - $15M. Not cost beneficial: since cost is greater than twice the benefit.
The costs were based on providing a new containment penetration, not using an existing one. This penetration would be high in containment, which would add to construction costs both inside and outside containment for scaffolding, cranes, etc. There would have to be isolation valves both inside and outside containment, two sets for train related redundancy. Valves would have to be electrically operated for increased reliability, which means running cabling from the valves to a control station in the Control Room. A hardened vent would require a missile shield constructed on the outside of the containment structure and the discharge of the vent would have to penetrate the enclosure building outside. **Upon further review, an alternate strategy currently exists via the auxiliary building, and is covered under the plant's Severe Accident Management Guidelines (SAMG). This alternative is detailed above in the response to RAI #8a. This would not involve any additional cost, and constitutes "already implemented" status.**				
43	Create a reactor cavity flooding system	Would enhance debris coolability, reduce core concrete interaction and provide fission product scrubbing.	$344,756	Estimate Range: $18M - $24M. Not cost beneficial: since cost is greater than twice the benefit.
Assumes a new source of water (new, large capacity storage tank), new containment penetration, redundant isolation valves, seismic piping inside containment, new instrumentation, cables to control room, cable tray analysis, safety analysis, new or modified procedures, incorporating into training, regular maintenance of system.				
44	Creating other options for reactor cavity flooding	Flood cavity via systems such as diesel driven fire pumps.	$344,756	Estimate Range: $18M - $24M. Not cost beneficial: since cost is greater than twice the benefit.
Same assumptions for SAMA 43 were used in this analysis. **If one assumes using existing equipment in a severe accident situation, Millstone 3 SAMGs currently have a provision for this option. The SAMG would rely on the Technical Support arm of the Station Emergency Response Organization to provide information on available options during the evolution. This alternative is further detailed above in the response to RAI #8a. Therefore, this SAMA is already implemented at Unit 3.**				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
63	Improved bus cross tie ability	Improved AC power reliability within same unit.	$429,606	Estimate Range: $2M - $5M. Not cost beneficial: since cost is greater than twice the benefit.
Comprehensive safety analysis would be required in order to cross-tie between trains, new cross-tie breakers, raceway/cabling, engineering and design, procedure changes, incorporation into training. It is important to note that safety related trains currently cannot be cross-tied. To do so would require, as a minimum, a breaker in each train and wiring to connect the breakers to their respective buses and each other. There is no room in the switchgear rooms to add another breaker; therefore, breakers would have to be located outside of the switchgear rooms, either in a new building, or in another building, such as the diesel building, which would require additional safety analysis to accommodate this electrical equipment. Electrical analysis on buses would have to be performed to determine loading restrictions.				
64	Alternate battery charging capability	Provide a portable diesel-driven battery charger.	$42,753	Estimate Range: $5M - $8M. Not cost beneficial: since cost is greater than twice the benefit.
This SAMA would require the installation of a new diesel generator to supply power to two 480-volt buses, or, alternatively, two separate diesels, one for each 480-volt bus. Electrical leads would be added to each bus to attach the diesel. This SAMA would require extensive engineering for design work and safety analysis. Also, a new procedure would be required, new operator training, and regular surveillance and maintenance. The assumptions made for the cost estimate above include the construction of a seismic building, since this equipment is supplying vital power. If the assumption is made that this equipment can be stored in a non-seismic building and transported via a flatbed, total cost would be reduced to $1 to $3 million.				
67	Create AC power cross tie capability across units	Improved AC power reliability across 2 units.	$170,796	Estimate Range: $4M - $6M. Not cost beneficial: since cost is greater than twice the benefit.
This SAMA would require safety analysis, engineering and design; physical installation of cross-tie, including new cable run; and installation of breakers to appropriate buses. It would also require a new swing bus for Unit 3 to connect to Unit 2 swing bus. Because of space concerns, new swing bus would have to be located in a new building. Long cabling runs and breakers would be required to maintain electrical separation.				
73	Install gas turbine generators	Improve on-site AC power reliability.	$500,060	Estimate Range: $8M - $10M. Not cost beneficial: since cost is greater than twice the benefit.
This SAMA would require extensive engineering and design work; installation of a gas turbine generator, including a seismically designed building; safety analysis required to connect to safety buses; numerous instruments to monitor system performance; regular calibration, surveillance and maintenance. **Note: Placing the gas turbine generator in a non-seismic building would reduce the cost to $6M-$8M.**				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
77	Provide a connection to alternate offsite power source (the nearest dam)	Increase offsite power redundancy. Notes: Assumes dedicated poles & overhead HV line approximately 20 miles to Hydro Facility at Norwich via existing right of ways. Includes transformers, breakers, etc. Assumes all necessary right of ways exists, no clearing or access fees required.	$635,074	Estimate Range: $6M - $10M. Not cost beneficial: since cost is greater than twice the benefit.
Assumes dedicated poles & overhead HV line approx 20 miles to Hydro facility at Norwich via existing right of ways. Includes transformers, breakers, etc. Assumes all necessary right of ways exist no clearing or access fees required.				
87	Replace steam generators with new design	Lower frequency of SGTR.	$144,816	Estimate Range: $175M - $200M. Not cost beneficial: since cost is greater than twice the benefit.
Based on actual costs from Unit 2 replacement: $200M actual in 1992.				
93	Additional instrumentation and inspection to prevent ISLOCA sequences.	Install additional instrumentation for detecting ISLOCA events. Implement a comprehensive piping inspection program to detect precursors to breaches in RCS integrity. The benefit assumes that the programs are so effective all ISLOCAs are eliminated.	$83,596	Estimate Range: $9M - $12M. Not cost beneficial: since cost is greater than twice the benefit.
In order to achieve the assumed benefit, all consequences of ISLOCAs are eliminated. It was assumed that this would necessitate extensive new instrumentation, wiring, cable tray analysis, safety analysis, rad monitors, and piping inspection program. Additionally, all equipment and instrumentation would require regular calibration, surveillance and maintenance. **Upon further evaluation, it was determined that, in reality, the instrumentation necessary for detecting ISLOCAs is already available. This includes: building radiation monitors; system radiation monitors; tank level indications; system pressure indications. This constitutes "already implemented" status.**				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
94	Increase frequency of valve leak testing	Decrease ISLOCA frequency.	$83,596	Estimate Range: $2M - $4M per Refueling Outage. Not cost beneficial: since cost is greater than twice the benefit.
Because most of these valves can only be tested during refuelings, during times when most critical path work is not being performed, it would add several days of critical path time to each outage. Upon further evaluation, the cost for this SAMA could be adjusted to $1M-$2M per refueling.				
99	Ensure all ISLOCA releases are scrubbed	Would scrub ISLOCA releases. One suggestion was to plug drains in the break area so the break point would be covered with water.	$83,596	Estimate Range: $4M - $6M. Not cost beneficial: since cost is greater than twice the benefit.
Because plugging drains in an area in which an ISLOCA is occurring is not practical, this estimate assumes engineering, design and installation of a new filtration system, with fans, filters, controls, instrumentation, cables; safety analysis, cable tray analysis; regular surveillance, calibration and maintenance on system. Note: If the ISLOCA was small enough to be handled by existing filtration, additional cost would be eliminated, and this SAMA could be handled by existing procedures.				
100	Add redundant and diverse limit switch to each containment isolation valve.	Enhanced isolation valve position indication, which would reduce frequency of containment isolation failure and ISLOCAs.	$133,754	Estimate Range: $18M - $24M. Not cost beneficial: since cost is greater than twice the benefit.
This SAMA would require extensive modifications to Control Boards in the main Control Room; engineering and safety analysis; installation of controls, power, wiring and limit switches for approximately 100 containment isolation valves; and regular surveillance, calibration and maintenance on each of these valves for the remaining life of the plant. Upon further evaluation, the cost for this SAMA could be adjusted to $12M-$18M.				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
113	Provide portable generators to be hooked in to the turbine driven AFW train, after battery depletion	Extend AFW availability in a SBO (assuming the turbine-driven AFW requires DC power).	$38,403	Estimate Range: $5M - $8M. Not cost beneficial: since cost is greater than twice the benefit.
The initial evaluation of this SAMA investigated using a portable diesel to drive an installed motor-driven AFW pump that would back up the turbine driven pump, not a portable generator to supply DC power to the installed TDAFW Pump. The costs assumed constructing a new building to house the pump, routing all the supply piping from the 2 different supply tanks, routing the discharge piping into the present building and connecting to the Auxiliary feedwater system. A more practical alternative to providing power to the AFW pump itself would be to establish a means of supplying power, to provide steam generator level indication. With manual control of the pump, SG level indication would enable feedwater operation without overfilling the SGs. This would require: An Engineering feasibility study; Engineering to determine the best way to provide power to the panels; Installing connections that would accept generator leads; Creation of a new SAMG, including engineering and safety review, and verification; Field verification of the actual operation; Incorporation into training; Periodic training. The total cost estimate for this alternative would be in excess of $130,000. Because the benefit for this SAMA is less than $39,000, no further analysis or action is justified.				
120	Create passive secondary side coolers	Provide a passive heat removal loop with a condenser and heat sink. Would reduce CDF from the loss of feedwater.	$532,887	Estimate Range: $50M - $100M. Not cost beneficial: since cost is greater than twice the benefit.
This SAMA would require extensive design engineering and analysis for an entirely new system. System would include a large heat sink, such as a cooling pool, tank, etc., heat exchangers, new buildings, piping, valves, instrumentation, cables; FSAR and license changes, new or modified procedures, new training, and regular surveillance, calibration and maintenance.				
123	Provide capability for diesel driven, low pressure vessel makeup	Extra water source in sequences in which the reactor is depressurized and all other injection is unavailable (e.g., firewater).	$396,036	Estimate Range: $7.5 - $12M. Not cost beneficial: since cost is greater than twice the benefit.
This would require construction of a new tank, with new piping and all other associated equipment for connection to piping going to the RCS; connection to boron batching system to maintain boron level in tank; installation of a diesel-driven pump to deliver the water to the system; new procedure, incorporation into training; regular surveillance, calibration and maintenance.				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
156	Secondary side guard pipes up to the MSIVs.	Would prevent secondary side depressurization should a steam line break occur upstream of the MSIVs. Would also guard against or prevent consequential multiple SGTR following a main steam line break event.	$335,690	Estimate Range: $10M - $15M. Not cost beneficial: since cost is greater than twice the benefit.
This would require completely encasing the steam lines inside containment from the steam generators to the containment wall, and then from containment to the MSIVs. For two of the four steam generators, the length of the steam lines inside containment is substantial. All pipe supports would require either substantial modifications or replacement. All would have to undergo new analyses. In the Main Steam Valve Building, it may be necessary to make substantial changes due to existing interferences, and several branch lines would have to be modified. Connecting to the containment penetration would likely require modification to the penetration cooling system. Work in containment would likely be critical path, and may increase the cost estimate well above that provided, due to an as yet undefined replacement power cost.				
160	Install turbine driven AF pump	Additional TDAFW pump would provide a backup to existing pump.	$712,156	Estimate Range: $12M - $16M. Not cost beneficial: since cost is greater than twice the benefit.
Room is not available in the existing buildings. This would require a new, seismic building for pump, Category 1 pump, new piping from pump to feedwater piping, new piping from steam lines to TDAFW, new cables to control room, cable tray analysis, new or modified procedures, incorporation into training, regular system maintenance. **Placing the pump in a non-seismic building would reduce the expense, but cost would still be $10M-$14M.**				
161	Install SBO diesel	Additional SBO diesel dedicated to Unit 3 would provide added emergency power instead of relying on the swing SBO diesel.	$105,417	Estimate Range: $8M - $10M. Not cost beneficial: since cost is greater than twice the benefit.
Based on historical costs for installation of the SBO diesel at Unit 3				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
162	Install Charging system train	Additional charging system train would provide additional flow path if valves fail to open or close in existing system.	$103,348	Estimate Range: $20M - $30M. Not cost beneficial: since cost is greater than twice the benefit.
Additional charging system train would require a new, seismically constructed building; new pump, piping, valves, instrumentation, power, wiring, all seismically qualified; safety analysis, cable tray analysis; regular surveillance, calibration and maintenance for entire system; procedure changes, and incorporation into training. Placing the additional train of equipment in a non-seismic building would reduce the cost; however, most of the system would continue to require seismic design and construction, resulting in a cost of approximately $18M-$28M. Also, the new building would now have to become part of the Radiologically Controlled Area.				
168	Automate Feed and Bleed	A separate redundant auto Feed and Bleed process would provide reliability to the existing manual process.	$480,825	Estimate Range: $1M - $3M. Not cost beneficial: since cost is greater than twice the benefit.
To automate the starting and stopping of Feed and Bleed would require extensive logic controls that can: determine steam generator level and pressurizer pressure; stop the reactor coolant pumps; initiate safety injection; verify at least one charging pump and one safety injection pump are running; check for required valve alignment; verify both PORV block valves are open, then open PORVs. If PORVs did not open, six other valves could have to be opened to establish bleed path. Requirements would include extensive engineering for design work and safety analysis; installation of logic system; extensive wiring to all affected components; system testing; surveillance, calibration and maintenance; procedure changes, and incorporation into training.				

SAMA No.	Potential Improvement	Discussion	Benefit (Bounding)	Cost Estimate and Basis for Conclusion
170	Add another AOV to isolate SW	Currently MOVs are used to isolate SW, by including an AOV in the same flow path, this would preclude a common cause failure event.	$143,769	Estimate Range: $2M - $3M. Not cost beneficial: since cost is greater than twice the benefit.
There are 4 service water MOVs that close to isolate portions of the service water system on certain accidents in order to maintain enough flow to the remaining components. This would require adding an AOV in series with each MOV. These valves are located in large bore piping (30" and 18"). They would require the AOVs, air lines, solenoids and DC power to operate the valves, cable runs to the control room, 4 valve controls mounted on Main Board 1 or 2 in the Control room, procedure changes to EOPS and Operating procedures.. Since these would be Fail closed valves, spurious closure of these valves would have to be evaluated for their effect on the plant and AOPs revised to address those failures. All operators would have to be trained on these valves. Other piping modifications may also be required to accommodate AOV installation, depending on where the valves are installed.				
173	Add additional SW AOVs (ATC/ATO)	Additional air operated valves in the SW system would assure SW cooling in case a CCF of the existing MOVs occurred.	$143,769	Estimate Range: $2M - $3M. Not cost beneficial: since cost is greater than twice the benefit.
There are 4 service water MOVs that close to isolate portions of the service water system on certain accidents in order to maintain enough flow to the remaining components. This would require adding an AOV in series with each MOV. These valves are located in large bore piping (30" and 18"). They would require the AOVs, air lines, solenoids and DC power to operate the valves, cable runs to the control room, 4 valve controls mounted on Main Board 1 or 2 in the Control room, procedure changes to EOPS and Operating procedures.. Since these would be Fail closed valves, spurious closure of these valves would have to be evaluated for their effect on the plant and AOPs revised to address those failures. All operators would have to be trained on these valves. Other piping modifications may also be required to accommodate AOV installation, depending on where the valves are installed.				

176	Add a redundant charging pump.	An additional charging pump would assure core cooling in case existing charging pump fails to run.	$103,348	Estimate Range: $10M - $16M. Not cost beneficial: since cost is greater than twice the benefit.
Adding a charging pump would require an additional, seismically constructed building. Entire system would require a Category 1 pedigree, including pump, motor, piping, valves, power, cable, instrumentation, etc. Also would require safety analysis, cable tray analysis, procedure changes, incorporation into training, and regular surveillance, calibration and maintenance. Upon further evaluation, the cost of this SAMA could be adjusted to $8M-$14M. Placing the additional pump in a non-seismic building would reduce the cost; however, most of the system would continue to require seismic design and construction, resulting in a cost of approximately $6M-$12M. The new building would also need to become part of the Radiologically Controlled Area.				
177	Add a redundant block valve for the PORV.	A redundant block valve would assure isolation of the PORV in case an automatic reseat circuitry failure occurs.	$55,118	Estimate Range: $2M - $4M. Not cost beneficial: since cost is greater than twice the benefit.
Installation of a redundant block valve would include engineering design and analysis; installation of Category 1 piping, valve, instrumentation, wiring, control board modifications; procedure modifications and incorporation into training; regular surveillance, calibration and maintenance.				
182	Add redundant AC bus.	A redundant AC bus would preclude the likelihood of complete AC bus failure.	$429,606	Estimate Range: $15M - $20M. Not cost beneficial: since cost is greater than twice the benefit.
Because there is no existing room, a new AC bus would require a new building, seismically constructed, safety analysis, design and installation of the bus itself, instrumentation, cable runs, Control Room board modifications, procedure changes, incorporation into training, and regular surveillance, calibration and maintenance. Placing the additional equipment in a non-seismic building would reduce the cost, but would still be in the range of $13M-$18M.				