June 22, 2004

Mr. David A. Christian
Senior Vice President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA  23060-6711

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR THE MILLSTONE POWER STATION, UNITS 2 AND 3 (TAC NOS. MC1827 AND MC1828)

Dear Mr. Christian:

The staff has reviewed the analyses of severe accident mitigation alternatives (SAMAs) submitted by Dominion Nuclear Connecticut, Inc. (DNC) in support of its applications for license renewal for Millstone Power Station, Units 2 and 3, and has identified areas where additional information is needed to complete its review.  Enclosed are the staff's requests for additional information, one set of RAIs for each unit.

As discussed with your staff, we request that you provide your responses to these RAIs within 60 days of the date of this letter.  If you have any questions, please contact me at (301) 415-1590.

Sincerely,

**/RA/**

Richard L. Emch, Jr., Senior Project Manager
Environmental Section
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.:  50-336 and 50-423

Enclosures:  As stated

cc w/encl:  See next page

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

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.

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

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.

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.

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.

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 $5^{th}$ 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 F.3.3 says that to account for uncertainties, the benefit or each SAMA list 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 this case based on appropriate scaling of both core inventory and replacement power costs.

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.

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.

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.

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

- 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 postive suction head

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

- 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

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

- 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.

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 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).

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

11. SAMA 3 is identified as being 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.

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

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.

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.

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 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.

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.

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.

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 discus 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.

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. 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.

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).

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

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