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October 20, 2006

BVY 06-095
TAC No. MC 9670

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Reference: 1. Letter, Entergy to USNRC, "Vermont Yankee Nuclear Power Station, License No. DPR-28, License Renewal Application," BVY 06-009, dated January 25, 2006.

Subject: Vermont Yankee Nuclear Power Station
License No. DPR-28 (Docket No. 50-271)
License Renewal Application, Amendment No. 18
Response to Request for Clarification of SAMA RAI Responses

On January 25, 2006, Entergy Nuclear Operations, Inc. and Entergy Nuclear Vermont Yankee, LLC (Entergy) submitted the License Renewal Application (LRA) for the Vermont Yankee Nuclear Power Station (VYNPS) as indicated by Reference 1.

This letter is a response to an NRC request for clarification of previous VY responses to RAIs pertaining to Severe Accident Mitigation Alternatives (SAMA).

This submittal does not contain new regulatory commitments.

Should you have any questions concerning this letter, please contact Mr. James DeVincentis at (802) 258-4236.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 20, 2006.

Sincerely,

[signature] for TAS per telecon 10/20/06

Ted A. Sullivan
Site Vice President
Vermont Yankee Nuclear Power Station

Attachment 1 (28 pages)
cc list: (next page)

A117

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Attachment 1

Vermont Yankee Nuclear Power Station

License Renewal Application

Amendment 18

(28 Pages)

REQUEST FOR CLARIFICATION

ENTERGY RESPONSES TO VERMONT YANKEE SAMA RAIS

DOCKET NO. 50-271

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Tables

NRC RAI 1.a Request for Clarification

The response to this RAI indicates that the contribution to Functional Classes IBE and IED from LOOP-initiated events is 2.27E-06 per year. This is 81% of the total CDF due to LOOP. This is essentially the SBO frequency, since these functional classes involve loss of both essential buses. Briefly explain why the percentage of LOOPs that result in SBO is so high.

Response to RAI 1.a Request for Clarification

The percentage of LOOPs that result in SBO is high because the dominant LOOP initiator (weather-related) assumes that a regional blackout occurs due to the severe weather conditions. Therefore, a high probability of failure to recover offsite power was assumed (~ 0.6), and a high probability of failure to recover power via the Vernon Tie was also assumed (~ 0.13). These assumptions are conservative; as noted in Amendment 4 to the LRA, the Vernon Hydro Station is a highly reliable black-start facility capable of supplying required SBO loads in less than 10 minutes. Amendment 4 notes that Vernon Hydro Station reliability was 99.9% in 1994 and has remained high. Also, the station remained on-line throughout the Northeast blackout of August 14, 2003. Failure of these sources of power leaves only the onsite emergency diesels to power the essential buses to prevent an SBO (probability that neither EDG will start nor load is ~ 0.01).

NRC RAI 1.b Request for Clarification

1. The response to this RAI indicates that the BWROG F&O pertaining to data analysis and initiating event frequencies were resolved in the VY02R0 update. Clarify in which version the resolution of the other F&Os was incorporated.

2. In regards to the CDF decreases from 8.73E-06 to 4.91E-06 from model VY02R8 to model VY04R0, clarify if most of this decrease can be attributed to any of the seven (in addition to those associated with the EPU) changes identified in the response to this RAI.

Response to RAI 1.b.1 Request for Clarification

Most of the BWROG peer review F&Os did not require a change to the PRA model. A total of fifty-two (52) level 'A' and 'B' F&Os were identified during the BWROG peer review:

- The one (1) level A F&O related to HRA dependencies did not require a model change.

- Nine (9) of the fifty-one (51) level B F&Os required model changes. Eight (8) of these pertained to data analysis and initiating event frequencies and were resolved in the VY02R0 update. The remaining level B F&O pertained to a model simplification whereby a single split fraction was commonly used to represent loss of support to either train of two train systems. This simplification had no impact on the core damage or LERF quantification, but specific basic event importance information was skewed due to this simplification. To correct this problem, train specific split fractions were incorporated in model VY00R0 for some systems, and the remaining system asymmetries were addressed in model VY04R0.

Response to RAI 1.b.2 Request for Clarification

Most of the decrease in CDF from model VY02R8 to model VY04R0 can be attributed to the following modeling changes, which were among those identified in the response to RAI 1.b:

- Updated loss of vital DC bus initiating event frequency
- Improved SW recovery model
- Re-evaluation of model for flooding on reactor building 280'
- Updated reactor protection system (RPS) fault tree model

NRC RAI 1.d Request for Clarification

This response indicates that the flooding analysis was reviewed in the 2002 BWROG Peer Review. The ER (p. E.1-37) states that the peer review was performed in 2000. Clarify.

Response to RAI 1.d Request for Clarification

This was a typographical error in the RAI response. The BWROG peer review was performed in June 2000.

NRC RAI 5.e Request for Clarification

In ER Table E.1-3, SAMA 47 is indicated as covering as many as 17 "risk significant terms" involving internal flooding initiators. However, based on the RAI response this SAMA seems to cover only 1 of 17 such terms. Provide justification that there are no cost-beneficial SAMAs for the other flood initiators.

Response to RAI 5.e Request for Clarification

Based upon the following revised ER Table E.1-3, there are now only 9 risk significant terms involving internal flooding initiators. The disposition column of the table has been revised to present Phase II SAMAs applicable to the 9 risk significant internal flooding terms.

NRC RAI 5.f Request for Clarification

1. The response for item 12 indicates the CDF contribution from events with a SW line break in a diesel generator room is approximately 1E-07. This corresponds to about 2% of the total CDF. Also, the RRW values for the two diesel room SW flooding events appear to be 1.0073 and 1.0053. This is above the RRW cutoff used to identify potential SAMAs in the ER. Provide additional justification as to why additional SAMAs would not be cost-beneficial for these events.

2. The response for item 14 indicates that floods in the reactor building basement (torus room) are not a significant contributor to risk. However, it appears that several of the "risk significant terms" in ER Table E.1-3 could be impacted by this SAMA (i.e., enhancements for aligning alternate cooling during a major flood). Identify the risk significant terms impacted by this SAMA, and the associated, combined CDF from these

contributors. Justify why this or other potential SAMAs were not further evaluated.

Response to RAI 5.f.1 Request for Clarification

In the model used for the revised SAMA evaluation (VY05R0), the RRW for initiating events associated with a SW line break in a diesel generator room do not exceed the RRW cutoff used to identify potential SAMAs. See revised ER Table E.1-3.

Response to RAI 5.f.2 Request for Clarification

As noted in the response to RAI 5f, sensitivity studies were performed which showed that significant water level on the torus room floor during postulated SW break scenarios leading to inability to align alternate cooling was not a significant contributor to risk. Based on this result, VYNPS did not pursue alternate cooling procedural and hardware changes. Rather, procedural enhancements were made to improve operator ability to diagnose and isolate the break prior to torus room water level exceeding the flood elevation which could challenge alternate cooling operation.

Revised ER Table E.1-3 lists Phase II SAMAs applicable to risk significant terms involving internal flooding initiators.

NRC RAI 5.g Request for Clarification

1. To support the assertion made in the third and fourth paragraphs of the response (that SAMA candidates to respond to internal risk contributors are also applicable to the significant fire scenarios), please cite the specific internal event candidate SAMAs that would also be applicable to fire risk, indicating the specific fire risk contributor (fire area or sequence) affected.

2. Confirm whether the items listed in Table RAI.5-2 are credited in the fire PRA. If so, justify why additional SAMAs were not further evaluated, given the relatively large residual level of fire risk.

Response to RAI 5.g.1 Request for Clarification

Fires in the cable vault, switchgear rooms and CRD repair room (reactor building elevation 252-foot south side of building) cause failure of HPCI, RCIC, core spray, LPCI, and support systems for containment decay heat removal and reactor depressurization. Applicable Phase II SAMAs to mitigate the loss of these systems are: Phase II SAMAs 49, 50, 51, 52, 53 and 54 to provide alternate high-pressure injections; Phase II SAMAs 37, 61, 65, and 66, to enhance low-pressure injection availability; Phase II SAMA 60 for reactor depressurization; and Phase II SAMAs 1, 4, 12, 37, and 64 for containment decay heat removal. These Phase II SAMAs mitigate the consequences of fires in these areas.

Fires in the reactor building (elevation 252-foot, northeast side of building) cause failure of division A of the ECCS initiation logic, divisions A and B of LPCI injection, division A of RHR torus cooling, division A core spray, HPCI, RCIC and the service water supply path to the turbine building (and assumed loss of feedwater and condensate). Applicable Phase II SAMAs are the same as those described in the previously paragraph.

Fires in the battery room are mitigated by Phase II SAMAs 28, 29, and 30, which provide additional DC power sources. Hence, these Phase II SAMAs mitigate the consequences of fires in these areas.

Fires in the turbine building cause failure of feedwater, condensate, main condenser, condensate transfer, service/instrument air, turbine building closed cooling water, and alternate shutdown battery (ASD). Phase II SAMAs 49, 50, 51, 52, 53, and 54, to provide alternate high-pressure injections mitigate loss of feedwater/condensate. Phase II SAMAs 1, 4, 12, 37, and 64, for containment decay heat removal, mitigate failure of the main condenser, service/instrument air and turbine building closed cooling water. Phase II SAMAs 28, 29, and 30, which provide additional DC power sources, mitigate loss of the ASD.

Response to RAI 5.g.2 Request for Clarification

VYNPS does not have a fire PRA. As documented in the VY IPEEE submittal a screening model was created to support the internal fire evaluation, which used the Fire Induced Vulnerability Evaluation (FIVE) method developed by EPRI. With few exceptions, items listed in Table RAI 5-2, "Fire Related Phase I SAMAs", pertain to potential improvements in the fire protection program for prevention and mitigation of fires. These items are not explicitly modeled in the screening model. SAMAs 218, 223, and 224 are physical plant features which were installed to support the Appendix R program. These modifications were included in the screening model used for the FIVE analysis.

The dominant fire zones are equipped with a detection system that alarms in the control room. Also, several zones are equipped with a suppression system. Therefore, no cost-effective hardware changes were identified to reduce CDF in these areas. Following the VYNPS Fire Hazards Analysis provisions and procedures provides assurance that risk in these areas is minimized. Therefore, no cost-effective procedural changes were identified to reduce CDF in these areas.

NRC RAI 5.h Request for Clarification

The response to this RAI indicates that valve improvements would decrease the likelihood of containment bypass scenarios and of MSIV closure during testing. It is not clear how either of these impacts would reduce the risk from "transients with power conversion system available" since the MSIVs must be open for these sequences. Clarify.

Response to RAI 5.h Request for Clarification

As stated in the response to RAI 5.h, the goal of SAMA 046 is to improve MSIV valve and actuator design for long term reliability. The scope of the proposed design includes improved MSIV actuator operation. Improved actuator reliability would decrease the probability of inadvertent MSIV closure during post-accident operation, when MSIVs are relied upon to support continued use of the normal plant heat sink (i.e., main condenser) for transients with power conversion systems available.

NRC RAI 5.j Request for Clarification

Even though SAMA 59 is intended for medium LOCAs, the proposed hardware improvement would presumably have an impact not only for medium LOCAs, but also for small LOCAs and possibly transients (with loss of makeup). The benefit of this SAMA should thus include these impacts. Address these impacts, and provide a revised benefit estimate, as appropriate.

Response to RAI 5.j Request for Clarification

As previously described, SAMA 59 represents a potential reduction in the frequency of medium LOCAs due to an RCS overpressurization event.

The benefit of SAMA 59 was re-evaluated by eliminating the occurrence of all RCS overpressure events (from accident sequences that required RCS overpressure protection). The evaluation, performed using the new PSA model (VY05R0), resulted in a CDF reduction of 0.05 percent and revised baseline benefit with uncertainty of $1,424.

NRC RAI 5.k Request for Clarification

1. In the response to this RAI, it is stated that a passive design would require closure of two isolation check valves. Explain the location and function of these check valves.

2. The response states that passive venting still requires operator action to control venting so that adequate NPSH is maintained. Either this must be done or alternate injection from sources outside containment must be utilized. Clarify whether alternate injections sources have been accounted for in the assessment. Also, the response to RAI 6.h, which considers SAMA 63, states that controlled venting is not included in the model. Clarify this discrepancy.

3. The response mentions that the cost of adding redundant components includes providing an alternate power source for valve V16-19-86. Explain this requirement.

4. Cost estimates are provided for three alternative vent system modifications, but only one benefit estimate is provided. Provide the estimated benefits for each of the vent system modifications considered.

Response to RAI 5.k.1 Request for Clarification

The check valves, located on the 280-foot elevation inside the reactor building, are part of the Standby Gas Treatment (SBGT) system. The SBGT check valves are used to isolate the low pressure SBGT fan/filter units and duct work from the higher torus vent pressure. This ensures the integrity of the hard pipe torus vent path to the plant stack and precludes venting steam to the reactor building. Hence, the model requires that these two check valves remain closed during a hard pipe torus vent evolution.

Response to RAI 5.k.2 Request for Clarification

The PSA model (VY05R0) does account for alternate injections sources following successful containment venting. The following sentence is hereby deleted from the response to RAI 5.k.2, "Although the venting process is passive in this model, subsequent operator action is still required to control the venting in order to maintain the required net positive suction head for LPCI pumps taking suction from the torus."

Controlled venting is not considered in the PSA model. The response to RAI 6.h addresses the potential SAMA to control venting to avoid adverse impact on the low-pressure injection systems taking suction from the torus. This condition does not exist for alternate injection systems because their suction sources are outside the containment.

Response to RAI 5.k.3 Request for Clarification

Since RAI 5.k requested an assessment of providing redundant components for the torus vent system, two alternatives were assessed. The potential cost of providing a redundant alternate power source to torus vent valve V16-19-86 was provided. In addition, the potential cost of providing a redundant vent path was provided.

Response to RAI 5.k.4 Request for Clarification

The estimated benefits for the three alternative vent system modifications are bounded by the estimate for conversion of the existing torus vent to a passive torus venting system. The benefit from conversion of the existing torus vent to a passive torus venting system was conservatively estimated by removing operator failure to implement torus venting. This benefit estimate is also conservative for assessment of the other alternative vent system modifications. Although both the alternate power source to torus vent valve V16-19-86 and redundant vent path potential modifications mitigate failure of specific components, operator failure to implement torus venting is the dominant contributor. Therefore, implementation of either of these alternatives would provide less benefit than that provided by removing operator failure to implement torus venting.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
Emergency Diesel Generators (A & B)	1.4267	This term represents random failures of the emergency diesel generators, leading to an SBO event. Phase I SAMAs to improve reliability of the emergency diesel generators by creating a crosstie of EDG fuel oil supplies and a backup source for diesel cooling have already been installed. In addition, Phase II SAMAs 002, 003 and 032 to improve reliability of the EDGs were evaluated.
Loss of Offsite Power - initiating event PC Plant Centered GR Grid Related WR Weather Related	1.0951-PC 1.0605-GR 1.2985-WR	This term represents the loss of offsite power initiating event. Industry efforts over the last twenty years have led to a significant reduction in plant scrams from all causes. Improvements related to enhancing offsite power availability or reliability and coping with plant SBO events were already implemented and evaluated during preliminary SAMA screening. Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system reliability or to cope with loss of offsite power and SBO events were evaluated.
HPCI	1.3931	This term represents random failure of the HPCI system. Phase I SAMAs to improve availability and reliability of the HPCI system that have already been implemented include raising backpressure trip setpoints and proceduralizing intermittent operation. Additional improvements were evaluated in Phase II SAMAs 049, 050, 051, 052, 053, and 054.
RCIC	1.3530	This term represents random failures of the RCIC system. Phase I SAMAs to improve availability and reliability of the RCIC system that have already been installed include raising backpressure trip setpoints and proceduralizing intermittent operation. Additional improvements were evaluated in Phase II SAMAs 049, 050, 051, 052, 053, and 054.
Operator Action: Operator fails to align firewater system and John Deere Diesel for alternate injection	1.2371	This term represents operator failure to align the John Deere diesel generator to provide electric power to 480VAC bus 9 during a loss of offsite power event. With bus 9 energized and supplying MCC8B and 9B, battery charging is maintained as well as power to RHR valves necessary for aligning the diesel fire pump for alternate RPV vessel injection. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.
ECCS Low Pressure Interlock	1.1962	This term represents random failures of reactor low-pressure transmitters during transients with stuck open SRVs or LOCAs in which random failures prevent all low-pressure injection valves

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
		from opening. Phase II SAMAs 065 and 066 to reduce the risk due to failure of the ECCS low-pressure interlock were evaluated.
Depressurization (SRVs and ADS Logic)	1.1582	This term represents random failures of the SRVs to open for depressurization during transients and small LOCAs. Phase I SAMAs to enhance reliability of the SRVs that have already been implemented include adopting symptom based EOPs and SAGs, modifying ADS logic, and upgrading SRV pneumatic components. Additional improvements were evaluated in Phase II SAMAs 059 and 060.
Feedwater/Condensate	1.1150	This term represents random failure of the feedwater and condensate injection path. Phase I SAMAs creating connections of existing or alternate water sources to feedwater and condensate, and installing motor driven feed water pumps, have already been installed to increase the availability of injection subsequent to MSIV closure. Many of the Phase II SAMAs (e.g. 050, 051, 052, 053, and 054) explored potential benefits of enhancing the reliability of high pressure injection systems.
Torus Vent via TVS-86 and Rupture Disk	1.1149	This term represents random failures of components in the containment vent path. A hardened pipe vent path was implemented as a result of the NRC Containment Performance Program to provide a redundant means for containment heat removal capability. Several Phase I SAMAs regarding the drywell spray system were already installed to provide containment decay heat removal capability by plant design. Therefore, no Phase II SAMAs were proposed to reduce random failure of containment vent path components. However, Phase II SAMA 063 to control containment venting within a narrow pressure band to prevent rapid depressurization during venting was evaluated.
Loss of Feedwater - initiating event	1.1072	This term represents the initiating event for loss of feedwater. Modifications to significantly reduce or eliminate the potential for loss of feedwater, such as installing a digital feedwater control system, providing a backup water supply and adding a third feedwater pump, have already been implemented. Many of the Phase II SAMAs (e.g., 035, 051, 052, 053, and 054) explored potential benefits for mitigation of this event.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
Loss of 4.16KV Bus 3 - initiating event	1.1105(IE)	This term represents loss of 4.16KV bus 3. Phase I SAMAs to improve 4.16KV bus crosstie capability and procedures to repair or replace failed 4.16KV breakers have already been implemented. Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system reliability or to cope with loss of offsite power and SBO events were evaluated.
Loss of 4.16KV Bus 4 - initiating event	1.1006	This term represents loss of 4.16KV bus 4. Phase I SAMAs to improve 4.16KV bus crosstie capability and procedures to repair or replace failed 4.16KV breakers have already been installed. Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system reliability or to cope with loss of offsite power and SBO events were evaluated.
Torus Cooling Mode of RHR & RHRSW	1.0735	This term represents random failure of the torus cooling mode of the RHR and RHRSW systems. Containment spray mode of RHR and fire protection system crosstie has already been implemented to provide redundant containment heat removal capability. In addition, Phase II SAMAs 004, 010 and 017 to improve the reliability of containment decay heat removal were evaluated.
Operator Action: Operator fails to open SRVs for vessel depressurization during transients and small LOCA	1.0684	This term represents operator failure to manually open the SRVs for depressurization during transients and small LOCAs. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.
Operator Action: Operator fails to initiate HPCI/RCIC during transients, medium and small LOCAs	1.0589	This term represents operator failure to initiate HPCI/RCIC to perform the core cooling function during transients, medium LOCAs, and small LOCAs when automatic initiation fails. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.
Operator Action: Operator fails to recognize the need to vent the torus for pressure reduction	1.0441	This term represents operator failure to recognize the need to vent the torus for pressure reduction during loss of containment heat removal accident sequences. Phase II SAMA 063 to control containment venting within a narrow pressure band to prevent rapid containment depressurization during venting was evaluated.
Containment N_2	1.0373	This term represents random failure of the containment nitrogen system for SRV operation

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
		during loss of offsite power. A Phase I SAMA, adding high-pressure nitrogen bottles as a backup to the normal nitrogen supply, has already been installed to improve reliability of the containment nitrogen system. Since failure of the SRVs has a larger risk reduction worth than failure of this support system, the benefit derived from Phase II SAMA 060, "improve SRV design," is greater than the benefit possible from improving the nitrogen supply system. Also, the cost of adding another nitrogen supply is judged comparable to the cost of modifying the SRVs. Therefore, no Phase II SAMAs were evaluated to further improve reliability of nitrogen supply to the SRVs.
Alternate Cooling	1.0373	This term represents random failure of alternate cooling from the west cooling tower deep basin to the suction of the RHRSW pumps. Phase II SAMA 064 to improve alternate cooling capability was evaluated.
Loss of Bus DC-2 and associated battery - initiating event	1.0367(IE) 1.0268	These terms represent the initiating event of a complete loss of 125VDC bus DC-2 and random failures of battery B-1. Phase I SAMAs to improve alternate battery charging capability, replace existing batteries with more reliable ones and DC bus crosstie capability have already been installed. Phase II SAMAs 028, 029, 030, and 033 for enhancing DC system availability and reliability were evaluated.
Loss of Bus DC-1 and associated battery - initiating event	1.0360(IE) 1.0226	These terms represent the initiating event of a complete loss of the 125VDC bus DC-1 and random failures of battery A-1. Phase I SAMAs to improve alternate battery charging capability, replace existing batteries with more reliable ones, and DC bus crosstie capability have already been installed. Phase II SAMAs 028, 029, 030, and 033 for enhancing DC system availability and reliability were evaluated.
Inadvertent Opening of Relief Valve - initiating event	1.0352	This term represents the initiating event of inadvertent opening of a relief valve. Improvement of the SRV design and SRV reseat reliability, to reduce the probability and consequences of this initiating event, were evaluated in Phase II SAMAs 055 and 060.
Operator Action: Operator fails to open SRVs for vessel depressurization during medium LOCA	1.0251	This term represents operator failure to manually open the SRVs to depressurize during a medium LOCA. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
Internal Flooding Initiator, SW pipe break in torus room, at El. 213' of the reactor building	1.0247	This term represents the initiating event of SW pipe break in torus room, at El. 213' of the reactor building. Both RCIC and HPCI are assumed to fail due to this flooding initiator. A Phase I SAMA, enhancement of "Loss of Service Water" procedure to contain a mitigation strategy for each break location, has already been implemented. In addition, Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure system to reduce the CDF contribution of this internal flooding initiator, were evaluated.
Internal Flooding Initiator, SW pipe break in NE ECCS corner room of the reactor building	1.0222	This term represents the initiating event of SW pipe break in NE ECCS corner room of the reactor building. RHR loop A and core spray loop A, and both RCIC and HPCI are assumed to fail due to this flooding initiator. A Phase I SAMA to increase berm height to prevent flooding of the ECCS corner room has already been installed. In addition, Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure system toreduce the CDF contribution of this internal flooding initiator, were evaluated.
Transient with PCS available - initiating event	1.0221	This term represents the initiating event of a transient with PCS available. Industry efforts over the last twenty years have led to a significant reduction of plant scrams from all causes. Phase II SAMA 046 to improve MSIV design and mitigate the consequences of this event was evaluated.
Diesel Fire Pump for Alternate Injection	1.0218	This term represents random failure of diesel fire pump P40-1A to provide alternate RPV vessel injection during a loss of offsite power event. Phase I SAMAs to use the fire protection system as a backup source for containment spray and reactor vessel injection during loss of offsite power have already been installed to provide redundant capability for RPV injection and heat removal. Phase II SAMA 064 to provide a crosstie for fire protection from RHRSW system to RHR loop B to further improve injection capability was evaluated.
Internal Flooding Initiator, SW pipe break in SE ECCS corner room of the reactor building	1.0214	This term represents the initiating event of SW pipe break in SE ECCS corner room of the reactor building. RHR loop B and core spray loop B, and both RCIC and HPCI are assumed to fail due to this flooding initiator. A Phase I SAMA modifying and sealing the hatch lift points and hatch edges has already been installed to ensure hatches are watertight. In addition, Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
		high pressure system toreduce the CDF contribution of this internal flooding initiator, were evaluated.
RPS	1.0189	This term represents random failure of the reactor protection system. Several Phase I SAMAs to minimize the risks associated with ATWS scenarios have already been installed. No Phase II SAMAs were evaluated to further improve reliability of RPS. However, Phase II SAMAs 057 and 058 to enhance the reliability of the standby liquid control system and improve ATWS capability to mitigate the consequences of this event were evaluated.
Internal Flooding Initiator, SW pipe break at El. 303' of the reactor building	1.0171	This term represents the initiating event of SW pipe break at El. 303' of the reactor building. Spray from this flooding initiator is assumed to affect the ECCS 24V DC distribution panel. A Phase I SAMA, adding chase berms at elevation 303', has already been installed. In addition, Phase II SAMA 047, to shield the ECCS power cabinet to reduce the CDF contribution of this internal flooding initiator was evaluated.
Bus 2 (supplied by SU XFMR) 4.16KV	1.0164	This term represents the initiating event of a complete loss of offsite power from the 345 KV switchyard and 115 KV line. Phase I SAMAs to improve 4.16KV bus crosstie capability, procedures to repair or replace failed 4.16KV breakers and provide connection to an alternate source of offsite power have already been installed. Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system reliability or to cope with loss of offsite power and SBO events were evaluated.
Operator Action: Operator fails to align a condensate transfer pump to inject via LPCI or core spray lines for alternate injection	1.0166	This term represents operator failure to align condensate transfer pump to inject via LPCI or core spray lines for alternate injection. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.
Operator Action: Operator fails to initiate alternate cooling mode from the cooling tower deep basin	1.0144	This term represents operator failure to align water from the west cooling tower deep basin to the suction of the RHRSW pumps to cool a number of loads normally cooled by the service water system. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
Internal Flooding Initiator, SW pipe break (north) affecting MCCs and ECCS in NE corner room of the reactor building	1.0137	This term represents the initiating event of SW pipe break in NE ECCS corner room of the reactor building. Spray from this flooding initiator can affect the RCIC alternate shutdown transfer switch panel and local starter panel for V13-16. RCIC is also subject to flooding within 12 to 15 minutes. In addition, the spray event can affect HPCI local starter panel for V23-16. HPCI is also subject to flooding within 30 minutes. A Phase I SAMA, enhancement of "Loss of Service Water" procedure to contain a mitigation strategy for each break location, has already been implemented. In addition, Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure system to reduce the CDF contribution of this internal flooding initiator, were evaluated.
Bus 1 (supplied by SU XFMR) 4.16KV	1.0096	This term represents the initiating event of a complete loss of offsite power from the 345 KV switchyard and 115 KV line. Phase I SAMAs to improve 4.16KV bus crosstie capability, procedures to repair or replace failed 4.16KV breakers and provide connection to an alternate source of offsite power have already been installed. Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system reliability or to cope with loss of offsite power and SBO events were evaluated.
Vernon Tie	1.0129	This term represents random failure of Vernon tie line circuit breakers to close and operator failure to close two breakers from the control room. Phase I SAMAs to provide an alternate source of offsite power, proceduralize steps in recovery of offsite power after SBO, and protect control cable of Vernon tiebreakers have already been installed. No Phase II SAMAs were evaluated to further improve reliability of the Vernon tie. However, Phase II SAMAs 028, 029, 030, 031, 033 and 036 for enhancing AC or DC system availability or reliability to cope with the loss of offsite power and SBO events were evaluated.
Internal Flooding Initiator, fire protection pipe break in upper RCIC room at El. 232'	1.0111	This term represents the initiating event of fire protection pipe break in torus room, at El. 232' of the reactor building. This flooding initiator fails RCIC since flood water and spray is delivered to the lower RCIC area. A Phase I SAMA, to provide a relief path to relieve water accumulation in the upper RCIC to lower RCIC area before floor failure, has already been implemented. Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
		system to reduce the CDF contribution of this internal flooding initiator, were evaluated.
ATWS with MSIV Closed - initiating event	1.0100	This term represents the ATWS initiating event. Several Phase I SAMAs to create a boron injection path through CRD, increase boron concentration, and provide RPT, ARI, and FW trip to minimize the risks associated with ATWS scenarios have already been installed. In addition, Phase II SAMAs 057 and 058 to enhance reliability of the standby liquid control system and improve ATWS capability to mitigate the consequences of this event were evaluated.
Internal flooding Initiator, SW pipe break in affecting instrument panels and 480V MCC, at El. 280' of the reactor building	1.0090	This term represents the initiating event of SW pipe break at El. 280' of the reactor building. A major break in the service water system 18" diameter supply piping on El. 280' (north) has the potential to fail ECCS instrument panel 6B (S2), channels A and C. Division S2 (channels A and C) of ECCS signal instruments are failed as a result of this flood event. A Phase I SAMA, enhancement of "Loss of Service Water" procedure to contain a mitigation strategy for each break location, has already been implemented. In addition, Phase II SAMA 047, to shield the ECCS power cabinet to reduce the CDF contribution of this internal flooding initiator was evaluated.
Operator Action: Operator fails to start a TBCCW pump	1.0083	This term represents operator failure to start TBCCW pump locally from the motor control panel and establish cooling to BOP components for RPV makeup and heat removal. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject
Operator Action: Operator fails to initiate SLC during an ATWS without main condenser	1.0083	This term represents operator failure to initiate SLC during an ATWS without main condenser. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject
Loss of PCS - initiating event	1.0083	This term represents the initiating event of a loss of PCS. Industry efforts over the last twenty years have led to a significant reduction of plant scrams from all causes. Phase II SAMA 046 to improve MSIV design and mitigate the consequences of this event was evaluated.
Stuck Open SRVs initiating event	1.0082	This term represents the initiating event of stuck open SRVs. Improvement of SRV reseat reliability and SRV design were evaluated in Phase II SAMAs 055 and 060.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
Internal Flooding Initiator, circulating water pipe break in turbine building	1.0081	This term represents the initiating event of circulating water pipe break in the turbine building. This break causes failure of turbine bypass and the main condenser. It results in degraded circulating water flow which leads to failure of feedwater and condensate. Phase I SAMAs to improve inspection of expansion joints on the main condenser and to change procedures to reduce the probability of a circulating water piping break have already been implemented. Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure system to reduce the CDF contribution of this internal flooding initiator, were evaluated.
Internal Flooding Initiator, SW pipe break in intake structure	1.0074	This term represents the initiating event of SW pipe break in the intake structure. This break causes significant flow diversion. The flow diversion causes circulating water, TBCCW, feedwater and condensate system failures. Phase II SAMAs 049, 50, and 53, to provide an additional high pressure injection pump with independent diesel, install independent AC high pressure injection system, and install an additional active high pressure system to reduce the CDF contribution of this internal flooding initiator, were evaluated.
Loss of Service Water - initiating event	1.0065	These terms represent random passive failures of the service water system and the initiating event of a complete loss of the service water system. Enhancement of the service water system was evaluated in Phase II SAMA 001.
24 VDC ECCS Bus B	1.0050	This term represents random failures of the 24VDC ECCS Bus B system. A Phase I SAMA, replacing the 24VDC batteries with 125VDC to 24VDC converters, has already been implemented. Phase II SAMA 047 to protect the power cabinet from internal flooding to further improve reliability of 24VDC ECCS buses was evaluated.
Operator Action: Operator fails to initiate and control feedwater and condensate during transients and small LOCA and medium LOCAs	1.0049	This term represents operator failure to align feedwater and condensate injection to perform the core cooling function during transients, medium LOCAs and small LOCAs. Phase I SAMAs including improvements to plant procedures, and installation of instrumentation to enhance the likelihood of success of operator action in response to accident conditions, have already been implemented. No additional Phase II SAMAs were recommended for this subject
24 VDC ECCS Bus A	1.0042	This term represents random failures of the 24VDC ECCS Bus A system. A Phase I SAMA, replacing the 24VDC batteries with 125VDC to 24VDC converters has already been installed.

Revised Table E.1-3 Correlation of Level 1 Risk Significant Terms to Evaluated SAMAs

Risk Significant Terms	RRW	Disposition
		Phase II SAMA 047 to protect the power cabinet from internal flooding to further improve the reliability of 24VDC ECCS buses was evaluated.

NRC RAI 6.a Request for Clarification

1. For SAMAs 9 and 23, it appears that flooding internal to the drywell was evaluated. It would appear that flooding (or sprays) on the outside might serve the same purpose and avoid the necessity for the relocation of the drywell vent. Discuss.

2. For SAMA 52, explain why minor modifications to the existing CRD system or modifications to the emergency procedures to enhance CRD flow rates would not be viable low-cost alternatives to the SAMA that was evaluated.

3. For SAMAs 10 and 24, it would appear that use of existing fire water sprays or relatively simple modifications to the sprays might be effective in mitigating releases. Discuss.

Response to RAI 6.a.1 Request for Clarification

SAMAs 9 and 23 evaluated flooding internal to the drywell to ensure the drywell head seal does not fail due to high temperature. Flooding or sprays on the outside might serve the same purpose, but would still cost more than the estimated benefit for these SAMAs ($0 in Revised Table E.2-1).

Response to RAI 6.a.2 Request for Clarification

SAMA 52 considered replacing one CRD pump with a flow capacity equal to the RCIC system (400 gpm). Minor modifications to the existing CRD system or modifications to the emergency procedures to enhance CRD flow rates would not be viable low-cost alternatives because the flow provided by the CRD system is limited by CRD pump capacity in addition to pipe friction losses (in both the CRD drive water header piping and suction piping).

Response to RAI 6.a.3 Request for Clarification

There are only a few fire protection automatic suppression systems within the reactor building. These are protecting the enclosed Northwest corner room 232' elevation, as well as a ~40'x40' area in the Northwest quadrant of the 252' elevation, and the recirculation MG foam system located in the Northeast quadrant of the 280' elevation.

The Northwest corner room 232'elevation contains a pre-action sprinkler system which requires an ionization detector signal and melting of the sprinkler head thermal linkage for actuation. The Northwest quadrant 252' elevation has a similar arrangement for actuation. The recirculation MG foam system is an open-deluge sprinkler system, but requires thermal or ionization detector signals for actuation or entry into the reactor building and manual valve manipulation.

As such, they have limited capability in providing fission product scrubbing. The proposed design modification would upgrade the fire protection system to a sufficient capacity to handle postulated loads from severe accidents. The revised baseline with uncertainty value of $2,025,199 is less than the estimated implementation cost of greater than $2.5 million. Therefore, this SAMA is not considered to be cost effective.

NRC RAI 6.b Request for Clarification

Most of the refined cost estimates for SAMA candidates 35, 49, 50, 51, 52, 53, 54, 55 and 60 have increased significantly when accounting for the single-unit site (from the greater than $2 million cost estimate that was used in the ER). One would expect this consideration to decrease cost estimates. Provide a further explanation of the methods and specific assumptions used to derive these cost estimates that would justify the increase in cost estimates from those reported in the ER.

Response to RAI 6.b Request for Clarification

The cost estimates provided in the VYNPS ER for SAMA candidates 35, 49, 50, 51, 52, 53, 54, 55 and 60 were drawn from a previous SAMA analyses for a dual-unit site (Peach Bottom). However, the cost estimates in the Peach Bottom SAMA analysis, as in the VYNPS SAMA analysis, are not always detailed cost estimates. As noted in Section 4.21.5 of the VYNPS ER, detailed cost estimates are often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit; rather costs are conceptually estimated to the point where conclusions regarding the economic viability of the proposed modifications can be adequately gauged. Therefore, the assumption that the cost estimate for a single-unit site must be less than the Peach Bottom estimate is not valid.

For example, Peach Bottom SAMA 10, "Provide an additional diesel generator," has an estimated cost of > $2 million listed in the summary table[1]. However, further comments on this cost estimate in the Peach Bottom SAMA analysis indicate that the implementation cost estimate is actually >> $2 million and also note that Calvert Cliffs estimated > $100 million for two new diesel generators. Based on this information in the Peach Bottom SAMA analysis, the implementation cost of SAMA 35, "Provide an alternate pump power source for feedwater or condensate pumps," at VYNPS was estimated to be at least $2 million. Since the benefit estimate for SAMA 35 in the ER was $460,000, it was sufficient to know that implementation would cost more than $2 million.

RAI 6b implied that a cost estimate of one-half of the Peach Bottom estimate should be used for SAMA candidates 35, 49, 50, 51, 52, 53, 54, 55 and 60. However, using a cost estimate of one-half of the Peach Bottom estimate is based on an invalid assumption and may artificially make SAMA candidates appear cost beneficial. Therefore, in response to RAI 6b, detailed cost estimates were performed for SAMA candidates 35, 49, 50, 51, 52, 53, 54, 55 and 60 to provide a plant-specific implementation cost estimate[2].

Detailed cost estimates for SAMA consideration followed Entergy's standard process for development of project estimates. The process is applied to establish conceptual (+/- 25% to 50% accuracy), preliminary (+/- 15% to 30% accuracy), and definitive (+/- 10% to 20% accuracy) estimates during the study, design, and implementation phases of a design project.

The SAMA cost estimates capture all anticipated expenses by identifying all parts of the

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[1] Letter, Exelon Nuclear to USNRC, "Peach Bottom Atomic Power Station, Units 2 and 3, License Nos. DPR-44 and DPR-56, Response to Request for Additional Information Related to Severe Accident Mitigation Alternatives," dated January 30, 2002.

[2] Letter, Entergy to USNRC, "Vermont Yankee Nuclear Power Station, License No. DPR-28, License Renewal Application, Amendment 13," BVY-06-086, dated September 19, 2006.

organization that must support the proposed SAMA modification from the conceptual perspective. Typical expenses associated with project cost estimating include calculations, drawing updates, specification updates, bid evaluations, contract issuance, design package preparation, walkdowns, planning and scheduling, estimating, procurement, configuration management, ALARA, QC/QA, training, simulator, IT, design basis update, construction, multi-discipline and independent review of design concepts and calculations, 50.59 review, FSAR update, cost control, contingency, security, procedures, post work testing, and project management and close-out. In addition, the project cost estimates include corporate indirect charges.

In summary, the cost estimates for the subject SAMAs followed Entergy's standard process for development of project estimates. Therefore, these cost estimates are reasonable conceptual level estimates.

NRC RAI 6.e Request for Clarification

The fourth sentence of the response appears incomplete.

Response to RAI 6.e Request for Clarification

The fourth sentence of the response to RAI 6.e is hereby revised to read as follows.

SAMA 42 was evaluated by eliminating ISLOCA events and adding the ISLOCA initiating event frequency to the MLOCA initiating event frequency.

NRC RAI 6.g Request for Clarification

The response to this RAI appears to describe SAMA 59 as a means of reducing the frequency of medium LOCAs due to overpressurization of the RCS rather than reducing the consequences of medium LOCAs. This is not consistent with the description and the basis for conclusions for this SAMA in Table E.2-1 or the corresponding operator action in Table E.1-3 (p. E.1-8). Describe this event/sequence more clearly and provide an analysis of the benefit consistent with this sequence.

Response to RAI 6.g Request for Clarification

SAMA 59 involves a modification to the SRVs such that existing solenoid valves on the pilot stage assembly will be energized and automatically open the SRVs when the pressure setpoint is exceeded. Therefore, this SAMA prevents an overpressure condition and thereby reduces the frequency of consequential LOCAs. SAMA 59 has been reanalyzed consistent with this definition in response to the request for clarification to RAI 5.j. SAMA 59 is not related to failure of the operator action to open SRVs for vessel depressurization during a medium LOCA. The basis for conclusions for this SAMA in Table E.2-1 is superseded by the response to the request for clarification to RAI 5.j.

NRC RAI 6.h Request for Clarification

The appropriateness of a factor of 3 reduction in operator failure to vent for SAMA 63 is not clear. The benefit of the controlled venting occurs for sequences involving successful venting and these sequences are not significantly affected by reducing the operator error to vent. Provide further support for the evaluation.

Response to RAI 6.h Request for Clarification

SAMA 63 (Control containment venting within a narrow band of pressure), would establish a narrow pressure control band to prevent rapid containment depressurization when venting is implemented thus avoiding adverse impact on the low pressure ECCS injection systems (LPCI and core spray) taking suction from the torus.

The response to RAI 6.h used a factor of 3 reduction in the operator failure to vent probability based on the following.

- Current PSA does not model controlled venting to allow LPCI and core spray operation,
- Modeling of controlled venting requires impact on net positive suction head (NPSH) requirements for LPCI and core spray when opening the torus vent path (currently there is no detailed engineering analysis that examines the impact of opening the torus vent path on NPSH requirements for LPCI and core spray),
- Examination of the feasibility of re-closing the torus vent shut off valve V16-19-86 against high containment pressures is not available, and
- MAAP computer runs predict that the available NPSH for core spray and LPCI will be below the required NPSH following manual opening of the torus vent path.

In response to this request for clarification, the RISKMAN PRA model binning rule for endstate bin IIV was revised to remove guaranteed failure of core spray and LPCI based upon successful venting of containment. This resulted in a CDF of 7.72E-6, a reduction of ~ 3.2% which is only slightly more than the 2.8% CDF reduction previously estimated for SAMA 63. Extrapolating the benefit estimate according to the CDF reduction ratio, there is an increase from $101k to $116k, which is below the estimated cost of $250k. Therefore, this SAMA is not cost effective for VYNPS.

NRC RAI 7.a Request for Clarification

This response describes a SAMA that includes a portable generator to prolong the life of the 125 Vdc batteries. This same function appears to be provided by the recent revision to the PSA, which credits the use of the John Deere diesel generator as an alternate power supply for the station battery chargers. Clarify.

Response to RAI 7.a Request for Clarification

The John Deere diesel generator is installed equipment which can be used prolong the life of the 125-Vdc batteries. RAI 7a requested that we consider use of a portable generator to extend the coping time in loss of AC power events (to power battery chargers).

Thus, the SAMA described in the response to RAI 7.a evaluates the benefit of having a portable diesel generator in addition to the John Deere diesel generator to extend the coping time in loss of AC power events (to power battery chargers).

NRC RAI 7.c Request for Clarification

The SAMA proposed by this RAI was to provide DC power directly to affected loads using a portable generator upon loss of a DC bus. This is somewhat different from that suggested by RAI 7.a. Discuss this alternative.

Response to RAI 7.c Request for Clarification

Upon loss of a DC bus, a portable generator could be used to provide power to an individual 125Vdc MCC. This would, for example, support returning HPCI to service in the event that 125Vdc bus DC-1 was to fail. Plant procedural changes, and potentially plant design modifications, would be required to implement this SAMA.

The CDF contribution due to failure of the HPCI system was eliminated to conservatively assess the benefit of this SAMA (equivalent to the benefit assessment for SAMA 49, "Provide an additional high pressure injection pump with independent diesel"). This resulted in a revised baseline with uncertainty benefit of approximately $1.6 million. The estimate cost of implementing and using the portable generator is $712K. Therefore, this SAMA is potentially cost effective for VYNPS.

Additional Information Needed as a Result of Revisions to PSA and SAMA Analyses

NRC RAI I

Confirm that a procedure is in place for the use of the John Deere diesel generator to supply power to the station battery chargers.

Response to NRC RAI I

Procedural guidance for using the John Deere diesel generator to supply power to the station battery chargers is provided in OT-3122, "Loss of Normal Power", Appendix C, "Connection of JDDG to MCC 8B/9B."

NRC RAI II

Describe the technical reviews conducted on the revisions made to VY04R1 to produce VY05R0.

Response to NRC RAI II

Independent technical review of the VY05R0 model included

- examination of the bases for any changes,
- verification of resulting fault tree and event tree structure,
- verification of required data modifications, and
- execution of the final model and verification of consistency of results with those provided within the documentation.

NRC RAI III

Explain the reasons for the more significant increases or decreases in CDF contributions for the major initiators in the current PSA update identified in Revised Table E.1-2. Specifically, address the internal flooding and loss of AC buses 3 and 4 changes.

Response to NRC RAI III

The contribution from internal flooding for model VY04R1 was 1.46E-06, and for model VY05R0 was 1.40E-06. This is not a significant decrease in CDF contribution.

The contribution to CDF due to loss of AC buses 3 (initiating event TA3) and 4 (initiating event TA4) for these same PRA models is as follows:

Initiator	TA3	TA4
Model VY04R1	4.02E-07	3.54E-07
Model VY05R0	7.94E-07	7.29E-07

Human failure event changes were made as part of the model change to use the John Deere diesel generator as an alternate power supply for station battery chargers in addition to its use for powering alternate injection valves. Specifically, an operator action to align the John Deere diesel and the diesel-driven fire pump for alternate injection was split into separate events. Reanalysis of the human failure event for use of the diesel-driven fire pump resulted in a higher probability of failure, which resulted in a higher CDF for initiating events TA3 and TA4.

NRC RAI IV

The estimated benefit for the candidate SAMAs, as well as many of their cost estimates, were changed in the Revised Table E.2-1. Provide the following in regards to these changes.

a. The RAI response states on p. 30 that more refined cost estimates were used for SAMA candidates 2, 3, 16, 28, 32, 33 and 41 to account for the new estimated benefit values. Provide details of the modifications considered in the cost estimate and the method by which the costs were calculated for each of these SAMAs.

b. Explain why the refined cost estimates are significantly greater than the original cost estimates for SAMA 2 (greater by a factor of 2), SAMAs 28, 33 and 41 (greater by a factor of 3), and SAMAs 3 and 32 (greater by a factor of 5).

c. Justify the change in cost estimate for SAMA 16, which was originally determined using a Peach Bottom estimate of greater than $2 million and was refined in the VYNPS RAI response to be greater than $2.1 million. This does not appear to be a refined cost (when compared to the others). Provide the refined cost estimate.

d. Revised Table E.2-1 provides estimated benefits (at 7% with uncertainty) for SAMAs 3, 24, 31, 32, 34, 36, 63, and 66 that could now be considered roughly equivalent to their estimated costs. Given the small difference between the cost and benefit values, provide more detailed cost estimates for these SAMA candidates, or rationale as to why these SAMAs should not be further evaluated for possible implementation.

e. Describe Entergy's plans with regard to SAMAs 47, which was cost-beneficial in the ER but are not cost-beneficial in the revised assessment. Also, SAMA 66 is indicated to be potentially cost-beneficial on page 30, but not cost effective on page 39. Clarify.

Response to NRC RAI IV.a

SAMA 2, "Provide a redundant train of EDG room ventilation," would increase the availability of components dependent on room cooling. The modification includes replacement of the existing fan and louver for each EDG room with two fans with redundant louvers. Power supplies would remain the same. Fan capacity would remain the same as currently designed. However, due to the smaller size of the opening required to provide redundancy, fan static head would need to be larger. Thus, horsepower requirement is anticipated to increase.

SAMA 3, "Add a diesel building high temperature alarm, or redundant louver and thermostat," would improve diagnosis of a loss of diesel building HVAC. The modification includes addition of a high temperature alarm in the diesel building, a redundant ventilation louver, and a thermostat to control the louver. It includes power cabling and an alarm in the control room.

SAMA 16, "Construct a building connected to primary containment that is maintained at a vacuum," includes adding a building of sufficient volume to depressurize containment and limit fission product release following an accident. The building would have to be maintained at a vacuum and a tunnel would have to be constructed connecting containment to the new building. A detailed cost estimate was not performed for this SAMA, because recent experience at the site indicates that construction cost of the Containment Access Building was approximately $2 million. The cost of maintaining a building at a vacuum and a connecting tunnel can reasonably be expected to cost more than $100,000. Therefore, the cost of implementation of SAMA 16 was estimated to be at least $2.1 million.

SAMA 28, "Provide additional DC battery capacity," SAMA 33, "Provide 16 hour station blackout injection," and SAMA 41, "Extended station blackout provisions," are redundant SAMAs to extend DC power availability in an SBO, which would extend HPCI and RCIC availability and allow more time for offsite power recovery. The modification includes installation of a new battery room; 125 VDC, 60 cell batteries capable of providing required DC power to diesel auxiliaries; and associated cable connections. It also includes barrier breaching into existing EDG room walls.

SAMA 32, "Change procedures to bypass diesel generator trips, or change trip set-points," would allow the EDG to operate longer. The modification includes changes to the EDG trip logic circuitry to allow bypassing of the trips when required to ensure continued EDG operation. Associated procedure changes are also included.

The method by which the costs were calculated for SAMA candidates 2, 3, 28, 32, 33 and 41 is discussed in response to part b.

Response to NRC RAI IV.b

As noted in Section 4.21.5 of the ER, detailed cost estimates are often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit; rather costs are conceptually estimated to the point where conclusions regarding the economic viability of the proposed modifications can be adequately gauged. Thus, engineering judgment was used to derive the cost estimates in the ER for SAMAs 2, 3, 28, 32, 33, and 41 based on knowledge of associated hardware costs and experience with similar plant modifications. Since benefit estimates changed in the revised analysis, more refined cost estimates were required to assess the economic viability of these SAMA candidates

Detailed cost estimates for SAMA consideration followed Entergy's standard process for development of project estimates. The process is applied to establish conceptual (+/- 25% to 50% accuracy), preliminary (+/- 15% to 30% accuracy), and definitive (+/- 10% to 20% accuracy) estimates during the study, design, and implementation phases of a design project.

The SAMA cost estimates capture all anticipated expenses by identifying all parts of the organization that must support the proposed SAMA modification from the conceptual perspective. Typical expenses associated with project cost estimating include calculations, drawing updates, specification updates, bid evaluations, contract issuance, design package preparation, walkdowns, planning and scheduling, estimating, procurement, configuration management, ALARA, QC/QA, training, simulator, IT, design basis update, construction, multi-discipline and independent review of design concepts and calculations, 50.59 review, FSAR update, cost control, contingency, security, procedures, post work testing, and project management and close-out. In addition, the project cost estimates include corporate indirect charges.

In summary, the cost estimates for the subject SAMAs followed Entergy's standard process for development of project estimates. Therefore, these cost estimates are reasonable conceptual level estimates.

Response to NRC RAI IV.c

See response to part RAI IV.a.

Response to NRC RAI IV.d

Detailed cost estimates for SAMAs 3 and 32 are discussed in the response to part a.

SAMA 66 is discussed in the response to part e.

SAMA 63 is discussed in the response to RAI 6h request for clarification.

SAMA 24, "Use an alternate method of reactor building spray," provides the capability to use firewater sprays in the reactor building to mitigate release of fission products following an accident. There are only a few fire protection automatic suppression systems within the reactor building (see response to RAI 6.a.3 Request for Clarification). As such, they have limited capability in providing fission product scrubbing. The proposed design modification would upgrade the fire protection system to a sufficient capacity to handle postulated loads from severe accidents. It is assumed that this upgrade would require addition of at least one more automatic suppression system in the reactor building. The cost of implementing this SAMA was estimated to be greater than $2.5 million by engineering judgment. The detailed cost estimate for SAMA 54, "Add a diverse injection system," is almost $4 million and the cost estimate for SAMA 12, "Install a passive containment spray system," is $5.8 million. The cost of adding an automatic fire suppression system in the reactor building is estimated to be the same order of magnitude. Since the benefit estimate with uncertainty for this SAMA is slightly greater than $2 million, it is not cost beneficial.

SAMA 31, "Install a gas turbine generator," and SAMA 36, "Install a gas turbine," are redundant SAMAs which would improve onsite AC power reliability by providing a redundant and diverse emergency power system. The cost of implementing this SAMA was estimated to be greater than $2 million since the Peach Bottom SAMA analysis[3] indicated that the cost would be >> $2 million. The estimate for installing an Appendix R diesel generator at Indian Point is more than $8 million, which provides further indication that a gas turbine would cost much more than $2 million. Since the benefit estimate with uncertainty for these SAMAs is less than $2 million, they are not cost beneficial.

SAMA 34, "Install a steam driven turbine generator," would provide a steam driven turbine generator that uses reactor steam and exhausts to the suppression pool. The cost of implementing this SAMA was estimated to be greater than $2 million since the Peach Bottom SAMA analysis indicated that the cost for two steam driven generators would be greater than $12 million. The estimate for installing an Appendix R diesel generator at Indian Point is more than $8 million, which provides further indication that a steam driven turbine would cost much more than $2 million. Since the benefit estimate with uncertainty for this SAMA is less than $2 million, it is not cost beneficial.

Response to NRC RAI IV.e

1. SAMA 47 is not considered potentially cost-beneficial as demonstrated in the revised assessment. Thus, Entergy does not plan to evaluate this SAMA for implementation.

2. Because the revised baseline benefit with uncertainty ($1,071,399) is greater than the estimated costs ($1,000,000), SAMA 66 is considered potentially cost-beneficial. Therefore, the conclusion for SAMA 66 in Table E.2-1, page 39 is hereby changed to "potentially cost effective."

[3] Letter, Exelon Nuclear to USNRC, "Peach Bottom Atomic Power Station, Units 2 and 3, License Nos. DPR-44 and DPR-56, Response to Request for Additional Information Related to Severe Accident Mitigation Alternatives," dated January 30, 2002.