NEXTera ENERGY SEABROOK

January 13, 2011

SBK-L-11001
Docket No. 50-443

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Seabrook Station
Response to Request for Additional Information
NextEra Energy Seabrook License Renewal Application

References:

1. NextEra Energy Seabrook, LLC letter SBK-L-10077, "Seabrook Station Application for Renewed Operating License," May 25, 2010. (Accession Number ML101590099)

2. NRC Letter "Request for Additional Information for the Review of the Seabrook Station License Renewal Application-SAMA Review (TAC NO. ME3959) November 16, 2010 (Accession Number ML 103090215)

In Reference 1, NextEra Energy Seabrook, LLC (NextEra) submitted an application for a renewed facility operating license for Seabrook Station Unit 1 in accordance with the Code of Federal Regulations, Title 10, Parts 50, 51, and 54.

In Reference 2, the NRC requested additional information in order to complete its review of the License Renewal Application. The Enclosure contains the NextEra Energy Seabrook response to the NRC request for additional information dated November 16, 2010. There are no new or revised commitments made in this submittal.

The License Renewal Application, Appendix E, page F-6 contains a list of acronyms used in these responses. If there are any questions or additional information is needed, please contact Mr. Richard R.Cliche, License Renewal Project Manager, at (603) 773-7003.

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NRR

If you have any questions regarding this correspondence, please contact Mr. Michael O'Keefe, Licensing Manager, at (603) 773-7745.

Sincerely,

NextEra Energy Seabrook, LLC.

Paul Freeman
Site Vice President

Enclosure

cc:

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NEXTera ENERGY SEABROOK

I, Paul O. Freeman, Site Vice President of NextEra Energy Seabrook, LLC hereby affirm that the information and statements contained within are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

Sworn and Subscribed

Before me this

13 day of January, 2011

Paul O. Freeman
Site Vice President

Notary Public

MICHAEL D. O'KEEFE
MY COMMISSION EXPIRES FEB. 13, 2013
NOTARY PUBLIC
NEW HAMPSHIRE

Enclosure to SBK-L-11001

NextEra Energy Seabrook
Responses to NRC Request for Additional Information
Regarding
Severe Accident Mitigation Alternatives Analysis

RAI Section 1

SAMA RAI 1a

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

a. Environmental Report (ER) Section F.3 states that Probabilistic Risk Assessment (PRA) model SSPSS-2006 is the model-of-record used to support the SAMA evaluation. Identify any changes to the plant (physical and procedural modifications) since 2006 that could have a significant impact on the results of the SAMA analyses, and provide a qualitative assessment of their impact on the PRA and on the results of the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 1a

There have been no major plant hardware changes or procedural modifications implemented at Seabrook Station that would have a significant impact on the results of the SAMA analyses since PRA model SSPSS-2006 was issued. In 2009, the PRA model SSPSS-2006 underwent a periodic update to incorporate minor plant changes including the latest plant-specific and generic information as shown below.

Plant Changes

- Plant specific data collection & update
- Emergency Core Cooling System (ECCS) Sump switchover timing
- Containment Building Sump strainer modification
- Supplementary Emergency Power System (SEPS) diesel alignment to Emergency Bus E6
- Condensate Storage Tank to Demineralized Water Storage tank (CST/DWST) connection
- Procedure changes as they impact plant operating state (POS) definition, operator action models, and accident sequences
- Operator review / input into operator action models

Model Changes

A number of modeling and documentation changes were made to improve the quality and usefulness of the PRA. The most significant changes include:

- Incorporated electric power convolution model
- Expanded SG model to include condenser cooling, circulating water and condenser steam dump

- Updated generic initiator frequency data using latest NUREG sources
- Updated generic component failure rate data using latest NUREG sources
- Updated generic data for LOOP & LOOP recovery using latest NUREG sources

Based on the updated 2009 PRA model (SSPSS-2009), the Seabrook Station baseline at-power core damage frequency decreased approximately 18.7 percent, from 1.44E-05/yr to 1.17E-05/yr. Also, there was no significant shift in the relative importance of initiating events or components. Based on this, it is judged that plant changes incorporated into the latest SSPSS-2009 PRA model would not have a significant impact on the overall SAMA results. The SSPSS-2009 results suggest that the SAMA benefits are reduced, thus providing additional margin between the SAMA benefits and associated costs.

Preliminary Results of SSPSS-2010 Model

The 2009 PRA model is currently in the process of being updated. This SSPSS-2010 model is scheduled to be issued in 2011. The most significant change to the SSPSS-2010 model is an upgrade to the internal flooding model to meet the latest IF requirements of the ASME PRA Standard and Regulatory Guide 1.200. Insights from the upgraded IF model indicate that Control Building flooding scenarios from postulated pipe breaks in the fire protection 6" and 4" diameter standpipe dominate the risk of internal flooding. A modification has been proposed to reduce the risk of Control Building flooding by installing a globe valve or flow limiting orifice upstream in the fire protection system. The globe valve or orifice would be sized to effectively limit the maximum postulated break flow, yet not impact the design function of downstream hose stations during normal fire fighting activities. A Phase 2 PRA case study was performed to assess the potential cost-benefit of installation of the proposed modification. The PRA case (NOCBFLD) assumes that the Control Building fire protection flooding initiators are eliminated. The following results were estimated:

Reduction in CDF:	~25%	Reduction in LERF:	~0.6%
Nominal Cost Benefit:	~$161K	Best Estimate Discount Rate:	~$143K
Extended Period Cost Benefit:	~$266K	Upper Bound Cost Benefit:	~$231K
% Reduction in OECR:	11%		

Cost of SAMA: The engineering, hardware and implementation cost of this design change to install a flow limiting device is estimated at approximately $200K.

Based on this case study, the modification to install the flow limiting device to reduce the risk of Control Building flooding is judged as potentially cost-beneficial. This SAMA is not aging-related and is identified as SAMA #192.

SAMA RAI 1b

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

   b. ER Section F.3 explains that the SAMA evaluation is determined from severe accident risk based on Level 1 and 2 PRA models for internal and external events, including internal floods, internal fires, external floods, and seismic events. A table in Section F.3.1.1.2 shows the PRA model history from 1983 to 2006 for internal and external full power events and indicates that it was a single PRA model. It is not clear from the table when internal flooding, external flooding, fire, and seismic modeling components were incorporated into the model or what were their individual contributions to the total core damage frequency (CDF) and large early release frequency (LERF). Also, it is not clear from the description of model changes provided on pages F-20 through F-28 what the most significant updates between models were. Relative to these issues, provide the following:

      1) The CDF and LERF contributions from internal and external events, including flooding, fire, and seismic hazard categories, for each PRA model update.

      2) Indicate when internal flooding, external flooding, fire, and seismic modeling components were incorporated into the model.

      3) Of the changes identified for each model update, identify those changes that had the most impact on changing CDF and LERF.

NextEra Energy Seabrook Response to SAMA RAI 1b1

The CDF & LERF contributions from internal & external events for each PRA model update are provided in the table below. This table follows the historical designation from IPE and IPEEE where "internal" events include internal floods and "external" events include external floods, fires, and seismic hazards.

	CDF Contribution			LERF Contribution		
SSPSS Update	CDF Total	Internal Events	External Events	LERF Total	Internal Events	External Events
2009	1.2E-5	59%	41%	8.1E-8	85%	15%
2006	1.5E-5	70%	30%	1.2E-7	91%	9%
2005	1.4E-5	68%	32%	1.1E-7	90%	10%
2004	3.0E-5	56%	44%	1.0E-7	89%	11%
2002	4.5E-5	56%	44%	6.8E-8	92%	8%
2001	4.8E-5	59%	41%	5.1E-8	92%	8%
2000	4.6E-5	58%	42%	5.1E-8	92%	8%
1999	4.6E-5	58%	42%	5.1E-8	92%	8%
1996	4.3E-5	49%	51%	3.7E-8	91%	9%
1993	8.0E-5	55%	45%	1.6E-8	n/a	n/a
1990 (IPEEE)	1.1E-4	55%	45%	2.2E-7	n/a	n/a
1989 (IPE)	1.4E-4	68%	32%	n/a	n/a	n/a
1983	2.3E-4	80%	20%	n/a	n/a	n/a

n/a = LERF results not available

NextEra Energy Seabrook Response to SAMA RAI 1b2

All hazards, including internal flooding, external flooding, fire, and seismic, were included in the Seabrook Station PRA from the initial 1983 PRA and every subsequent update to the PRA model.

NextEra Energy Seabrook Response to SAMA RAI 1b3

The following model changes had the most impact on CDF & LERF for each update from 1993 to 2009:

Basis for Change in CDF from 1993 to 2009 Update

1993 to 1996 Update:

The CDF decreased by almost a factor of 2. The most significant change quantitatively is in the modeling of PCC, specifically the common cause modeling of the PCC single train initiators with the opposite PCC train failure. Because these sequences dominated risk in the SSPSS-1993 model, a more realistic modeling made a significant reduction in CDF and in transient-initiator contribution to CDF. The ATWS contribution increased due to the change from 18-month to 24-month fuel cycle. Also, plant specific data tends to be better (lower mean value) than generic data distributions, which contributes to the reduction in failure rate for a number of risk important systems.

1996 to 1999 Update:

Several significant changes were made to the model. The LOCA initiator frequencies were updated, which generally reduced their importance. The ATWS model was updated to account for more current failure rates (reactor trip breakers, etc) and to account for the return to an 18-month fuel cycle. These changes reduced the internal events contribution to ATWS by over two orders of magnitude. The RCP seal LOCA model and related electric power recovery models were revised to be explicit in the event tree model (rather than calculated offline). The EDG mission time for weather-related LOSPs (and other similar initiators) was changed from 6 hours to 24 hours. Also, the definition of "internal" verses "external" events was changed so that the summary of results for "internal" events includes weather-related LOSP (LOSPW) and internal floods. The common cause factors and mission time for system initiators (SWS and PCC) were modified based on a Peer Review comment. Operator dependencies were reviewed and changes were made to event tree rules and HEP quantification.

1999 to 2000 Update:

The primary change for the 2000 Update was the change from DOS-based RISKMAN 9.2 (model SB99PR) to windows-based RISKMAN 3.0 (model SB2000). This change in software allowed lower truncation limits in solving fault trees, which resulted in some slight increase in the results for SWS and PCC systems. There was no change in the CDF results.

2000 to 2001 Update:

The primary changes for the 2001 Update were minor changes to system initiator models. The change in CDF was not significant.

2001 to 2002 Update:

The primary changes for the 2002 Update were related to integrating the shutdown and low power risk models into an all-modes model. Changes to the full power model CDF results were not significant.

2002 to 2004 Update:

A number of changes were made in the 2004 Update, both for modeling and documentation. The most significant changes with regard to quantitative results include updates in the HRA analysis using the EPRI HRA tool, a revised fire PRA, and the addition of the SEPS diesel generator. The change in CDF was not significant.

2004 to 2005 Update:

A number of changes were made in the 2005 Update, both for modeling and documentation. The most significant changes include revision to success criteria and operator timing, revised seismic PRA, and SEPS design and modeling changes. The change in CDF was not significant.

2005 to 2006 Update:

A number of changes were made in the 2006 Update focused on the Mode 4, 5 and 6 shutdown model. The change in CDF was not significant.

2006 to 2009 Update:

As mentioned in the response to SAMA RAI 1a, a number of changes were made in the 2009 Update, both for modeling and documentation. The most significant changes include data updates (plant specific data and generic data distributions), updates to the electric power model (convolution, revised generic LOOP initiator and recovery data), and revisions to operator action modeling. These changes resulted in a small improvement to the CDF.

Basis for Change in LERF Results from 1993 to 2009

1993 to 1996 Update:

The LERF increased due to the change in definition of LERF to include steam leak from SGTR (early core melt), consistent with the WOG guidelines. The frequencies of the SERF (small-early) and INTACT categories decreased due to the decrease in CDF. The relative contribution of INTACT decreased due to the modeling changes that reduced the importance of loss of PCC initiators. The LATE category increased due to a change in how seismic sequences are modeled for failures of small containment penetrations. The seismic SBO sequences now include credit for an operator to manually close the RCP seal return line MOV. This moved the sequence frequency from SERF to LATE.

1996 to 1999 Update:

The changes in the Level 2 results are due to the impact of changes to the Level 1 model. For example, the LERF contribution from SGTR was increased based on modeling of operator dependencies.

1999 to 2000 Update:

The primary change for the 2000 Update was the change from DOS-based RISKMAN 9.2 (model SB99PR) to windows-based RISKMAN 3.0 (model SB2000). These changes are described in the Level 1 update summary, above. There was no change in the LERF results.

2000 to 2001 Update:

No changes were made to the Level 2 model. The changes in the Level 2 results are due to the impact of changes to the Level 1 model. There was no change in the LERF results.

2001 to 2002 Update:

No changes were made to the Level 2 model. The changes in the Level 2 results are due to the impact of changes to the Level 1 model. The change in LERF was not significant.

2002 to 2004 Update:

Most of the changes in the Level 2 results are due to the impact of changes to the Level 1 model. The LERF model was expanded by the addition of a consequential SGTR model to SLB (steam line break) and ATWS sequences. The change in LERF was not significant.

2004 to 2005 Update:

Significant changes were made to update the Level 2 analysis to the current state of knowledge, including modeling of SAMG actions within the CET. The change in LERF was not significant.

2005 to 2006 Update:

No changes were made to the Level 2 model. The changes in the Level 2 results are due to the impact of changes to the Level 1 model.

2006 to 2009 Update:

The most significant changes that impact the Level 2 model include data updates (plant specific data and generic data distributions) and revisions to operator action modeling. These changes resulted in a small improvement in LERF consistent with CDF.

SAMA RAI 1c

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

   c. The table in Section F.3.1.1.2 that shows the PRA model history from 1983 to 2006 provides the CDF and LERF. The ratio of LERF to CDF (<1%) is atypically small. Explain why LERF is so low compared to CDF.

NextEra Energy Seabrook Response to SAMA RAI 1c

Seabrook Station has a very large and extremely strong containment building in comparison to the design capacity (52 psig) and to other containment designs. The containment structure has a median failure pressure of 187 psia (dry) and 210 psia (wet). (Note, the terms "dry" and "wet" refer to the status of RWST injection; the "dry" state results if the RWST is not injected). The most likely overpressure failure mechanism is a leak-before-break failure mode involving several small (0.5 in^2 leak area) mechanical penetrations. As a result of the high containment ultimate strength, there are no conceivable severe accident progression scenarios that result in a catastrophic containment overpressure failure early in the accident sequence. The containment would eventually fail as a result of overpressure given a core melt accident without recovery of containment cooling. However, this type of failure would occur late (well more than 24 hours) after core melt and thus does not contribute to LERF.

As a result of the strength of Seabrook Station's containment, the important events that contribute the most to LERF are containment bypass and containment isolation failure. The conditional probability of these events occurring given core melt is approximately 0.007.

SAMA RAI 1d

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

   d. ER Section F.3.3 identifies two peer reviews that have been performed on the PRA: a 1999 Westinghouse Owner's Group certification peer review and a 2005 focused peer review against the American Society of Mechanical Engineers (ASME) standard and presents all the Category A and B facts and observations along with their associated resolutions. However the scope of those peer reviews was not described and other reviews (e.g., internal reviews) were not identified. Provide the following:

      1) A summary of the scope of the 2005 focused peer review against the ASME standard and the 1999 peer review including whether Level 1, Level 2, internal flooding, external flooding, fire, or seismic event modeling was reviewed.

      2) A summary of the scope of any other PRA model reviews, a discussion of how each finding was resolved, and an assessment of the impact of all unresolved findings on the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 1d1

The scope of 1999 peer review was a full review of all internal events and internal flood, including all technical elements. This included Level 1 and Level 2 restricted to LERF. The 2005 peer review was a focused scope, including internal events limited to Level 1 accident sequences, success criteria, post-initiating event HRA, and configuration control. Neither the 1999 or 2005 peer reviews included external flooding, fire or seismic hazards. A Peer Review was conducted in late 2009 focusing exclusively on internal flooding.

NextEra Energy Seabrook Response to SAMA RAI 1d2

A number of other internal reviews and vendor-assisted reviews have been performed on specific model updates. Comments from these reviews along with plant changes and potential model enhancements are tracked through a model change database to assure the comments are addressed in the periodic update process. Unresolved PRA comments from these reviews primarily reflect model completeness and documentation issues and are not significant to the results and conclusions of the PRA. As a result, unresolved PRA comments are judged not to have a significant impact on the SAMA evaluation.

SAMA RAI 1e

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

   e. Describe the quality control process for the PRA, including the process of monitoring potential plant changes, tracking items that may lead to model changes, making model changes (including frequency for model updates), documenting changes, software quality control, independent reviews, and qualification of PRA staff.

NextEra Energy Seabrook Response to SAMA RAI 1e

Seabrook Station PRA Group instructions define the process of maintaining and updating the Seabrook Station PRA model. The process is consistent with the requirements of the ASME/ANS PRA Standard and ensures that the PRA accurately reflects the current Seabrook Station plant design, operation and performance, and that the PRA remains consistent with current risk technology and modeling. A general description of the configuration control process is as follows:

(a) Monitor PRA inputs for new information. This includes monitoring changes to Seabrook Station plant design and operation, monitoring Seabrook Station and industry operating experience, and changes in PRA technology and modeling.

(b) Record applicable new information. Applicable new information that has the potential to impact the PRA model is recorded in the Model Change Database (MCDB). These MCDB entries form the content of the next PRA revision. Until close-out, these records are pending changes against the PRA model of record.

(c) Assess the significance of new information. The significance of the new information is reviewed with regard to its impact on the PRA model, including cumulative impacts from pending changes. This process identifies the need for a prompt focused PRA revision verses periodic PRA revision, and the need for PRA upgrade (with Peer Review) verses PRA maintenance.

(d) Perform the PRA revision. The PRA is revised to evaluate the new information and incorporate the model changes identified in the MCDB as appropriate. Control of PRA revisions is provided in PRA Group Instructions. A "periodic" revision to the PRA model is performed at least once every three cycles (~4.5 years) to address open items in the MCDB as well as incorporate any changes in plant design and operations; and to reflect operating experience.

    Each model change documented in the MCDB requires an independent technical review. The review of each model change is documented in the "Disposition of Change" field within the MCDB. The purpose of the independent review is to verify that the model change was performed correctly and adequately reflects the plant or data change. The review may consist of a point-by-point check or an audit of calculations, analysis and documentation. Note that for PRA changes judged to be PRA "upgrades" (new methodology or significant change in scope or capability) a formal peer review would be required in addition to the independent technical review.

The PRA model documentation is updated as applicable for each update. The Seabrook Station PRA documentation consists of three levels (or tiers). Tier 1 is an Executive Summary, a high level report appropriate for plant management. Tier 2 is the comprehensive documentation of the model at a level adequate for an external reviewer to understand the basis for the risk from Seabrook Station. Tier 2 consists of the detailed systems notebooks, data notebooks, and RISKMAN model file reports for event tree rules and master frequency file. Tier 3 consists of spreadsheets, data bases, and other detailed calculations and reports as well as the RISKMAN computer model itself. This level is adequate for an external reviewer to be able to reproduce any of the risk results. Tier 2 and 3 comprise the controlled risk model.

(e) Control of computer codes and models. Control of computer codes and models is provided in PRA Group Instructions. These instructions provide guidance for maintaining the computer codes that form the basis of the Seabrook Station PRA and risk-informed applications for both vendor-provided software and in-house software. The PRA computer codes are controlled and maintained to meet requirements of the NextEra Energy corporate Software Quality Assurance Program including: classification of PRA software, identification of associated SQA requirements, and control of computer code configuration.

Seabrook Station PRA staff members have many years of plant engineering, operations and PRA experience. PRA qualification is performed as part of the Engineering Support Personnel Training Program (ESPT) for the duty area of Risk Management Engineer/Analyst Engineering.

SAMA RAI 1f

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

   f. ER Table F.3.1.1.1-2 presents the top basic events by Risk Reduction Worth (RRW) for the Level 1 PRA. While the contributions of initiating events to CDF are provided in Table F.3.1.1.1-1, no initiating events appear in the list for RRW in Table F.3.1.1.1-2. Clarify if initiating events were included in the determination of the RRW listing and, if initiating event were not included, determine their RRW values and identify and evaluate SAMAs to address these events.

NextEra Energy Seabrook Response to SAMA RAI 1f

The determination of basic event Risk Reduction Worth (RRW) importance presented in Table F.3.1.1.1-2 includes consideration of initiating events. Support system failures of either one or both trains are specifically modeled in the PRA and thus accounted for in the basic event importance.

It is also noted that, as presented in Appendix F.A of the SAMA report, a number of SAMA PRA "case studies" were performed in support of Phase II screening. Many of these SAMA case studies specifically determined the risk reduction when assuming complete elimination of certain initiating events. The results of these case studies, in terms of reduction in CDF and reduction in offsite dose, are identified for applicable SAMAs in Table F.7-1, Seabrook Station Phase II SAMA Analysis.

SAMA RAI 1g

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

g. ER Section F.3.1.1.1 states that "The event tree quantification was calculated using a truncation cut-off frequency of 1.0E-14." It is not clear whether this value indicates the truncation level for the Level 1 PRA model. Clarify what truncation level was used for the Level 1 PRA model results used for the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 1g

The initiating event truncation level used when performing the event tree sequence quantification for SAMA cases is 1E-14. This value determines the CDF limit used in quantifying event tree sequences. At Seabrook, Station this truncation level is used as a standard truncation level to assure that results for low frequency initiators are fully accounted.

The event tree top event nodes are quantified separately using Binary Decision Diagram (BDD) methodology, which provides an exact solution. The BDD method quantifies split fractions without solving for cutsets and, thus, truncation is not an issue for any split fraction value.

The BDD quantification method is not used for support system initiators modeled by fault tree logic. For these initiators, cutsets are used in the quantification process along with selected truncation level. The cutset solver within the Systems module in RISKMAN has two cutoff parameters – frequency cutoff and cutset order cutoff. Most initiating event systems are solved at zero frequency cutoff and 12th order cutset order (maximum value). However, several initiator-related fault trees require frequency cutoffs to limit the number of cutsets, based on RISKMAN split fraction quantification limitations. These include:

Loss of Primary Component Cooling Water Train A and B (solved at 1E-12, 12th order)

Loss of Service Water Train A and B (solved at 1E-08, 8th order)

Loss of Offsite Power (plant-centered) (solved at 1E-12, 12th order)

Loss of RCP Seal Cooling (solved at 1E-12, 12th order).

Of these, only Service Water is sensitive with regard to truncation limit. However, the related Service Water single train split fraction values are more than two orders of magnitude above the Service Water top event truncation limit, which is judged sufficient to assure meaningful results.

SAMA RAI 1h

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

h. Section F.3.1.1.1 explains that "The fault tree method of quantification is binary decision diagram quantification which provides an exact solution for split fractions." We understand binary decision diagram quantification to be used to evaluate Event Trees to pass along dependencies in associated fault trees. Is this what is meant?

NextEra Energy Seabrook Response to SAMA RAI 1h

RISKMAN uses the large event tree (Event Tree Module), small fault tree (Systems Module) modeling approach. Fault tree linking to account for support system dependencies is not performed. Instead of fault tree linking, a support system dependency analysis is used to identify all dependent support system impacts on each top event - system, train or function.

Top event split-fractions are defined (within the Systems Module) based on the dependent support system impacts. As mentioned in the response to SAMA RAI 1g, each top event node is quantified separate from the event tree quantification using Binary Decision Diagram (BDD) methodology. The top event split-fraction values are maintained in a database file (Master Frequency File), which is common to both the systems and event tree modules.

The Event Tree Module quantifies the event trees. Split-fraction logic rules are used to apply the proper system/train split-fraction (obtained from the Master Frequency File) for a given sequence of events during quantification of the event trees. Thus, it is both the development of the system/train dependent split-fractions and the event tree logic rules that account for system dependencies, not the BDD method. For example, if Train A of AC power is failed in the support system tree, split fraction logic rules would guarantee failure of system/train top events in the frontline system tree that rely on Train A AC power.

SAMA RAI 1i

1) Provide the following information regarding the Level 1 Probabilistic Safety Assessment (PSA) used for the Severe Accident Mitigation Alternatives (SAMA) analysis:

i. Table F.3.1.1.1-1 listed two switchgear (SWGR) room fire frequencies as 1.0E-3/yr, which would seem low unless these were specifically for localized fires involving only the buses cited. Are only the cited buses involved with these events?

NextEra Energy Seabrook Response to SAMA RAI 1i

The fire initiating event frequencies for FSGAE5 and FSGBE6 are based on the following calculations from the Seabrook PRA:

FSGAE5, Fire in SWGR Room A, Loss of Essential 4KV Bus E5: frequency = 1.1E-03/yr. Fire initiation frequency for this scenario is based on the total ignition frequency for Bus E5 (21 cubicles) and other electrical cabinets (170 cabinets) located in the "A" switchgear room. These cabinets are modeled as follows:

- Bus E5 cabinets are a fixed combustible and fire within the bus is assumed to stay inside the bus, no severity factor or suppression is credited, and the probability of bus damage is equal to one. Therefore, the total fire frequency for Bus E5 is equal to (21 cabinets x 4.6E-5/yr per cabinet) = 9.7E-4/year.
- Other electrical cabinets located in the switchgear room are also a fixed combustible and have a potential to raise the room temperature to 120°F, and to jeopardize operation of the various electrical components. 120°F is the maximum operating temperature of the thermal overloads of the MCC cabinets, based on Motor Control Cabinet Specification. Based on screening results, at least 380,000 BTUs are needed to get to this temperature in the room. Transient fire sources in this room are not significant and assumed not to have the required heat content. The ignition frequency of these cabinets is equal to (170 cabinets x 4.6E-05/yr) = 7.8E-3/year. A severity factor of 0.2 is used based on cabinet fires in SGWR. The results from the heat-up analysis show that it would take approximately 20 minutes to reach 120°F (half of the cabinet burning time). Thus, manual suppression is credited at 0.1 because the total fire brigade response time for SWGR-A is about 8 minutes. Therefore, the fire frequency of other cabinets impacting Bus E5 is 7.8E-03/yr x 0.2 x 0.1 = ~ 1.6E-04/yr.
- Total fire frequency for impact to Bus E5 = 9.7E-04/yr + 1.6E-04/yr = 1.1E-03/yr

FSGBE6, Fire in SWGR Room B, Loss of Essential 4KV Bus E6: frequency = 1.0E-03/yr. Fire ignition frequency for this scenario is based on the total ignition frequency for Bus E6 (21 cubicles) and other electrical cabinets (86 cabinets) located in the "B" switchgear room. These cabinets are modeled as follows:

- Bus E6 cabinets are a fixed combustible and fire within the bus is assumed to stay inside the bus, no severity factor or suppression is credited, and the probability of bus damage is equal to one. Therefore, the total fire frequency for Bus E6 is equal to (21 cabinets x 4.6E-5/yr per cabinet) = 9.7E-4/year.
- Other electrical cabinets located in the switchgear room are also a fixed combustible and have a potential to raise the room temperature to 120°F, and to jeopardize operation of the various electrical components. 120°F is the maximum operating temperature of the thermal overloads of the MCC cabinets, based on Motor Control Cabinet Specification. Based on screening results, at least 300,000 BTUs are needed to get to this temperature in the SWGR-B room. Transient fire sources in this room are not significant and assumed not to have the required heat content. The ignition frequency of these cabinets is equal to (86 cabinets x 4.6E-05/yr) = 3.9E-3/year. A

severity factor of 0.2 is used based on cabinet fires in SGWR. The results from the heat-up analysis show that it would take approximately 18 minutes to reach 120°F (half of the cabinet burning time). Thus, manual suppression is credited at 0.1 because the total fire brigade response time for SWGR-A is about 13 minutes. Therefore, the fire frequency of other cabinets impacting Bus E6 is 3.9E-03/yr x 0.2 x 0.1 = ~ 7.8E-05/yr.

- Total fire frequency for impact to Bus E6 = 9.7E-04/yr + 7.9E-05/yr = 1.0E-03/yr

SAMA RAI 2a

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

a. ER Section F.3.2.1 explains that "inputs to the Level 2 analysis are the core damage sequences," and that these sequences are "considered in groups of accident sequences that exhibit similar thermal-hydraulic behavior." The ER does not identify or discuss the use of Plant Damage States (PDSs). Describe the grouping of Level 1 accident sequences that provide the input to Level 2. Include in that discussion identification of those groups (e.g. PDSs), the attributes that define that group, and the CDF associated with each group.

NextEra Energy Seabrook Response to SAMA RAI 2a

The quantification of the Level 1 & Level 2 models employs the linked event tree method and does not use the plant damage state (PDS) method. With the event tree linking method, the Level 1 event trees are linked directly to the containment event tree (CET). Therefore all Level 1 sequences are evaluated by the CET and it is not necessary to summarize and group similar sequences into Level 1 plant damage states before input to the CET.

SAMA RAI 2b

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

b. ER Section F.3.2.1 explains that "mapping of sequences between the Level 1 model and the release categories is governed by the CET [containment event tree]" and that "containment analysis covers all conceivable failure modes of the containment, including pre-existing leaks, containment bypass sequences, external events impacting the structure, and internal loads that have the potential to fail the containment early (shortly after core melt) or late (many hours after the melt)." No example or actual CET is presented. Present or describe the CETs. Discuss the selection of the top events, how the branch point probabilities are determined, and the number of CETs developed for each of the four PRA model aspects (i.e., internal events, internal fire, seismic, external flooding).

NextEra Energy Seabrook Response to SAMA RAI 2b

The Level 2 model employs a single containment event tree (CET). The single CET is used for all PRA model aspects of internal events, internal fire and external events including seismic events.

The CET has 37 top events, which includes: 10 hardware-related, 13 human action-related and 13 phenomena-related top events along with a single mapping top event. MAAP analyses, supplemented by specialized phenomena assessments are used to determine which phenomena-based CET top events are to be included in the CET structure. Except for the first top event (MAPX), the CET is a branch-everywhere tree. As a result, there are a large number of potential sequences.

CET branch point split fraction numerical values are determined differently based on the type of top event. Hardware-related top event numerical values are determined and assigned based on systems analysis and development of associated system fault tree logic and associated split fractions. Human action-related top event numerical values are determined and assigned based on human reliability analysis (HRA) methodologies and development of associated human error probabilities (HEP). Phenomena-related top event numerical values are determined and assigned based on review of relevant physical phenomenon for a given group of accident sequences (MAAP analyses or supplemental phenomena assessments).

The CET top event success criteria is defined and split fraction logic rules are used to apply the correct top event split fraction values during CET quantification. For example, the top event for the operator action to depressurize the RCS (top event XODP1) would not be applicable to large and medium LOCA events because the RCS is already depressurized as a result of the initiating event. Therefore, the CET rule logic would assign success (or bypass) to this operator action top event.

A description of each CET top event is provided below.

CET Mapping Top Event

Top event MAPX – Sequence Mapping

This is the first top event in the tree. This top event has three branches: LEVEL1, LEVEL2 and SUCCESS. MAPX is a "mapping" top event designed to separate sequences into SUCCESS (stable, non-melt sequences) and failed (melt sequences). The SUCCESS branch sequences bypass the remainder of the top events in the CET. All melt sequences are mapped to both LEVEL1 and LEVEL2 branches. The LEVEL1 branch also bypasses the remainder of the CET top events. The LEVEL2 branch is mapped through the CET. This allows both Level 1 results (MELT) and Level 2 results (LERF, etc.) to be calculated at the same time.

CET Hardware Top Events

Top Events CBSIA, CBSIB – Containment Building Spray Injection

These top events model the injection mode of the Containment Building Spray (CBS) pump trains. CBS consists of two independent trains, A and B. Success of these top events requires that the associated RWST valves open, motive and control power are available, and all support systems (including a start signal) are available. CBS protects the containment from overpressure and scrubs the containment atmosphere of radionuclides. These functions also reduce the chance of containment failure should core melt occur and reduce the severity of release if the containment does fail.

Top Events CBSRA, CBSRB – Containment Building Spray Recirculation

These top events model the recirculation mode of the CBS pump trains. Success of these top events requires that the associated CBS pump runs, room cooling and pump cooling are available, sump valves open, with CBS injection path open. For MELT sequences, the success of these top events is useful for containment fission product scrubbing and heat removal functions.

Top Events CBSXA, CBSXB – Containment Building Spray Cooling

These top events model the availability of the CBS heat exchangers (CBS-E-16A, CBS-E-16B), including opening of the Primary Component Cooling Water isolation MOVs (CC-V137, CC-V136) to the associated CBS heat exchangers. These exchangers provide cooling to the containment spray water recirculated from the containment sump prior to entering the spray nozzles. The CBS pump trains must be successful for the heat exchangers to function.

Top Event CIL – Containment Isolation Large

This top event models the automatic isolation of the two, 8" diameter containment on-line purge (COP) lines, and referred to as the "large" containment isolation lines. Success of this top event is defined as proper actuation and operation (closure) of at least one valve in each of the COP supply and exhaust lines. This top event also includes the potential for large unidentified pre-existing openings (leakage) in containment that are not automatically isolated.

Top Event CIS – Containment Isolation Small

This top event models the automatic isolation of the small containment isolation lines. "Small" is defined as any line which has an inside diameter less than or equal to three inches; this definition incorporates all containment isolation lines except the COP lines (top event CIL). All containment isolation lines contain isolation valves which are required to automatically close on receipt of a containment isolation signal. Success of this event is defined as the proper actuation of at least one of the two in-series valves in each line. Top events CIL and CIS are mutually exclusive.

Top Event CILK – Containment Leakage

This top event models containment leakage within Technical Specification limits. For sequences with successful containment isolation, this top event distinguishes two leakage cases – "nominal" small leakage below the Technical Specification limit and "excessive" leakage above the Technical Specification limit but well below the size of a small penetration.

Top Event SGTI – Steam Generator Tube Integrity

This top event models the potential for SG tubes to be intact at the time of core melt. This top event includes consideration of both SGTR initiating event sequences and overpressure sequences with the potential for a consequential SGTR.

CET Human Action Top Events

Top Event OPSIG – Operator Action to Initiate "P" Signal

This top event models failure of the operator to manually initiate a "P" signal prior to core melt. This is modeled for sequences that require CBS actuation, i.e., containment pressure exceeding 18 psig.

Top Events OCI1, OCI2 – Operator Action to Isolate Containment

These top events model the operator actions needed to manually complete containment isolation. All containment isolation lines contain isolation valves which are required to close automatically on a containment isolation signal ('T' signal or 'P' signal). However, if these isolation signals failed to perform their function, the operator is instructed to verify containment isolation. Top event OCI1 models failure of the operator to manually initiate a containment isolation actuation. Top event OCI2 models failure of a local action to isolate the RCP seal return MOV for a station blackout sequence.

Top Events XODP1, XODP2 – Operator Action to Depressurize RCS

These top events represent an operator action to depressurize the RCS using the Pressurizer Operated Relief Valves (PORV). The Seabrook Station PORVs are DC powered with an AC powered, normally opened, block valve upstream. Each PORV is powered from a different train of DC electric power, and opening of both PORVs is assumed required to accomplish depressurization. Top event XODP1 models failure to depressurize prior to hot leg creep rupture. The act of depressurizing will reduce the potential for direct containment heating (DCH) and will essentially eliminate the potential for thermally induced steam generator tube rupture (TISGTR). Top event XODP2 models failure of the same action, but on a longer time frame, i.e., prior to core relocation. Success of this action prevents a high pressure melt ejection (HPMI) event.

Top Events XRACE, XRACL – Recovery of AC Power

These top events model failure to recover AC power using the same recovery curve used to calculate recovery of offsite power (ROSP) in the Level 1 Transient (TRANS) tree. These operator actions model different time phases – early (prior to core relocation) and late (after vessel failure but before containment failure). Success of these recovery actions allows recovery of equipment to restore RCS and/or containment injection, as modeled by subsequent action.

Top Event XOECC – Recovery of ECCS Injection

This top event models failure to restore RCS injection via ECCS pumps after core melt but before core relocation. This action requires previous success of recovery of AC power (XRACE) to restore pump flow or RCS depressurization (XODP1) to allow RHR injection at low pressure.

Top Event XOEFW – Restore Feedwater Flow to Steam Generators

This top event models failure to restore feed flow to the faulted SG given a SGTR. This action must be started prior to significant release (i.e., before core exit thermal couples reach ~1800°F).

Top Events XOINE, XOINL – Operator Action to Inject Water into Containment

These top events model failure of the operator action to inject water into containment. Injection should occur either early (prior to core relocation) or late (after vessel failure but before containment failure). Success of the early action supports ex-vessel cooling and assures that the RPV remains intact. The late action, along with late recovery of AC power (XRACL) and success of sump recirculation, allows for long term cooling of containment and assures that the containment remains intact.

Top Event XOSMP – Operator Action to Transfer Injection to Recirculation

This top event models failure of the actions required to transfer ECCS or CBS from injection mode to sump recirculation mode. This action requires the sump to be functional and successful injection of the RWST inventory.

Top Event XOVNT – Operator Action to Vent Containment

This top event models failure of the operator action to vent the containment to the environment when containment pressure exceeds 130 psia.

CET Phenomena Top Events

The CET structure groups phenomena-related top events into three phases of the severe accident progression. These phases include:

EARLY - after core damage but before failure of the reactor pressure vessel (RPV)

RPV Failure - RPV failure and phenomena immediately following, to debris quench or to dry-out

LATE - long term behavior, from RPV failure to containment failure.

CET Top Events during the "Early" Phase

Top Event XHLI - Hot Leg Remains Intact (No HLCR)

This top event represents the potential failure of the RCS hot leg (the pressurizer surge line) by thermal creep rupture prior to RPV failure. Seabrook Station's hot legs are fabricated from stainless steel. Success in the preceding top event (XODP=S) precludes the possibility of hot leg failure since the differential pressure is sufficiently reduced.

Top Event XDCIV – Core Debris Cooled In-Vessel

This top event represents those sequences where the accident is terminated with the core debris still in the vessel. Possible cooling mechanisms include: (a) recovery of in-vessel core cooling after the start of core damage; (b) heat transfer from the core debris through the lower head to a water-filled reactor cavity.

Top Event XSGTI – SG Tubes Remain Intact (Thermally Induced Steam Generator Tube Rupture - TISGTR)

This top event represents the possibility that the steam generator tubes experience such high temperatures that they fail from thermal creep rupture prior to hot leg or vessel failing. This top event is guaranteed successful (i.e., no TISGTR) given low RCS pressure – which can occur due to the accident sequence, success of XODP1 or XODP2, or failure of XHLI (HLCR occurs). In addition, the secondary side must be dry (i.e., secondary cooling failure) or the tubes will never reach the required temperature.

Top Event XNH2E - No Early Hydrogen Burn (Prior to Reactor Pressure Vessel Failure)

This top event represents the possibility of a hydrogen burn prior to vessel failure. This has the potential to cause early containment failure. However, the burn also consumes hydrogen which decreases the probability of a later burn when the containment pressure might be higher.

Top Event XCONE - Containment Remains Intact Early

This top event represents the possibility that an early containment failure may result from either the initial primary system blow-down forces or an early hydrogen burn. A detailed evaluation of the accident loads and containment strength shows that there are no sequences where the containment fails structurally during this early phase.

CET Top Events during the "RPV Failure" Phase

Top Event XRPV – Reactor Pressure Vessel Remains Intact

This top event represents the probability that the RPV remains intact following core melt. With successful in-vessel core debris cooling (XDCIV) or successful injection of the RWST into containment (XOINE), the RPV is highly likely to remain intact.

Top Event XNHPM – No High Pressure Melt Ejection

This top event represents the possibility of a Direct Containment Heating (DCH) event occurring during the vessel blow-down. This top event serves to track when a DCH event can occur, based on previous top events. The probability of containment failure due to the pressure rise from DCH is included in Top Event XCONV. Evaluation of the pressure increase resulting from a DCH event found the peak pressure to be within the capacity of the containment. This event is precluded if the RPV pressure at failure is low, the operator depressurizes using the PORVs (XODP1=S, XODP2=S), the hot leg fails (XHLI= F), or the vessel remains intact (XRPV=S).

Top Event XNH2V - No Hydrogen Burn at Vessel Failure

This top event represents the possibility of a hydrogen burn occurring as the vessel blow-down occurs or as the debris is quenched in the cavity. Hydrogen previously contained in the oxygen depleted vessel is now available in the containment where oxygen is present. The burn may occur at the vessel failure location or a global burn may occur slightly later as the hydrogen generated in the cavity is mixed with the containment atmosphere. A previous burn before vessel breach reduces the probability of this burn since the hydrogen concentrations will be lower.

Top Event XCONV - Containment Failure at Vessel Failure

This top event represents the possibility that the containment will fail simultaneously or slightly after the vessel blow-down. The additional possible pressure loads considered include those arising from the vessel blow-down, debris quench including potential steam explosion, DCH, and hydrogen burns. Not all of the possible loads may occur in a given sequence, based on previous CET top events and plant/containment conditions.

Top Event XDCXV – Core Debris Cooled Ex-Vessel

This top event models the cooling of debris dispersed from the cavity at vessel failure. The debris is unlikely to be cooled if the RWST is not injected. The Seabrook Station lower compartment configuration includes a 30" high lip around the openings into the cavity. Approximately two-thirds of the RWST contents must be injected before overflowing into the cavity. There is little uncertainty regarding the coolability of debris if water is introduced before significant core-concrete interaction has begun.

<u>CET Top Events during the "Late" Phase</u>

Top Event XSUMP – Recirc Sump Functional Post Core Melt

This top event models the potential that the containment recirculation sump is functional during severe accident conditions. If high pressure melt ejection occurs, it is likely that the sump functionality is challenged.

Top Event XNH2L - Late Hydrogen Burn

This top event represents the possibility that the containment will experience a late hydrogen burn. The combustible gas concentration will be impacted by the extent of debris quenching and core-concrete attack. The combustible gas mixture will be primarily hydrogen since little carbon monoxide will be produced from the core attack of the basaltic concrete used in the Seabrook Station containment structure. No hydrogen burn would occur if the debris is cooled ex-vessel.

Top Event XCONL- Late, Large Containment Failure

This top event represents the possibility that the containment structure may fail in the long term. Failure may be a result of a slow pressurization from an uncooled debris bed, lack of containment heat removal (even if sprays operate), or a rapid pressure spike from a hydrogen burn. A detailed analysis of the loads present and the containment structural strength, including the impact of a very hot containment atmosphere, was performed to evaluate this top event.

This top event also represents the possibility that the containment may fail from basemat melt-through. This event is dependent on the outcome of Top Event XDCXV, i.e., whether the debris is cooled in cavity since a quenched debris bed will not attack the basemat. An unquenched debris bed does not necessarily penetrate the basemat since the debris may be sufficiently diluted by inclusion of the ablated concrete into the debris pool that the penetration stops.

SAMA RAI 2c

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

c. ER Section F.3.2.1 explains that the "CET is linked directly with the Level 1 event trees to generate the frequencies of each release category bin." Explain how release category bin frequencies are determined, beginning with Level 1 accident sequence grouping and CET sequence results.

NextEra Energy Seabrook Response to SAMA RAI 2c

Also refer to NextEra Energy Seabrook response to SAMA RAI 2a. The quantification of the Level 1 & Level 2 models employs the linked event tree method, which directly links all Level 1 event trees to the containment event tree (CET). As a result, all Level 1 sequences are evaluated by the CET. The event trees used in the "at power" Level 1 and Level 2 Seabrook Station PRA are shown below in the Seabrook Station PRA Event Tree Table.

Seabrook Station PRA Event Tree Table

Event Tree	Description
Support/System	
Status Tree	Status tree is the initial tree to define the plant operating states
Hazard Tree	Hazard tree models plant response to seismic and control room fire initiators
Support Tree 1	Support tree 1 models availability of AC and DC power systems
Support Tree 2	Support tree 2 models availability of cooling and control systems
Systems Tree	Systems tree models availability of EFW and ECCS systems
Frontline	
ATWS Tree	ATWS tree models plant response to a transient without reactor trip
LOCA Tree	LOCA tree models plant response to medium and large LOCA inside containment
SGTR Tree	SGTR tree models response of the operator and plant safety systems to a SG tube rupture event
SLB	SLB tree models plant response to a secondary side break (feedwater and main steam)

Event Tree	Description
Support/System	
TRANS	Transient tree models plant response to loss of feedwater, loss of RCP seal cooling and small LOCA
VSEQ	VSEQ tree models the response of the operator and plant safety systems to a inter-system LOCA from the RCS to the RHR system
Containment	
CET	CET models the containment response to core damage

Each tree in the Support/System group is linked together beginning with the "Status" tree. The output from the "Systems" tree is linked directly to the frontline tree for the initiating event being evaluated. The output of the frontline tree is linked directly to the input of the CET. Each initiating event is run through all the applicable event trees including the CET to evaluate the Level 1 core damage frequency results and the Level 2 release category (RC) frequency results. The total frequency of each RC bin is the sum of all Level 2 sequences assigned to that bin.

SAMA RAI 2d

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

   d. ER Section F.3.2.1 explains that representative Level 1 sequences are used to evaluate the thermal-hydraulic response of the core and containment in order to determine whether certain phenomena would be expected to occur and that Modular Accident Analysis Program (MAAP) 4.0.5 was used to investigate severe accident progression for the Level 2 analysis. Section F.3.2.1 does not identify or discuss the representative MAAP cases selected for each release category. Describe the MAAP cases selected to represent each release category and the basis for their selection, and discuss how scenarios of less than dominant frequency but larger potential consequences were considered in the selection of each MAAP case.

NextEra Energy Seabrook Response to SAMA RAI 2d

The Level 2 analysis was updated in 2005. The basis for the Level 2 update is documented in a Westinghouse report WCAP-16600-P Revision 0 (June 2006) and summarized in the Seabrook Station PRA. This update included the following release categories, as the interface between the Level 2 model and the Level 3 model.

Release Category	Description	Notes
LE1A	LARGE, EARLY - SGTR-initiated (or pressure-induced tube ruptures) core melt with NO feedflow to faulted SG (failure of EFW/SUFP or operator does not restore flow).	Mapped to LE1
LE1B	LARGE, EARLY - Thermally-induced SGTR.	Mapped to LE1
LE2	LARGE, EARLY - Interfacing LOCA with RHR pipe rupture (V sequence).	
LE3	LARGE, EARLY - Failure of large containment penetration to isolate (COP valves).	
LE4	LARGE, EARLY - Early containment failure due to direct containment heating or steam explosion.	Contributes 0.0.
SE1	SMALL, EARLY - Early SGTR-initiated core melt with feed to the faulted SG.	
SE2	SMALL, EARLY - Interfacing LOCA through RHR pump seals (submerged release).	
SE3A	SMALL, EARLY - Small containment penetration leak that may progress to large late failure.	Mapped to SE3
SE3B	SMALL, EARLY - Failure of large containment penetration to isolate, with spray injection / scrubbed release.	Mapped to SE3
SE4	SMALL, EARLY - Small early leak that may progress to large late failure.	Contributes 0.0
LL3	LARGE, LATE - Vented containment.	
LL4	LARGE, LATE - Long term containment overpressure failure.	
LL5	LARGE, LATE - Basemat melt-through.	
SL4	SMALL, LATE - Small containment failure.	Mapped to LL3
INTACT1	INTACT - Containment intact with less than Tech Spec allowed leakage.	Mapped to INTACT
INTACT2	INTACT - Containment intact with greater than Tech Spec allowed leakage.	Mapped to INTACT

Note that in a few cases, a single source term group is defined for two release categories. This is a case where the release categories occur due to different phenomena but the consequence is essentially the same. For example, source term group LE-1 represents SGTR-type releases; release categories LE-1a and LE-1b represent tube ruptures prior to core melt (LE-1a) or following core melt, induced by the high temperature gas (LE-1b). Release category is LE-1a is much more likely to occur than LE-1b, so the source term is based on LE-1a type sequences. The Level 2 release category bins were combined to simplify and broaden the Level 2 binning as follows:

1. Combine LE-1A and LE-1B into one bin LE-1

Bin LE-1A captured sequences associated with STGR initiating events with no feedwater to the ruptured SG; the LE-1A sequences are ~1E-07/yr. LE-1B captured sequences involving thermally-induced SGTR (SGTR as a result of accident progression); the LE-1B sequences are ~1E-11/yr. Given the very low frequency of LE-1B, both bins are combined into single large/early bin with source term based on LE-1A.

2. LE-4 contributes 0.0 to frequency

Bin LE-4 was used to capture containment failure resulting from direct containment heating or steam explosion. Given the reactor/cavity design at Seabrook, DCH is not a credible containment challenge because the peak pressure associated with DCH is within the capability of containment. The LE-4 bin sequence total is 0.0, thus LE-4 does not contribute.

3. Combine SE-3A and SE-3B into one bin SE-3

Bins SE-3A and SE-3B are both containment penetration failures and were used to discriminate between a small penetration failure with no source term scrubbing (Bin 3A) and a large penetration failure with the possibility of successful scrubbing with containment building spray (Bin 3B). The 3A bin sequence total is ~1E-06 and the 3B bin sequence total is ~2E-11. These bins are combined and source term associated with SE-3A is used.

4. SE-4 contributes 0.0 to frequency

Bin SE-4 was used to capture sequences associated with a small early containment leak that could progress into a large, late containment failure. The SE-4 bin sequence total is 0.0; thus, SE-4 does not contribute.

5. Combine LL-4A, LL-4B and SL-4 into one bin LL-4

Bins 4A and 4B are used to discriminate the timing and potential large source terms between long term containment failure when dry (4A) (base mat failure) and containment failure when wet (4B) (overpressure failure). The source term and timing from MAAP case 101a (representing 4B) are worse than from MAAP case 101e (representing 4A); thus source term from 101a are used in the combined bin LL-4 as the representative source term. Bin SL-4 is used to capture sequences that result in similar late containment failures but with small release. This bin is added to LL-4 to simplify the bins. This provides a conservative result to LL-4.

6. Combine INTACT1 and INTACT2 into one bin INTACT.

INTACT1 and INTACT2 are used to discriminate between successful containment isolation with nominal leakage - less than Tech. Spec. leakage (INTACT1) and successful containment isolation but with excessive leakage – greater than Tech. Spec. leakage but less than the leakage associated with a small penetration (INTACT2). The INTACT2 frequency is approximately two orders of magnitude less than INTACT1, but assumes a source term 10 times greater than INTACT1. INTACT 1 and INTACT2 were analyzed separately to account for each. For reporting purposes they were combined to INTACT.

The following table shows the map between release categories and source term IDs.

SAMA Source Term Group	Description	Related Release Categories
LE-1	Early Large Containment Bypass – Tube Rupture	LE-1a, LE-1b
LE-2	Early Large Containment Bypass - ISLOCA	LE-2
LE-3	Unisolated Containment (Large)	LE-3
SE-1	Early Small Containment Bypass	SE-1
SE-2	Early Small Containment Bypass	SE-2
SE-3	Unisolated Containment (Small)	SE-3a, SE-3b
LL-3	Containment Venting	LL-3
LL-4	Late Containment Failure – Overpressurization by Noncondensible Gases or Steam	LL-4a, LL-4b
LL-5	Basemat Failure	LL-5
INTACT	Nominal/Excessive Containment Leakage	INTACT-1, INTACT-2

A series of MAAP cases are used to support Level 2 success criteria and timing. These cases were run using MAAP Version 4.0.5 and a Seabrook Station-specific parameter file. The MAAP cases described below were used to assess the source term releases for categories LE1, SE-1, LL-3, LL-4 and INTACT. Refer to RAI 4e for discussion of other release categories.

The 2009 PRA model is currently in the process of being updated and is scheduled to be issued in 2011. The scope of the PRA update will include a reassessment of source terms along with update of other PRA elements, e.g., update to pre-initiator (latent) human actions. Based on preliminary update results, including more current source terms, no changes to the overall SAMA conclusions are expected. An update to the SAMA evaluation will be provided in the next ER annual report.

LE-1 – MAAP Case 103d: LE-1 captures releases involving SGTR sequences. SG tube rupture events were evaluated to judge whether the fission product releases are early or late and whether covering the tube rupture location with water by initiating EFW to the ruptured SG may provide scrubbing to reduce the fission product releases. Seven MAAP case scenarios were evaluated. MAAP Case 103d was used to define the event timing and release assuming all EFW failed and no benefit of opening PORVs to depressurize RCS. This case represents the situation where a containment bypass is via a failed SG tube and the RSC is not depressurized to containment. The source term from a thermally-induced SGTR was not determined in the MAAP analyses because no TI-SGTRs were predicted. However, the source term would not be expected to be significantly different since the release from the core goes straight to the environment in both cases with very little opportunity for retention. Core overheating occurs at ~3 hours with vessel failure at ~4.7 hours as opposed to over 20 hours for cases with EFW. The core heatup plateau is at ~5 hours with release of ~3% of the CsI core inventory.

SE-1 – MAAP Case 103g: SE-1 captures small, early release involving containment bypass. Case 103g is similar to case 103d and considers the impact of pressurizer PORV opening. Opening of PORVs delays, but does not prevent RPV failure since there is no cooling of the debris by either internal or external cooling. The MAAP analyses show that the source term is significantly reduced if the SG can be reflooded to provide scrubbing of releases. The volatile fission product release starts at ~3 hours as the core overheats and plateaus at about 4 hours, after the PORVs are open, with ~0.5% of the core inventory of CsI. This release fraction is almost an order of magnitude lower than the case without the PORV opening.

LL-3 – MAAP Case 107b: LL-3 captures large, late releases involving containment venting during medium or large LOCA sequences. Containment venting is represented in five MAAP cases. MAAP Case 107b is the case chosen to define the realistic timing and release and is judged as the median source term case from the 107 series cases. In this case, the containment vent pressure setpoint is reached at 35 hours, which is slightly longer than other cases with assumed auto actuation of containment spray. This case is a dry cavity sequence – no injection of RWST water and significant CCI. Two separate containment ventings are performed in the 100 hour simulation time. The CsI release is ~0.28% of the core inventory at 100 hours.

LL-4 – MAAP Case 101a: LL-4 captures late containment failure due to overpressurization by noncondensible gases or steam. Seven MAAP case scenarios were evaluated. MAAP Case 101a is the case used to define the realistic timing and release. A small LOCA event with limited ECCS and EFW are assumed. In this case, RPV failure occurs at ~2.9 hours. The SI pump injects a small amount of RWST inventory at ~0.5 hours as the primary pressure drops. ECC is assumed to be insufficient to prevent core melt and vessel failure. The RWST is assumed completely injected to containment after RPV failure by the SI pumps. Containment overpressure failure occurs at 37 hours due to heat transfer from the top of the core debris to the overlying pool. The pool eventually dries out after containment failure and CCI is re-initiated. Also in this case, the CsI fraction of the core inventory released is ~35%. This is due to the presence of two openings in the RCS after vessel failure, which permits natural circulation through the RCS and the efficient transfer to the containment of fission products.

INTACT – MAAP Case 102k: INTACT captures releases involving sequences with an intact containment with nominal Tech. Spec. leakage (INTACT1) and excessive leakage (INTACT2). Ten MAAP case scenarios were evaluated using transient - loss of feedwater events. INTACT1 - MAAP Case 102k is the case chosen to define the realistic timing and release for nominal containment leakage.

In this case, containment spray (CBS) was started when core exit thermal couples were at 1100F and the RPV was externally submerged at ~2.8 hours. The RPV failed at 4.5 hours due to ejection of an in-core tube. CBS recirculation was effective in preventing containment pressurization to the failure pressure and scrubbing the fission product release. Ex-vessel cooling was not effective due to the high RCS pressure. INTACT2 - excessive containment leakage is assumed to be ten times the nominal Tech. Spec. leakage, which translates to 10 times the release from cases with nominal Tech. Spec. leakage.

SAMA RAI 2e

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

   e. ER Table F.3.2.1-2 presents the top basic events by RRW for the Level 2 PRA basic events that contribute to a large early release frequency (LERF). While the contributions of initiating events to CDF are provided in Table F.3.1.1.1-1, no initiating events appear in the list for RRW in Table F.3.2.1-2. Relative to Table F.3.2.1-2, address why there are no initiating events in this list. Clarify if initiating events were included in the determination of the RRW listing and, if initiating events were not included, determine their RRW values and identify and evaluate SAMAs to address these events.

NextEra Energy Seabrook Response to SAMA RAI 2e

The determination of basic event RRW importance presented in Table F.3.2.1-2 includes consideration of initiating events. It is also noted that, as presented in Appendix F.A of the SAMA report, a number of SAMA PRA "case studies" were performed in support of Phase II screening. Many of these SAMA case studies specifically determined the risk reduction when assuming complete elimination of certain initiating events. The results of these case studies, in terms of reduction in CDF and reduction in offsite dose, are identified for applicable SAMAs in Table F.7-1, Seabrook Station Phase II SAMA Analysis.

SAMA RAI 2f

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

   f. Relative to Table F.3.2.1-2, provide a listing of the risk important basic events contributing to the other release categories (e.g., LL3, SE3) that contribute 90% of the population dose-risk. Identify and evaluate SAMAs to address these events.

NextEra Energy Seabrook Response to SAMA RAI 2f

The top ranked release categories that contribute approximately 90% to the population dose-risk include release categories SE3 (40.2%), LL3 (27.8%), LE1 (9.4%), SE1 (7.5%) and LL4 (6%). The top 15 basic events that contribute to each of these release categories is provided below along with a SAMA disposition. Based on assessment of these basic events, one new SAMA candidate, related to containment isolation valve basic event CSV167.FO, is identified as "potentially cost-beneficial". CS-V-167 is an MOV that provides the outboard containment isolation function of the RCP seal water return line. A Phase 2 PRA case study (V167AC) was performed to assess the potential cost-benefit of the concept to eliminate the valve's AC power dependence via possible installation of an AOV. The following results were estimated:

Nominal Cost Benefit: ~$192K

Best Estimate Discount Rate: ~$171K

Extended Period Cost Benefit: ~$240K

Upper Bound Cost Benefit: ~$365K

% Reduction in OECR: ~44%

Cost of SAMA: The engineering, hardware and implementation cost of this change is estimated at approximately $250K to $300K.

Based on this case study, the concept to modify the isolation design of the seal water return line is judged as potentially cost-beneficial. This SAMA is not aging-related and is identified as SAMA #193.

Top Basic Events Contributing to RC SE3						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#1 DGDG1A.FR3	DG-1A fails to run for 24 hours	1.096	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#2 DGDG1B.FR3	DG-1B fails to run for 24 hours	1.076	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#3 ZZ.CIS.PRE.EXIST	Small pre-existing unidentified containment leakage	1.044	Hardware or procedural change to eliminate or reduce likelihood of small pre-existing unidentified leakage	CISPRE	$11K (nominal benefit) $20.3K (UB benefit) OECR Red: ~2% Min. Cost: >$50 to 100K	Not cost beneficial based on assumed elimination of small pre-existing leakage failure contribution
#4 HH.OSEP2Q.FA	Operator fails to close SEPS breaker from MCB, given SI Signal Top Event OSEP	1.028	Hardware change for auto closure of SEPS breaker to eliminate operator action	OSEPALL	$32.5K (nominal benefit) $62K (UB benefit) OECR Red: ~3% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all operator actions needed to close SEPS breaker
#5 FWP37A.FR	Turbine Driven Pump FW-P-37A fails to run	1.028	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#6 CSV167.FO	Top Event CIS, Pen. X-37 isolation valve CS-V-167	1.025	Hardware change to eliminate MOV AC power dependence	V167AC	$198K (nominal benefit) $376K (UB benefit) OECR Red: ~46% Min. Cost: >$300K	Potentially cost beneficial based on assumed replacement of MOV with FC AOV

Top Basic Events Contributing to RC SE3						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#7 HH.OSEP1Q.FA	Operator fails to close SEPS breaker from MCB given seismic event	1.016	Hardware change for auto closure of SEPS breaker to eliminate operator action	OSEPALL	$32.5K (nominal benefit) $62K (UB benefit) OECR Red: ~3% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all operator actions needed to close SEPS breaker
#8 SEPSDG2A.FR3	1-SEPS-DG-2-A fails to run within 24 hours	1.014	#9, #14, Elimination of all potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#9 SEPSDG2B.FR3	1-SEPS-DG-2-B fails to run within 24 hours	1.014	#9, #14, Elimination of all potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#10 HH.OCI2Q.FL	Operator fails to close containment isolation valve CSV-167 locally given medium seismic event	1.010	Provide a hardware modification (additional signals or remote capability) to automatically close V-167.	OCI2S	$2.6K (nominal benefit) $5K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed complete elimination of human action
#11 DGP115A.FS	DG-1A Engine Driven Lube Oil Pump fails to run	1.010	Provide hardware modification to improve lube oil pump reliability	DGP115A/B	$9K (nominal benefit) $17K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of DGP115A/B basic event RRW SE3, LL3, SE1, LL4 failure contribution
#12 DGDG1A.FS	DG-1A fails to start on demand	1.009	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures

Top Basic Events Contributing to RC SE3						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#13 DGDG1A.FR1	DG-1A fails to run for first hour	1.008	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#14 DGP115B.FS	DG-1A Engine Driven Lube Oil Pump fails to run	1.008	Provide hardware modification to improve lube oil pump reliability	DGP115A/B	$9K (nominal benefit) $17K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of DGP115A/B basic event RRW SE3, LL3, SE1, LL4 failure contribution
#15 DGDG1B.FS	DG-1B fails to start on demand	1.007	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures

Top Basic Events Contributing to RC LL3						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#1 XX.EDESWG5.FX	4KV Bus E5 fault (IE)	1.115	Improve Bus E5 reliability, eliminate potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault, case E6S representative
#2 XX.EDESWG6.FX	4KV Bus E6 fault (IE)	1.113	Improve Bus E6 reliability, eliminate all potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#3 CCTE2271.FZ	PCC Train B Temperature Element CC-TE-2271 transmits false low	1.075	Improve PCC TE reliability, eliminate potential for temp. element failure	PCCTS	$29K (nominal benefit) $55.3K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with TE-2171 and TE-2271 failures
#4 CCTE2171.FZ	PCC Train A Temperature Element CC-TE-2171 transmits false low	1.074	Improve PCC TE reliability, eliminate potential for temp. element failure	PCCTS	$29K (nominal benefit) $55.3K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with TE-2171 and TE-2271 failures
#5 FWP37A.FR	Turbine Driven Pump FW-P-37A fails to run	1.064	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#6 ZZ.SY1.FX	Loss of Offsite Power subsequent to Plant Trip	1.058	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power

Top Basic Events Contributing to RC LL3						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#7 HH.XOSMP1.FA	Operator aligns containment sump recirculation after core melt	1.056	Provide a hardware modification for auto-control, eliminate operator action to align sump after core melt.	XOSMPS	$21K (nominal benefit) $39.7K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of human action
#8 CCE17B.GL	Train B HX E-17B Excessive Leakage During Operation	1.052	Improve PCC Ht Ex reliability, eliminate potential for heat exchanger leakage	PCCLS	$21.8K (nominal benefit) $41.6K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with heat exchanger E17A and E17B leakage
#9 ZZ.SY2.FX	Loss of Offsite Power subsequent to LOCA initiator	1.052	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power
#10 CCE17A.GL	Train A HX E-17A Excessive Leakage During Operation	1.051	Improve PCC Ht Ex reliability, eliminate potential for heat exchanger leakage	PCCLS	$21.8K (nominal benefit) $41.6K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with heat exchanger E17A and E17B leakage
#11 EDESWG11B.FX	DC Power Panel 11B fails to operate Top Event DCP, CCF Group BUSFL	1.048	Improve Bus E11B reliability, eliminate bus failure	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of SWG11A/B basic event, case E6S representative

Top Basic Events Contributing to RC LL3						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#12 EDESWG11A.FX	DC Power Panel 11A fails to operate Top Event DCP, CCF Group BUSFL	1.041	Improve Bus E11A reliability, eliminate bus failure	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of SWG11A/B basic event, case E6S representative
#13 SWV5.FO	SW Secondary Isolation MOV SW-V-5 fails to close on demand	1.038	Improve SWV-5 reliability, eliminate valve failure	SWV5	$8K (nominal benefit) $16K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of SWV5 basic event RRW LL3, LL4, SE1 failure contribution
#14 DGDG1A.FR3	DG-1A fails to run for 24 hours	1.034	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#15 EDESWG6.FX	4KV Bus E6 Fault	1.031	Improve Bus E6 reliability, eliminate potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault

Top Basic Events Contributing to RC LE1						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#1 FWP37A.FR	Turbine Driven Pump FW-P-37A fails to run	1.445	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#2 HH.XOEFW1.FA	Operator establishes feed flow to faulted SG	1.197	Hardware for automatic feed flow, eliminate potential for operator failure to feed SG	XOEFW	$4.1K (nominal benefit) $7.8K (UB benefit) OECR Red: ~1% Min. Cost: >100K	Not cost beneficial based on assumed elimination of operator failure to feed SG
#3 ZZ.SY2.FX	Loss of Offsite Power subsequent to LOCA initiator	1.187	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power
#4 FWV156.FC	SUFP to EFW Header MOV FW-V-156 fails to open on demand	1.124	Improve reliability of SUFP, eliminate potential for SUFP failures	SUFPS	$42.4K (nominal benefit) $81K (UB benefit) OECR Red: ~4% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#5 FWV163.FC	SUFP to EFW Header MOV FW-V-163 fails to open on demand	1.124	Improve reliability of SUFP, eliminate potential for SUFP failures	SUFPS	$42.4K (nominal benefit) $81K (UB benefit) OECR Red: ~4% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#6 FWP37B.FS	EFW motor-driven pump FW-P-37-B fails to start on demand	1.096	Hardware change to eliminate or reduce mechanical failures of MD EFW pump.	MEFWS	$38.5K (nominal benefit) $73.4 (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with MD EFW pump failures

Top Basic Events Contributing to RC LE1						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#7 HH.OTSI3.FA	Operator action for SI termination given successful cooldown and depressurization for SGTR.	1.090	Implement hardware change to improve reliability of SGTR control, eliminate or reduce operator failure to terminate SI	OTSIS	$28.3K (nominal benefit) $53.8K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of the human failure risk including actions OTSI3, OTSI4 and OTSI5 for SI termination during SGTR
#8 FWP37A.FS1	Turbine Driven Pump TURBINE FW-P-37A fails to start on demand	1.083	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#9 HH.ORWMZ1.FA	Operator minimizes ECCS flow w/recirculation failure	1.065	Implement hardware change for automatic ECC control, eliminate or reduce operator failure to min. ECC flow	ORWS	$31.8K (nominal benefit) $60.6K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of the human failure risk
#10 ZZ.2PORV.NOCRI	ATWS - Unfavorable Exposure Time (UET) Probability, given 2 PORVs & 3 SVs available, w/o Control rod insertion (CRI)	1.056	Improve hardware/ procedures to reduce or eliminate BE exposure probability, improve CRI availability	UET	$3K (nominal benefit) $6K (UB benefit) OECR Red: <1% Min. Cost: >$50K	Not cost beneficial based on assumed elimination of UET basic event RRW LE1, LL4 probability contribution

Top Basic Events Contributing to RC LE1						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#11 HH.OSUFP2.FA	Operator fails to start SUFP given SI initiator	1.054	Provide auto-start of SUFP, eliminate potential for operator failure to start SUFP	OSUFPS	$6.6K (nominal benefit) $12.7K (UB benefit) OECR Red: <1% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with manual action to start the SUFP
#12 FWP113.FS	Startup Feed Pump FW-P113 fails to start on demand	1.053	Improve SUFP reliability, eliminate potential for SUFP mechanical failures	SUFPS	$42.4K (nominal benefit) $81K (UB benefit) OECR Red: ~4% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#13 FWP37B.FR	EFW motor-driven pump FW-P-37-B fails to run	1.044	Hardware change to improve pump reliability, eliminate or reduce mechanical failures of MD EFW pump	MEFWS	$38.5K (nominal benefit) $73.4 (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with MD EFW pump failures
#14 FWPCV4326.FC	1-FW-PCV-4326 SUFP recirculation fails to open on demand	1.040	Hardware change to improve SUFP reliability, eliminate or reduce potential for SUFP/valve failures	SUFPS	$42.4K (nominal benefit) $81K (UB benefit) OECR Red: ~4% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault

Top Basic Events Contributing to RC LE1						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#15 FWV347.OP	EFW P-37B recirculation MOV FW-V-347 transfers open (flow diversion)	1.033	Hardware change to improve reliability, eliminate or reduce mechanical failures of MD EFW pump/valves	MEFWS	$38.5K (nominal benefit) $73.4 (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with MD EFW pump failures

Top Basic Events Contributing to RC SE1						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#1 HH.OTSI3.FA	Operator action for SI termination given successful cooldown and depressurization for SGTR.	1.944	Provide automatic control, eliminate or reduce operator failure to terminate SI	OTSIS	$28.3K (nominal benefit) $53.8K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of the human failure risk including actions OTSI3, OTSI4 and OTSI5 for SI termination during SGTR
#2 HH.ORWMZ1.FA	Operator minimizes ECCS flow w/recirculation failure	1.570	Implement hardware change for automatic ECC control, eliminate or reduce operator failure to min. ECC flow	ORWS	$31.8K (nominal benefit) $60.6K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of the human failure risk
#3 ZZ.SY2.FX	Loss of Offsite Power subsequent to LOCA initiator	1.465	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power
#4 HH.ODDSG1.FA	Operator fails to diagnose SG Tube Rupture Event	1.096	Implement hardware change to eliminate or reduce operator failure to terminate SI	OTSIS	$28.3K (nominal benefit) $53.8K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	OTSIS is representative case for HH.ODDSG1.FA. Not cost beneficial based on assumed elimination of the human action to diagnose SGTR event

Top Basic Events Contributing to RC SE1						
Basic Event	Description	RC Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#5 HH.OSGRD1.FA	Operator depressurizes RCS to Stop Break Flow to Ruptured SG (SGTR)	1.084	Implement hardware change to improve reliability of SGTR control, eliminate operator action to depressurize	OSGRDS	$4.5 K (nominal benefit) $8.5K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of operator action to depressurize RCS
#6 HH.ORWCD1.FA	Operator fails to Cooldown/Depressurize RCS to Minimize Leak w/Recirculation Failure (VSEQ)	1.072	Implement hardware change to improve reliability, eliminate operator action to depressurize	ORWCDS	$4.4 K (nominal benefit) $8.3K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of operator action to cooldown and depressurize RCS
#7 FWP37A.FR	Turbine Driven Pump FW-P-37A fails to run	1.049	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#8 HH.ORWIN1.FA	Operator fails to initiate makeup to RWST given LOCA w/ recirculation failure	1.048	Hardware change to provide auto-makeup to RWST, eliminate operator action	ORWS	$31.8K (nominal benefit) $60.6K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	ORWS is representative case for HH.ORWIN1.FA. Not cost beneficial based on assumed elimination of the human action to perform RWST makeup
#9 HH.OTEFW3.FA	Operator fails to terminate EFW flow to ruptured SG - SGTR	1.038	Hardware change to eliminate operator action to depressurize	OSGRDS	$4.5 K (nominal benefit) $8.5K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	OSGRDS is representative case for HH.OTEF3.FA. Not cost beneficial based on assumed elimination of operator action to terminate EFW flow for SGTR

Top Basic Events Contributing to RC SE1						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#10 HH.ORWLT1.FA	Operator fails to maintain stable plant conditions w/ long term makeup	1.036	Hardware change for automatic control or eliminate operator action to maintain stable conditions	ORWS	$31.8K (nominal benefit) $60.6K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	ORWS is representative case for HH.ORWLT1.FA. Not cost beneficial based on assumed elimination of the human failure risk
#11 HH.OSGRC1.FA	Operator fails to cooldown RCS to allow isolation of ruptured SG (SGTR)	1.032	Hardware change for automatic control or eliminate operator action to cooldown RCS	OSGRDS	$4.5 K (nominal benefit) $8.5K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	OSGRDS is representative case for HH.OSGRC1.FA. Not cost beneficial based on assumed elimination of operator action to cooldown RCS
#12 HH.ORHCD8.FA	Operator fails to cool/depressurize RCS for RHR S/D cooling for SGTR w/ failure of OSGRD	1.030	Hardware change for automatic control or eliminate operator action to cooldown RCS	ORHCDS	$12.3 K (nominal benefit) $23.5K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all ORHCD related operator actions to cooldown RCS
#13 CBSV17.FC	Containment Building Spray Pump P-9B discharge MOV CBS-V-17 fail to open on demand	1.025	Hardware change to improve valve reliability, eliminate CBS discharge MOV failures	CBSDVS	$<1K (nominal benefit) $<1K (UB benefit) OECR Red: <1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of both CBS-V-11 and CBS-V-17 failure to open on demand

Top Basic Events Contributing to RC SE1						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#14 CBSV11.FC	Containment Building Spray Pump P-9A discharge MOV CBS-V-11 fail to open on demand	1.023	Hardware change to improve valve reliability, eliminate CBS discharge MOV failures	CBSDVS	$<1K (nominal benefit) $<1K (UB benefit) OECR Red: <1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of both CBS-V-11 and CBS-V-17 failure to open on demand
#15 HH.OSEP2.FA	Operator fails to close SEPS breaker from the MCB given SI signal	1.019	Hardware change for auto closure of SEPS breaker to eliminate operator action	OSEPALL	$32.5K (nominal benefit) $62K (UB benefit) OECR Red: ~3% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all operator actions needed to close SEPS breaker

Top Basic Events Contributing to RC LL4						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#1 HH.XOVNT1.FA	Operator fails to vent containment late	5.196	Hardware change for automatic venting control, eliminate need to perform late containment venting	XOVNTS	$30.4K (nominal benefit) $58K (UB benefit) OECR Red: ~9% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of operator action to vent containment
#2 HH.XOSMP1.FA	Operator aligns containment sump recirculation after core melt	1.531	Provide a hardware modification for auto-control, eliminate operator action to align sump after core melt.	XOSMPS	$21K (nominal benefit) $39.7K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of human action
#3 FWP37A.FR	Turbine Driven Pump FW-P-37A fails to run	1.134	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#4 DGDG1A.FR3	DG-1A fails to run for 24 hours	1.088	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#5 XX.EDESWG5.FX	4KV BUS E5 fault (IE)	1.080	Improve Bus E5 reliability, eliminate all potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault, case E6S representative

Top Basic Events Contributing to RC LL4						
Basic Event	**Description**	**RC-Specific RRW**	**Associated SAMA**	**PRA Case**	**Assessment**	**Disposition**
#6 DGDG1B.FR3	DG-1B fails to run for 24 hours	1.073	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#7 XX.EDESWG6.FX	4KV BUS E6 fault (IE)	1.068	Improve Bus E6 reliability, eliminate all potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#8 ZZ.SY1.FX	Loss of Offsite Power subsequent to plant trip	1.049	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power
#9 EDESWG6.FX	4KV BUS E6 fault	1.042	Improve Bus E6 reliability, eliminate all potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#10 SEPSDG2A.FR3	1-SEPS-DG-2-A fails to run within 24 hours	1.038	#9, #14, Improve reliability of SEPS DG, eliminate potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#11 SEPSDG2B.FR3	1-SEPS-DG-2-B fails to run within 24 hours	1.038	#9, #14, Improve reliability of SEPS DG, eliminate potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures

Top Basic Events Contributing to RC LL4						
Basic Event	Description	RC-Specific RRW	Associated SAMA	PRA Case	Assessment	Disposition
#12 CCTE2271.FZ	PCC Train B Temperature Element CC-TE-2271 transmits false low	1.036	Improve PCC TE reliability, eliminate potential for temp. element failure	PCCTS	$29K (nominal benefit) $55.3K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with TE-2171 and TE-2271 failures
#13 CCTE2171.FZ	PCC Train A Temperature Element CC-TE-2171 transmits false low	1.036	Improve PCC TE reliability, eliminate potential for temp. element failure	PCCTS	$29K (nominal benefit) $55.3K (UB benefit) OECR Red: ~3% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with TE-2171 and TE-2271 failures
#14 HH.OINE3.FA	Operator fails to start containment injection early without AC power (gravity drain of RWST)	1.033	Hardware change for automatic initiation of containment injection gravity drain, eliminate operator action	XOINES	$4.1 K (nominal benefit) $7.7K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all operator actions to initiate containment injection (XOINE1, XOINE2, XOINE3)
#15 EDESWG5.FX	4KV BUS E5 fault	1.030	Improve Bus E5 reliability, eliminate all potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault, case E6S representative

SAMA RAI 2g

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

g. Table F.3.4.3-2 provides the accident category frequencies and release fractions. The release times indicate a range for the bulk of noble gas and cesium (Cs) release. Clarify the meaning of the two release time ranges provided for each of the release categories. In addition, for each MAAP case, provide the following for noble gas, Cs, and Iodine releases: (1) time after SCRAM or when a general emergency (GE) is declared, (2) total duration of the release modeled, and (3) release fraction and start/end of release for each plume release (if multiple plume releases are modeled).

NextEra Energy Seabrook Response to SAMA RAI 2g

The two release time ranges are the start and end times (hours from SCRAM) of the noble gas and Cs releases. For the Seabrook original analysis accident categories (LE-2, LE-3, SE-2, SE-3, and LL-5), the time ranges represent the entire release plume. For example, the entire LE-2 release of noble gas and Cs is between 2.5 and 3 hours from scram. For the MAAP accident categories, the time range represents most of the entire release (see following tables).

The following tables give the noble gas, iodine, and cesium release fractions, start time of release plume (measured from SCRAM), and duration of release plume (the release plume end time would be the start time + duration) for each of the MAAP cases (all modeled with multiple release plumes). The tables also give the accident category general emergency declaration time. In the following tables, all times are in seconds (in keeping with MACCS2 input specifications).

Release Category LE1	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	9846	N/A	N/A	N/A
Plume Duration, sec	2984	2912	1156	69502
Plume Start Time, sec from SCRAM	9846	12830	15743	16898
Noble Gas Release Fraction	2.44E-02	5.86E-01	8.80E-02	1.00E-03
Iodine Release Fraction	2.38E-03	2.65E-02	9.00E-04	1.00E-04
Cesium Release Fraction	2.26E-03	2.37E-02	7.17E-04	8.34E-06

Release Category LE2	Plume-1
Category General Emergency Declaration, sec from SCRAM	3600
Plume Duration, sec	1800
Plume Start Time, sec from SCRAM	9000
Noble Gas Release Fraction	9.00E-01
Iodine Release Fraction	7.00E-01
Cesium Release Fraction	5.00E-01

Release Category LE3	Plume-1	Plume-2	Plume-3
Category General Emergency Declaration, sec from SCRAM	10800	N/A	N/A
Plume Duration, sec	7200	14400	36000
Plume Start Time, sec from SCRAM	14400	21600	36000
Noble Gas Release Fraction	2.00E-01	3.00E-01	5.00E-01
Iodine Release Fraction	4.00E-03	5.00E-03	1.00E-03
Cesium Release Fraction	4.00E-03	5.00E-03	1.00E-03

Release Category SE-1	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	9846	N/A	N/A	N/A
Plume Duration, sec	2635	4856	2866	66197
Plume Start Time, sec from SCRAM	9846	12481	17338	20203
Noble Gas Release Fraction	1.26E-02	2.15E-02	5.00E-03	1.30E-03
Iodine Release Fraction	9.47E-07	4.58E-03	5.00E-05	7.00E-05
Cesium Release Fraction	8.68E-07	4.51E-03	4.08E-05	2.42E-05

Release Category SE-2	Plume-1
Category General Emergency Declaration, sec from SCRAM	7200
Plume Duration, sec	25200
Plume Start Time, sec from SCRAM	30600
Noble Gas Release Fraction	9.00E-01
Iodine Release Fraction	7.00E-04
Cesium Release Fraction	5.00E-04

Release Category SE-3	Plume-1	Plume-2	Plume-3
Category General Emergency Declaration, sec from SCRAM	50400	N/A	N/A
Plume Duration, sec	43200	28800	86400
Plume Start Time, sec from SCRAM	79200	122400	151200
Noble Gas Release Fraction	1.50E-01	2.00E-01	6.50E-01
Iodine Release Fraction	4.00E-03	7.00E-03	2.00E-03
Cesium Release Fraction	4.00E-03	7.00E-03	2.00E-03

Release Category LL-3	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	0	N/A	N/A	N/A
Plume Duration, sec	5998	2804	86400	86400
Plume Start Time, sec from SCRAM	1541	7538	10343	122882
Noble Gas Release Fraction	1.07E-04	5.60E-05	4.22E-03	6.85E-01
Iodine Release Fraction	2.31E-05	4.70E-06	6.08E-05	2.73E-03
Cesium Release Fraction	2.24E-05	4.52E-06	2.59E-05	1.32E-03

Release Category LL-4	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	0	N/A	N/A	N/A
Plume Duration, sec	637	3481	86400	86400
Plume Start Time, sec from SCRAM	1847	2484	5965	129218
Noble Gas Release Fraction	6.43E-07	2.86E-05	6.70E-03	9.93E-01
Iodine Release Fraction	1.06E-07	1.75E-06	2.81E-05	3.51E-01
Cesium Release Fraction	9.13E-08	1.33E-06	8.45E-06	2.21E-01

Release Category LL-5	Plume-1
Category General Emergency Declaration, sec from SCRAM	266400
Plume Duration, sec	3600
Plume Start Time, sec from SCRAM	320400
Noble Gas Release Fraction	1.00E+00
Iodine Release Fraction	1.00E-03
Cesium Release Fraction	1.00E-03

Release Category INTACT1 (a)	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	6826	N/A	N/A	N/A
Plume Duration, sec	378	2772	19858	86400
Plume Start Time, sec from SCRAM	9011	9389	12161	32018
Noble Gas Release Fraction	3.26E-07	1.04E-05	1.95E-04	3.25E-03
Iodine Release Fraction	4.98E-09	7.01E-08	1.94E-08	7.50E-09
Cesium Release Fraction	4.16E-09	5.21E-08	1.09E-08	1.18E-09

Release Category INTACT2 (a)	Plume-1	Plume-2	Plume-3	Plume-4
Category General Emergency Declaration, sec from SCRAM	6826	N/A	N/A	N/A
Plume Duration, sec	378	2772	19858	86400
Plume Start Time, sec from SCRAM	9011	9389	12161	32018
Noble Gas Release Fraction	3.26E-06	1.04E-04	1.95E-03	3.25E-02
Iodine Release Fraction	4.98E-08	7.01E-07	1.94E-07	7.50E-08
Cesium Release Fraction	4.16E-08	5.21E-07	1.09E-07	1.18E-08

Note (a): Sum of INTACT1 and INTACT2 risks are reported in ER as release category INTACT risk. ER Table F.3.4.3-2 frequency for category INTACT is sum of INTACT1 and INTACT2 frequencies; for reporting, ER Table F.3.4.3-2 INTACT release fractions are for INTACT1, which contributes 91% of the INTACT dose risk.

SAMA RAI 2h

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

h. With respect to F&O 3, discuss how this resolution addresses the Peer Review Finding aspect regarding the training, qualification, and familiarity of plant staff with the long-term operation of the turbine-driven (TD) emergency feedwater (EFW) pump.

NextEra Energy Seabrook Response to SAMA RAI 2h

As stated in the resolution to F&O 3, the battery lifetime was recalculated and battery life is up to 12 hours with load shedding/cross tie actions. These actions “preserve” the 125V DC vital bus power needed to control the steam-driven EFW pump and provide power to necessary instrumentation (e.g., SG level). Therefore, during an extended station black-out condition with successful DC power, long term control of SG water level and heat sink uses the normal control room instrumentation and procedures for which the operators are trained and familiar with.

RAI Section 3

SAMA RAI 3a

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

a. The ER does not address the status of one plant improvement identified in the IPEEE SER: modification of several exterior doors so that they will be able to withstand the design pressure differential resulting from high winds. Discuss the status of this improvement and, if not already implemented, provide a cost-benefit evaluation of a SAMA that addresses this improvement recommendation.

NextEra Energy Seabrook Response to SAMA RAI 3a

The door modifications mentioned in the IPEEE submittal and associated SER were completed in 1993. Therefore, the door modifications need not be evaluated for cost-benefit in the SAMA. The doors subject to the modification included doors: P-900 (RHR Vault El. 20'-8"), P-604 (PAB Roof El. 81'-0"), EF-400 and EF-404 (EFW Pump Room El. 27'-0") and EM-210 (Main Steam Pipe Chase, El. 3'-0"). The modification to these doors included replacement of the mortise locksets with higher capacity locksets.

SAMA RAI 3b

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

b. ER Section F.3 explains that internally initiated fire events are included in the current PRA and that the fire risk analysis has been updated since the IPEEE. There is no discussion of the fire PRA method in the ER and no presentation of the important fire areas and their contribution to Level 1 or fire CDF. In light of this, provide:

    a) A description of the fire risk analysis method including to what extent the method was based on NUREG/CR-6850. In the response, specifically discuss how fire-induced ISLOCAs are addressed, how fire-induced containment impact is addressed, and model conservatisms. In the response, specifically address whether the RRWs listed in Table F.3.2.1-2 include fire-induced sequences where a component required to maintain containment integrity could be failed by the fire itself rather than randomly and independently from failures that induce core damage.

    b) Fire PRA results including revised fire zone contribution to the CDF. Additionally, explain the reason for significant differences between the IPEEE and updated Fire PRA results.

NextEra Energy Seabrook Response to SAMA RAI 3ba

A. Fire Risk Analysis Methodology

The most recent update to the Seabrook Station fire PRA was done in 2004, prior to the publication of NUREG/CR-6850. The methodology used to assess the fire risk at Seabrook Station was the most current available at that time. The fire risk analysis consists of the following general steps:

1. Definition of fire areas to be analyzed - The Appendix R fire areas and zones were used as a basis for this study since they include all safety related areas and some additional areas. Some areas were combined for this analysis in order to streamline the screening process.

2. Development of a spatial data base of equipment and cable routing for the defined fire areas - A record for each key component within each fire area was created, which included the component location, power and control cable location, motive and control power supplies and locations, etc. Appendix R was the principle source for equipment location and cable routing. Information for equipment not addressed in Appendix R was obtained from plant arrangement drawings, walkdowns, and the CASP computer code cable routings.

3. Qualitatively screening out any areas which did not contain equipment or cables which could cause or mitigate an initiating event.

4. Development of fire ignition frequencies for those areas that had not been qualitatively screened out - The fire ignition frequencies were developed by reviewing the latest industry fire frequency data for components and areas and applying them to Seabrook Station areas based on actual components in the defined fire areas.

5. Quantitatively screening out areas based on the area fire ignition frequencies developed in Step 4 - For this screen, it is conservatively assumed that all equipment and cables in the area could fail at the calculated frequency. The resulting fire initiating events are compared to the existing internal events. If their contribution to the same internal event is negligible (less than about five percent), they are screened from the further analysis. If all possible fire initiating events in a specific area are screened out, the entire area is considered to be quantitatively screened out.

6. Areas remaining after the quantitative screening receive detailed hazards analysis. The methodology for the hazards analysis is based upon the quantitative fire hazard equations and FIVE Methodology. The analysis includes:

   - Identifying the location of critical equipment (i.e., target sets) and the severity of a fire needed to disable this equipment.

   - Estimating the frequency of a disabling fire based on ignition sources, estimated severity factor and detection and suppression system availability.

7. Impacts on the plant from failures of those target sets that the hazards analysis identified as potentially important were modeled in detail. This included evaluating human actions needed to respond to the fire, such as control room evacuation and operation of equipment from remote locations.

B. Fire-induced ISLOCA & Containment Impact

The potential impacts from fire hazard on the containment function, including ISLOCA bypass sequences, are addressed below. As described below, the only credible impact of fires on containment performance is to fail a single train of isolation. For isolation failure of one or more valves of a single train, either redundant isolation would be available or the ability to remove power from fail-closed valves to provide isolation. The frequency of fires that could cause this level of damage is low enough, compared to hardware failures, to not contribute significantly to containment isolation failure. As a result, no fire impacts on containment isolation components are included in the PRA.

Containment performance was evaluated in three areas, with regard to the fire hazard:

1. Containment structure. Fires could have no impact on the containment structural integrity.

2. Containment response to core damage event. Fire-initiated core damage events would have the same impact, with regard to containment response, as internal initiated events. This impact is handled in the Containment Event Tree.

3. Containment isolation/bypass failure. This is the focus of the evaluation described below.

The potential for containment isolation/bypass failure has been evaluated for each containment penetration. The important isolation valves are discussed below.

Cables for containment isolation valves are routed through two distinct paths. Cables for isolation valves located inside the containment building travel through one of the two train-related electrical tunnels. Cables for valves in the mechanical penetration area travel through the following areas; the PAB electrical chase, duct bank DB-3B, the RHR vaults and the mechanical penetration area. Therefore, a fire in any of these areas could only impact the set of isolation valves inside containment or the set outside containment, but not both. The only area where isolation valves both inside and outside containment could be affected would be in the control room or the cable spreading room, and in this event, important isolation valves could be controlled locally at the valve or from the remote shutdown panels.

Fires can affect valves in several ways. Failure of MOV power cables will fail the valve in its current position. If the valve can be accessed, the position could be changed manually. A hot short to an MOV control cable can possibly result in a change in position of the valve. Shorts to ground of control cables for AOVs or SOVs will move the valve to its failed position just as loss of control power to the circuit. Hot shorts to de-energized control circuits can also result in inadvertent valve movement, which could be terminated by removing power to the affected control circuit. Hot shorts to three phase power cables would require multiple contacts and are not considered credible.

Because during operation a number of isolation valves to containment are open, the most likely adverse affect of a fire would be inadvertent isolation of a system. The letdown system has several fail closed AOVs which could isolate letdown with failure of their control cables. It is not credible for all three valves to hot short. The excess letdown system does have AOVs in the closed position. These valves fail closed; therefore, a hot short in 3 valves in series would be required to open a path out of containment and they could easily be closed by removing power to the control circuits. The PCC flow to the thermal barrier heat exchangers has fail-open AOVs outside of containment, but the PCC flow is not open to the RCS, and additional isolation between the RCS and PCC is provided inside containment.

The large RHR suction line MOVs which are modeled for V-sequence events are normally closed and their breakers are locked open at-power. Therefore a fire could not cause them to spuriously open.

The RCP seal return line isolation valves (penetration X-37) are MOVs, which fail as-is on loss of AC power. Fires that cause loss of AC power are modeled to account for this small containment penetration line failing open (given failure of operator action to manually close the outside valve).

Other large isolation valves, such as the containment on-line purge valves are normally closed and will fail closed on loss of Instrument Air or AC power.

The conclusion of this review is that the only impact of fires on containment performance is to fail a single train of isolation. For isolation failure of one or more valves of a single train, either redundant isolation would be available or the ability to remove power from fail closed valves to provide isolation. The frequency of fires that could cause this level of damage is low enough, compared to hardware failures, to not contribute significantly to containment isolation failure.

C. Model Conservatism

Fire risk analysis contains a number of conservative modeling steps. Perhaps the most significant is the postulation that small fires, typical of the generic fire events database, can actually grow to cause the maximum damage assumed. Because it is difficult to model the specific fire growth scenario for each potential fire source, the method uses conservative assumptions to allow the fire risk to be bounded. In general, these fire sequences have such low frequencies and such large uncertainties that it is difficult to determine the impact of the conservatism on the overall fire CDF.

NextEra Energy Seabrook Response to SAMA RAI 3bb

The following table summarizes the fire CDF contribution by fire area from the 2009 Update & the IPEEE:

Seabrook Fire Area Contribution to CDF		
Fire Location (Fire Zone / Area ID)	**2009 Update Contribution to Fire CDF**	**IPEEE (1990) Contribution to Fire CDF**
Control Room (CB-F-3A-A)	52 %	34 %

Seabrook Fire Area Contribution to CDF		
Fire Location (Fire Zone / Area ID)	**2009 Update Contribution to Fire CDF**	**IPEEE (1990) Contribution to Fire CDF**
Essential Switchgear Rooms (CB-F-1A-A, CB-F-1B-A)	41 %	18 %
Turbine Building (TB-F-1A-Z, ... TB-F-3-Z)	5 %	13 %
Primary Auxiliary Building (PAB-F-1A-Z, ... PAB-F-3C-Z)	2 %	26 %
Ocean Service Water Pumphouse (SW-F-1A-Z, ... SW-F-1E-Z, SW-F-2-0)	1 %	9 %
Electrical Tunnels (ET-F-1A-A, ... ET-F-1D-A)	<1 %	<1 %
FIRE CDF TOTAL	1.7e-6 / yr	1.2e-5 / yr

The 2009 fire CDF is approximately 1.7e-6/yr, a 14% contribution to total CDF. This is in comparison to the IPEEE fire CDF of 1.2e-5, an 11% contribution to the total CDF in 1990. Thus, while the fire CDF has decreased significantly from 1990 to 2009, the relative contribution to CDF total has remained relatively constant.

The 2009 Update differs from the IPEEE model in the following areas: (1) the inclusion of the current plant data and procedures, (2) the performance of detailed walkdowns verifying locations of the major fire sources and important targets, (3) the availability of the new EPRI Fire Database which includes fire records through December 2000, (4) new severity factors were evaluated for cabinets, pumps, control room panels and transients, (5) the quantitative screening results were revisited, (6) the new data on the cabinet release rates were included in the fire hazard evaluation, and (7) total area heat-up was considered in the analysis and evaluated by using quantitative fire hazard equations or CFAST software. The reduction in fire CDF is due to more detailed modeling of the fire areas shown to be important in the IPEEE, using the factors described above. No single change explains the decrease in fire CDF.

SAMA RAI 3c

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

   c. In the description of PRA model changes made since 1993, on pages F-20 through F-28 of the ER, at least one instance of a major update to the seismic PRA was indicated (i.e., on page F-27).

However, there is no discussion of the updated seismic PRA methodology in the ER. In light of this, provide:

a) A description of the seismic risk analysis method including the seismic hazard curves being modeled. Additionally, provide a discussion of model conservatisms.

b) Seismic PRA results including revised seismic initiator contribution to the CDF. Additionally, explain the reason for significant differences between the IPEEE and updated Seismic PRA results.

NextEra Energy Seabrook Response to SAMA RAI 3ca

The current seismic PRA analysis was updated from the IPEEE model in 2005. The seismic PRA was performed using the following methods:

Hazard Analysis - determination of the frequency of ground motions of various magnitudes at the site. Seabrook Station site specific probabilistic hazard curves were developed for the SSPSA (1983). However, the present PRA model has been updated to the more recent EPRI hazards. This was done because, while the methodology and experts used in developing the EPRI hazard are essentially the same as the SSPSA, the EPRI hazard is more recent and the EPRI uniform hazard spectrum (UHS) developed for the Seabrook Station site is more realistic than that used in the SSPSA. The EPRI UHS was the basis for the revised equipment fragilities. The sensitivity of different hazard inputs, including the SSPSA and LLNL hazard curves is addressed.

Fragility Analysis - determination of the seismically initiated ground acceleration at which plant structures and components are predicted to fail. The probabilistic estimates of seismic capacity of structures and components have been updated to reflect component-specific fragility information and a site-specific UHS. Structures and components with a median capacity of 2.5g or greater were screened out of the analysis. The sensitivity of this screening level is addressed.

Seismic Model (Systems Analysis) – this involves several tasks, from identifying the equipment list that needs fragility analysis to integrating the results of the above elements into the PRA model and quantifying risk. The RISKMAN software is used to combine hazard and fragility inputs, develop initiating event frequencies, and fragility values at discrete hazard levels to yield conditional system failure probabilities. These are used to provide initiating event and split fraction values for the plant model. The PRA model event trees used for internal events are used to integrate seismic initiators and seismic-initiated component failures with random (non-seismically caused) hardware failures and maintenance unavailability. A separate event tree "HAZARD" is included in the plant model. The HAZARD tree models the seismic failure contribution of components conditional on the seismic initiating event. Then, all the support and plant response event trees are conditional on the initiator and equipment fragilities in the HAZARD tree. In this way, seismic failures are treated as other failures and are combined with non-seismic failures as appropriate based on the model logic.

The most recognizable conservatism in the seismic model is the use of complete correlation of the fragility between identical components. An example is both EDGs are assumed to fail at the same seismic hazard level.

NextEra Energy Seabrook Response to SAMA RAI 3cb

The following table summarizes the seismic CDF contribution by initiator from the 2009 Update & the IPEEE:

Initiating Group	2009 Update Contribution to Seismic CDF	IPEEE (1990) Contribution to Seismic CDF
TRANS Total	78%	65%
ATWS Total	11%	24%
LLOCA Total	10%	11%
Seismic CDF TOTAL	3.1e-6 / yr	1.2e-5 / yr

The dominate seismic hazard level for the 2009 Update is the 0.7g earthquake, which accounts for 35% of the seismic CDF. The dominate seismic hazard level for IPEEE was also the 0.7g earthquake, which accounted for 36% of the seismic CDF.

A number of changes were made in the 2005 Update that revised the IPEEE seismic model. The most significant changes include the following:

- The fragility screening of equipment was extended from >2.0g to >2.5g for several reasons. The frequency of exceeding 2.5g is less than 1E-7/year, which is considered a small change in risk and an appropriate cutoff for the seismic hazard. Also, with improved more realistic fragilities, there were fewer components to model. Seabrook has added supplemental diesels, which are expected to reduce seismic station blackout risk. Thus, there was a need to consider extending the seismic initiating events (hazard) to higher accelerations to better capture seismic risk. As a result, the PRA model was revised to consider seismic initiating events and equipment fragility up to 2.5g.

- A plant-specific uniform hazard spectrum was adopted and used to update the equipment fragilities. The original UHS used in the fragility analysis was conservative based on current understanding of the hazard frequency spectrum. Adjustments to the calculation for equipment fragilities resulted in increased equipment capacities. However, several new component fragilities were added to the seismic PRA model in the 2005 update. There were cases where equipment was originally screened because its fragility was higher than other equipment with the same impact. With the update, this truncation was not always appropriate. Also, extending the screening value to 2.5g resulted in the addition of equipment to the model.

- Supplemental emergency power supply (SEPS) diesel generators had been added to the plant design and are important to the reduction of station blackout risk. Thus, a component-specific seismic fragility was developed for SEPS and added to the PRA model.
- The modeling and documentation of operator actions credited in the seismic PRA were improved.

SAMA RAI 3d

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

   d. ER section F.3.1.2.2 explains that the NUREG-1407 procedure for screening high wind, flooding, and other external (HFO) events was used to conclude that contribution to the Seabrook Station total CDF from HFO is less than 1.0E-06 per year. However, the IPEEE discusses two external events that have a CDF contribution greater than 1.0E-06 per year. While the ER addresses one of these events, flooding caused by a storm surge, it does not address the second: a truck crash into the SF6 transmission lines having an IPEEE CDF contribution of 1.4E-06 per year. Discuss whether this event is addressed by a loss of off-site power initiator in the current PRA model and, if not, assess the impact of this event on the results of the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 3d

The external initiating event involving a truck crash into the SF6 transmission lines (previous initiator TCTL), has been screened from the PRA model based on the installation of jersey barriers associated with security upgrades. These barriers are located before the access road parallels the SF6 bus duct, which was the "target" for initiator TCTL. Now a truck must completely stop and have a security escort before proceeding into the protected area. Additional guard rails, which were added a number of years ago, also limit the possibility of a slow speed truck crash impacting the transmission lines. As a result, there is no impact on the SAMA evaluation.

SAMA RAI 3e

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

   e. While the ER and IPEEE address flooding resulting from a storm surge caused by a hurricane, neither appears to specifically address the impact of hurricane-force winds. In light of the potential for hurricanes and "Nor'easters" hitting the Seabrook Station, assess the risk of hurricane-force and the impact of that risk on the results of SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 3e

An assessment of high wind hazards was performed and documented in Section 5.1 of the Seabrook Station IPEEE. The assessment consisted of a review of UFSAR site design basis for high winds and tornadoes against SRP criteria and site-specific weather data. High wind hazards were screened from further detailed assessment based on review of the SRP criteria against Seabrook Station's design. All seismic category I structures exposed to high wind forces are designed to withstand wind velocity of 110 mph at 30 ft above nominal ground elevation. In addition, tornado loads are based on a 290 mph tangential wind velocity and a 70 mph translational wind velocity, with a simultaneous atmospheric pressure drop of 3 psi at a rate of 2 psi per second. Plant impacts from hurricanes and northeasters are considered bounded by these stringent design requirements. The confirmatory walkdowns performed for high wind hazards identified the need to modify several exterior doors so that they would be able to withstand the design pressure differential resulting from high winds. These door modifications are complete - refer to NextEra Energy Seabrook Response to RAI 3a. Based on the above, the risk to plant structures from high winds due to hurricanes and northeasters is not significant and there is no impact to the SAMA evaluation.

SAMA RAI 3f

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

f. ER Section E.5.5.3 does not identify any reviews of the fire or seismic PRAs. Identify any internal and external reviews of the fire and seismic PRAs, discuss how each finding was resolved, and provide an assessment of the impact of any unresolved findings on the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 3f

The fire and seismic portions of the PRA were reviewed extensively when originally performed in 1983, when revised for the IPEEE and, and when revised in the 2005 update. These reviews were typical internal technical reviews performed for any PRA model revision. No significant comments were documented from these reviews. These reviews were not a formal Peer Review with findings and observations.

SAMA RAI 3g

3) Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

g. NRC Information Notice 2010-18, Generic Issue 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," informs licensees that updated seismic data and models show increased seismic hazard estimates for some plants. The NRC report cited in the information notice estimates the seismic CDF for Seabrook Station to be between 5.9E-06 and 2.2E-05 per year using 2008 U.S. Geologic Survey (USGS) seismic hazard curves. Depending upon the contribution of seismic CDF to the total CDF, the impact of an increased seismic frequency could be significant enough to increase the estimate of the maximum attainable benefit, based on the current seismic frequencies employed for the Seabrook Station seismic CDF (to be provided via RAI 1.b), such that previously non-cost-beneficial SAMAs could become cost-beneficial. As the seismic CDF is applied to non-seismic-related as well as seismic-related SAMAs, this could affect the determination of "cost-beneficiality" for non-seismic-related as well as seismic-related SAMAs. Provide an assessment of the impact of the updated seismic CDF for Seabrook Station on the SAMA evaluation, including the basis for the increased seismic frequency that is chosen if other than the maximum of the range (2.2E-05 per year).

NextEra Energy Seabrook Response to SAMA RAI 3g

It is noted in the NRC Information Notice 2010-18 that NRC's risk assessment results for Generic Issue 199 ("Implications of Updated Probabilistic Seismic Hazard Estimates in Central and eastern United States on Existing Plants") included the following Limitations of the Risk Methodology and Data Used:,

"The approach used to estimate SCDF in the Safety/Risk Assessment is highly sensitive to the inputs used. While work to date supports a decision to continue to the GIP Regulatory Assessment Stage; the methodology, input assumptions, and data are not sufficiently developed to support other regulatory decisions or actions".

Given the preliminary status of the in-progress GI-199 study and results, use of these preliminary GI-199 results to the SAMA evaluation may not be meaningful. Nevertheless, using NRC's suggested approach discussed in the RAI, candidate SAMAs that were originally determined to be non-cost-beneficial based on their cost exceeding the plant's "maximum attainable benefit" (MAB) have been reassessed for "sensitivity" to their cost benefit value when considering the potential increase in baseline seismic CDF as presented in the latest GI-199 studies.

The approach taken in this assessment is as follows:

Seabrook Station baseline CDF from (at power) internal and external events: 1.17E-05/yr (SSPSS-2009)

Seismic contribution to CDF: 3.11E-06/yr (~26.5% of total CDF)

Estimated maximum seismic contribution from GI-199: 2.2E-05/yr

Increase factor to apply to the MAB: 2.6

(1.17E-05/yr – 3.11E-06/yr + 2.2E-05/yr) / 1.17E-05/yr = 2.6 factor increase in CDF

The factor of 2.6 increase results in the following MAB estimates:

Case	Base Case (7% Discount)	3% Discount	8.5% Discount	41 Yr Period	95% UB
Orig. MAB	$0.818M	$1.28M	$0.729M	$1.22M	$1.56M
MAB at 2.6	$2.13M	$3.34M	$1.89M	$3.17M	$4.05M

The following SAMA candidates that were originally determined to be non-cost beneficial based on MAB are reassessed for their sensitivity to a new estimate of MAB at 2.6.

SAMA #56 – Install an independent RCP seal injection system, without dedicated diesel.

Assessment: Adding an independent RCP seal injection pump should improve reliability of the RCP seal injection function and this would tend to reduce the risk of RCP seal LOCA events. Installation of an independent seal injection system is anticipated to realistically cost more than $3M. However, this SAMA is similar to other Seabrook Station SAMAs, for which PRA Case RCPLOCA was used to estimate the upper bound (UB) risk reduction benefit of $176K ($457K with assumed 2.6 increase factor). Therefore, SAMA #56 is not cost-beneficial.

SAMA #65 – Install a digital feedwater upgrade.

Assessment: Adding a digital feedwater control system should improve the reliability of the feedwater and SG water level control function and would tend to reduce plant trips due to loss of feedwater. It is noted that Seabrook Station is implementing a phased digital upgrade to balance of plant control systems (including feedwater controls). The initial phase of this upgrade included a digital EHCS. Installation of the entire digital feedwater control system is anticipated to realistically cost over $30M. Therefore, SAMA #65 is not cost-beneficial.

SAMA #77 – Provide a passive secondary-side heat rejection loop consisting of a condenser and heat sink.

Assessment: Installation of a passive SG heat rejection loop with condenser would tend to result in a reduction in core damage events from loss of feedwater events. For a "passive" system to function effectively, the scope of the system would need to include some type of large isolation-type condenser positioned and sized in such a way so as to allow a passive means of decay heat removal. The installation of such a system is judged not practical at an existing nuclear power plant such as Seabrook Station. The cost of this SAMA would be in excess of $10M. Therefore, SAMA #77 is not cost-beneficial.

SAMA #90 – Create a reactor cavity flooding system.

Assessment: Installation of a cavity injection system would tend to enhance core debris cooling, reduce core concrete interaction and possibly increase fission product scrubbing. The installation of such a reactor cavity flooding system is judged not practical at Seabrook Station. For Seabrook Station, the design and implementation costs are anticipated to realistically exceed $3M to $4M. This cost is based on a range of cost information identified in Calvert Cliffs and Indian Point SAMA submittals. Therefore, SAMA #90 is judged not cost-beneficial. It is noted also that Seabrook Station currently has several proceduralized methods to ensure that water is present in the reactor cavity for quenching of core debris.

These methods include containment injection of the RWST contents and containment injection via the fire protection system through an ILRT flange (refer to SAMA #188). Therefore, it is judged that the current Seabrook Station design meets the intent of SAMA #90.

SAMA #91 – Install a passive containment spray system.

Assessment: Installation of a passive containment spray system would improve containment spray reliability and thus improve fission product scrubbing and reduce long term containment pressure challenges. The installation of a passive containment spray system is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $3M to $6M. This cost is based on cost information identified in Sharon Harris SAMA submittal. However, this SAMA is related to other Seabrook Station SAMAs, for which PRA Case CONT01 was used to estimate the upper bound (UB) risk reduction benefit of $310K ($810K if assuming a 2.6 factor increase) when assuming the containment spray system is guaranteed success. Based on the above, SAMA #91 is not cost-beneficial.

SAMA #93 – Install an unfiltered, hardened containment vent.

Assessment: Installation of a hardened containment vent would tend to increase decay heat removal capability for non-ATWS events, without scrubbing released fission products. The scope of this SAMA is to provide a decay heat release path via containment venting. At Seabrook Station, decay heat removal function to protect containment is already provided via any one of four steam generators, one of two trains of RHR and one of two trains of containment spray. Design and implementation costs associated with adding a high capacity vent (designed for decay heat removal) are judged to realistically exceed $3M. Based on the current plant design, adding yet an additional heat removal capability would not significantly reduce plant risk. This SAMA is related to other Seabrook Station SAMAs, for which PRA Case CONT01 was used to estimate the upper bound (UB) risk reduction benefit of $310K ($810K if assuming a 2.6 factor increase) when assuming the containment spray system is guaranteed success, thus eliminating a challenge to containment overpressure. Based on the above, SAMA #93 is not cost-beneficial. Seabrook Station has SAMG for containment venting at ~135 psig to protect containment structure.

SAMA #97 – Create a large concrete crucible with heat removal potential to contain molten core debris.

Assessment: This proposed SAMA infers the installation of a core catcher and cooling system in the reactor cavity. Such a design would tend to increase the reliability of cooling and containment of molten core debris, thus preventing melt-through of the base mat. The installation of such a core catcher/cooling system is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $40M to $50M. This cost is based on a range of cost information from the Indian Point, Farley and Calvert Cliff SAMA submittals. Therefore, SAMA #97 is not cost-beneficial. It is noted that Seabrook Station currently has several proceduralized methods to ensure that water is present in the reactor cavity for quenching of core debris. These methods include containment injection of the RWST contents and containment injection via the fire protection system through an ILRT flange (refer to SAMA #188). Industry severe accident progression studies show that quenching of the core melt debris with water delivered to the cavity will effectively limit the core concrete interaction. Therefore, it is judged that the current Seabrook Station design meets the intent of SAMA #97.

SAMA #98 – Create a core melt source reduction system.

Assessment: The scope of this SAMA is to increase cooling and containment of molten core debris. Refractory material would be placed underneath the reactor vessel such that a molten core falling on the material would melt and combine with the material. Subsequent spreading and heat removal from the vitrified compound would be facilitated, and concrete attack would not occur. The installation of this SAMA is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $40M to $50M. This cost is based on a range of cost information from the Indian Point, Farley and Point Beach SAMA submittals. Therefore, SAMA #98 is not cost-beneficial. It is noted that Seabrook Station currently has several proceduralized methods to ensure that water is present in the reactor cavity for quenching of core debris. These methods include containment injection of the RWST contents and containment injection via the fire protection system through an ILRT flange (refer to SAMA #188). Industry severe accident progression studies show that quenching of the core melt debris with water delivered to the cavity will effectively limit the core concrete interaction. Therefore, it is judged that the current Seabrook Station design meets the intent of SAMA #98.

SAMA #99 – Strengthen primary/secondary containment, e.g., add ribbing to containment shell.

Assessment: The scope of this SAMA is to add stiffening to the containment structure so as to reduce its probability of over-pressurization failure. As mentioned in Seabrook Station's response to RAI 1c, Seabrook Station's current containment is very large and very strong, with median failure pressure of approximately 215 psig. The installation of structural ribs to effectively increase the strength of the containment is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $10M. This cost is based on cost information from the Point Beach SAMA submittal. In addition, this SAMA is related to other SAMAs, for which PRA Case CONT01 was used to estimate the upper bound (UB) risk reduction benefit of $310K ($810K if assuming a 2.6 factor increase) when assuming the containment spray system is guaranteed success, thus eliminating a challenge to containment overpressure. Based on the above, SAMA #99 is not cost-beneficial.

SAMA #100 – Increase depth of the concrete basemat or use an alternate concrete material to ensure melt-through does not occur.

Assessment: The function of this SAMA is similar to SAMAs 97 and 98 and is focused on reducing the probability of base mat melt-through. Seabrook Station's basemat consists of approximately 10 feet of concrete. Design and implementation costs to increase the depth of concrete are judged to realistically exceed $5M. This cost is based on cost information from the Indian Point and Farley SAMA submittals. Therefore, SAMA #100 is not cost-beneficial. It is noted that Seabrook Station currently has several proceduralized methods to ensure that water is present in the reactor cavity for quenching of core debris. These methods include containment injection of the RWST contents and containment injection via the fire protection system through an ILRT flange (refer to SAMA #188). Industry severe accident progression studies show that quenching of the core melt debris with water delivered to the cavity will effectively limit the core concrete interaction. Therefore, it is judged that the current Seabrook Station design meets the intent of SAMA #100.

SAMA # 101 – Provide a reactor vessel exterior cooling system.

Assessment: The scope of this SAMA is to increase the potential to cool a molten core before it causes vessel failure, by submerging the lower head in water. Design and implementation costs of a reactor vessel external cooling system are judged to realistically exceed $3M and installation is not practical for Seabrook Station. Therefore, SAMA #101 is not cost-beneficial. It is noted that Seabrook Station currently has several proceduralized methods to ensure that the reactor cavity can be flooded to provide a means of external vessel cooling. These methods include containment injection of the RWST contents and containment injection via the fire protection system through an ILRT flange (refer to SAMA #188). Therefore, it is judged that the current Seabrook Station design meets the intent of SAMA #101.

SAMA #102 – Construct a building to be connected to primary/secondary containment and maintained at vacuum.

Assessment: The focus of this SAMA is to reduce the probability of containment over-pressurization. As mentioned in RAI 1c, Seabrook Station's current containment is very large and very strong, with median failure pressure of approximately 215 psig. The current containment design includes a "double" containment, with a negative pressure annulus between the primary and secondary containment structures to contain leakage. The installation of yet an additional structural to effectively reduce overpressure challenges to the primary containment is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $10M. In addition, this SAMA is related to other SAMAs, for which PRA Case CONT01 was used to estimate the upper bound (UB) risk reduction benefit of $310K ($810K if assuming a 2.6 factor increase) when assuming the containment spray system is guaranteed success, thus eliminating a challenge to containment overpressure. Based on the above, SAMA #102 is not cost-beneficial.

SAMA #107 – Install a redundant containment spray system.

Assessment: The focus of this SAMA is to increase containment heat removal ability. Seabrook Station currently has a redundant (two-train) containment spray and heat removal system. The installation of yet an additional containment spray system to effectively remove containment heat and reduce overpressure challenges to the primary containment is judged not practical at Seabrook Station. Design and implementation costs are judged to realistically exceed $3M to 4M. This cost is based on our original SAMA assessment and inspection of cost information from the Indian Point SAMA submittal ($61M). In addition, this SAMA is related to other Seabrook Station SAMAs, for which PRA Case CONT01 was used to estimate the upper bound (UB) risk reduction benefit of $310K ($810K if assuming a 2.6 factor increase) when assuming the containment spray system is guaranteed success, thus eliminating a challenge to containment overpressure. Based on the above, SAMA #107 is not cost-beneficial.

SAMA #110 – Erect a barrier that would provide enhanced protection of the containment walls (shell) from ejected core debris following a core melt scenario at pressure.

Assessment: The focus of this SAMA is to reduce the probability of containment failure. The installation of barrier walls to protect the containment shell from ejected corium would have minimal (if any) benefit on improving containment performance. It is noted that the reactor is located within the reactor cavity structure. This provides significant protection of the containment shell during a melt ejection. According to Seabrook Station severe accident phenomena assessments, the majority of the core remains within the cavity area and containment energetic failure is unlikely. Corium attack on the containment shell structure has not been shown to be a severe accident issue at Seabrook Station. Design and implementation costs of protection walls are judged to realistically exceed $3M to $4M and would not be practical for Seabrook Station. Based on the above, SAMA #110 is not cost-beneficial.

SAMA RAI 4a

4) Provide the following information concerning the Level 3 analysis:

   a. Provide the breakdown of the baseline population dose-risk (person-rem/yr) and offsite economic cost-risk (OECR in $/yr) by release category and the total.

NextEra Energy Seabrook Response to SAMA RAI 4a

The following table presents the breakdown of the baseline population dose risk and offsite economic cost risk by accident category and the total.

Accident Category:	LE-1	LE-2	LE-3	SE-1
Population dose risk (person-rem/yr) 0-50 miles	1.01	0.59	0.0033	0.80
Offsite economic cost risk ($/yr) 0-50 miles	1,234	119	9	2,012
Accident Category:	**SE-2**	**SE-3**	**LL-3**	**LL-4**
Population dose risk (person-rem/yr) 0-50 miles	0.16	4.31	2.98	0.64
Offsite economic cost risk ($/yr) 0-50 miles	197	12,559	4,106	3,003
Accident Category:	**LL-5**	**INTACT**		**Total**
Population dose risk (person-rem/yr) 0-50 miles	0.22	0.0022		10.70
Offsite economic cost risk ($/yr) 0-50 miles	298	0.00		23,534

The table shows that 40% of the total baseline dose risk and 53% of the cost risk is from the highest risk category, SE-3. 68% of the total baseline dose risk and 71% of the cost risk is from the two highest risk categories, SE-3 and LL-3.

SAMA RAI 4b

4) Provide the following information concerning the Level 3 analysis:

b. ER Section F.3.4.3 explains that the Cobalt inventory was based on the MACCS2 sample problem A, multiplied by the ratio of the Seabrook Station projected future power to the reference power (3659 MW / 3412 MW). The ER also states that the core inventory was estimated using ORIGEN2.1. Clarify why the cobalt inventory required correction. The statement is confusing in that: 1) if a Seabrook Station specific calculation was performed, why was correcting the cobalt required and 2) if sample problem A was scaled for cobalt, why not for iodine? If a Seabrook Station specific core inventory was not calculated, quantitatively discuss the impact of long-lived isotopes that are cycle specific (such as Sr-90, Cs-134 and Cs-137) and not just power-related.

NextEra Energy Seabrook Response to SAMA RAI 4b

A Seabrook-specific core inventory was calculated using ORIGEN2.1. The calculation included all of the nuclides which were part of MACCS Sample Problem A (and many other nuclides as included in ER Table F.3.1), except Cobalt-58 and -60. The ORIGEN fission product calculation results did not provide detailed isotope inventories of Cobalt-58 and -60 because Co-58 and Co-60 are not core fission products, rather they are activation products from the stainless steel and Inconel® components of the RCS pressure boundary materials. For analysis completeness, the isotope inventories of Co-58 and Co-60 were added to the calculated Seabrook specific core inventory. The basis for the Cobalt isotopes' inventory was the MACCS Sample Problem A inventory, corrected by the ratio of Seabrook's power level to the MACCS Sample Problem A power level. All other nuclides are represented by their Seabrook specific core inventory.

Adding the Cobalt inventory (as described above) to the ORIGEN2.1-calculated Seabrook specific core inventory, increases both the total baseline population dose risk and offsite cost risk by 0.1%.

SAMA RAI 4c

4) Provide the following information concerning the Level 3 analysis:

c. Sensitivity analyses are presented in ER Section F.8.4. Provide a quantitative discussion of the results of each of the sensitivity analyses (i.e., provide the percent change in population dose-risk and OECR). Also, discuss the sensitivity of the SAMA results to the population projection assumptions.

NextEra Energy Seabrook Response to SAMA RAI 4c

The following table provides the percent change in total population dose risk and offsite economic cost risk (OECR) for each sensitivity analysis.

Seabrook Station SAMA Sensitivity Results			
Parameter (MACCS Input Parameter in CAPS)	**Input Discussion**	**Ratio to 50-Mile Baseline Population Dose/Cost Risk**	**Output Discussion**
Annual Met Data Set	Each year 2004-2008	Dose = 87% (2007) to 95% (2004) Cost = 88% (2008) to 97% (2004)	2005, maximum dose risk and cost risk year, chosen as baseline.
Release Height, DPLHITE	Baseline assumed release from top of containment vessel. Releases at ground-level, 25% up containment, 50% up containment and 75% up containment considered.	Dose = 97% to No change (note a) Cost = 96% to 99%	Decrease in release height increases near-release deposition. Larger downwind population affected by relatively depleted plume. Minimum risks for ground-level release, increasing with increasing release height to top of containment.
Release Heat, DPLHEAT	Baseline assumed no heat (ambient). 1 and 10 MW heat released with each release plume segment for each accident category.	Dose= 88% to 98% Cost = 91% to 99%	Buoyancy associated with increasing heat results in less ground-level consequences near the release. The risk from some accident categories (e.g., LE-1, LE-2) is concentrated near the release, resulting in decreasing risk with increasing release heat; the risk important category, SE-3, does not exhibit this behavior. Total risk increases with decreasing heat.
Wake Effects, SIGYINIT, SIGZINIT	Baseline determined from containment building. Uncertainty due to proximity of other buildings. Base case wake size halved and doubled.	Dose = 99% to 101% Cost = No change to 101%	Minor changes very near release. Smaller wake results in less plume dispersion near the release. Halving wake size results in maximum risk
Evacuation Speed, ESPEED	One-half and double base case evacuation speed.	Dose = 96% to 103% Cost = No change	Increases in dose risk as evacuation speed decreases. 0-10 mile risk is minor contributor to 50-mile risk.
Evacuation Preparation Time, DLTSHL	Base case was 2 hours (MACCS sample problem A) One-half and	Dose = 91% to 98% Cost = No change	Dose generally increases (small changes) or remains the same with increasing preparation time. For categories with major releases early,

Seabrook Station SAMA Sensitivity Results			
Parameter (MACCS Input Parameter in CAPS)	**Input Discussion**	**Ratio to 50-Mile Baseline Population Dose/Cost Risk**	**Output Discussion**
	double base case preparation period considered (with no change in evacuation speed).		the dose can decrease with increasing preparation time if evacuation and plume release are simultaneous; in such a case the dose while sheltered (preparing to evacuate) can be less than the dose while evacuating. The larger total dose risk reduction corresponds with doubling of preparation time. Changing preparation time had a minor effect on most accident category risks, but larger effect on categories with early releases whose risk is concentrated near the release (e.g, LE-1, LE-2). The risk important category, SE-3, exhibits less than 0.5% change with these changes in preparation times.
Warning to Evacuate (General Emergency Declaration) Time, OALARM	Emergency declaration dependent on accident progression; core uncovery from MAAP simulations used as declaration marker. One-half and double base case preparation period considered.	Dose = 94% to 97% Cost = No change	Similar behavior as changes in Evacuation Preparation Time (see above). The risk important category, SE-3, exhibits less than 0.5% change with decrease in alarm time but a 6% increase with a doubling of alarm time (from 14 hours to 28 hours) because evacuation would then coincide with a portion of the release.
Fraction of Population Evacuating, EZWTFRAC, EZLASMOV	An important contributor to category SE-3 is a seismically induced station blackout. Sensitivity considers that the population does not evacuate during an SE-3 occurrence.	Dose = 104% Cost = No change	No evacuation for accident category SE-3 results in a dose-risk increase in that category of 9%. The increase on total dose-risk reflects the fraction due to SE-3
Meteorology specification in last spatial segment,	Rainfall imposed at all times from 40 to 50 miles from release to force	Dose = 86% Cost = 83%	Entire decrease is due to removing perpetual rainfall (wet deposition) and specifying measured meteorology in ring from 40 to 50 miles from site.

Seabrook Station SAMA Sensitivity Results			
Parameter (MACCS Input Parameter in CAPS)	**Input Discussion**	**Ratio to 50-Mile Baseline Population Dose/Cost Risk**	**Output Discussion**
LIMSPA	conservative population exposure for base case. Sensitivity allows 40-50 mile meteorology to temporally follow the onsite meteorology.		The baseline modeling conservatism of specifying rainfall in the spatial ring from 40-50 miles is seen to more than balance any increases that might be due to alternative specification of release parameters.

Note (a) - "No change" indicates < 0.5% change in risk.

The population distribution was exponentially projected to 2050 by applying the county (or counties) specific growth rate applicable to each of the 160 population sectors (16 directions * 10 distance rings). As population increases both dose and offsite cost risks increase. A linear population projection would result in a lower 2050 population projection and thus lower risks. See RAI response 4h for further discussion of population projections.

SAMA RAI 4d

4) Provide the following information concerning the Level 3 analysis:

d. Three SECPOP2000 code errors have been publicized, specifically: 1) incorrect column formatting of the output file, 2) incorrect 1997 economic database file end character resulting in the selection of data from wrong counties, and 3) gaps in the 1997 economic database numbering scheme resulting in the selection of data from wrong counties. Address whether these errors were corrected in the Seabrook Station analysis. If they were not corrected, then provide a revised cost-benefit evaluation of each SAMA with the errors corrected.

NextEra Energy Seabrook Response to SAMA RAI 4d

These SECPOP errors were corrected in the Seabrook Station analysis.

(1) MACCS2 requires spatially distributed agriculture and economic data (the fraction of land devoted to farming, annual farm sales, fraction of farm sales attributed to dairy production, and property values of farm and non-farm land). The SECPOP output file (MACCS input file) containing this information was in a different format than the MACCS code expects. The SECPOP output file was modified to conform to MACCS input requirements.

(2) and (3) SECPOP2000 accesses data from the 1997 National Census of Agriculture. The version 3.12.01 data file accessed by SECPOP2000 for that information, County97.dat, was modified to correct two errors that caused SECPOP to select data for incorrect counties. These errors are sometimes referred to as the missing notes parameter error (incorrect database file end character) and the missing county numbers error (gaps in the database numbering scheme).

SAMA RAI 4e

4) Provide the following information concerning the Level 3 analysis:

e. ER Section F.3.4.3 states that release fractions for accident categories LE-2, LE-3, SE-2, SE-3 and, LL-5 were taken from Seabrook Station original analyses and all others were from Seabrook Station MAAP simulations. Clarify what this means, and specifically address how release fractions were developed for the original analyses.

NextEra Energy Seabrook Response to SAMA RAI 4e

The release fractions for release categories LE-2, LE-3, SE-2, SE-3, and LL-5 are based on an assessment of release fractions from the original analyses to support the Seabrook Station Probabilistic Safety Assessment (SSPSA). The basis for these original release category source terms is provided below.

The 2009 PRA model is currently in the process of being updated and is scheduled to be issued in 2011. The scope of the PRA update will include a reassessment of source terms along with update of other PRA elements, e.g., update to pre-initiator (latent) human actions. Based on preliminary update results, including more current source terms, no changes to the overall SAMA conclusions are expected. An update to the SAMA evaluation will be provided in the next ER annual report.

LE-2, Release S7A-R: This release category contains sequences involving a large containment bypass. The sequence is identified as the "V-sequence" based on WASH-1400 terminology. The release path explicitly considered is a RHR pipe break in the RHR vaults as a result of failure of the RHR MOV isolation valves which pressurizes the low pressure RHR system to the RCS pressure. The break elevation is above the water level accumulated from discharge of the RCS and RWST inventories into the vault. The release will not be scrubbed in this case. The release fractions and timing are based on WASH-1400, Table 5-1, PWR-2 release category.

LE-3, Release S6-R: This release category contains sequences involving a large containment isolation failure as a result of the purge valves failure to close. It also includes sequences with large pre-existing leaks. The source term release fractions are based on an IDCOR MAAP analysis for the Zion plant. Based on the design comparison between Seabrook and Zion, the IDCOR analysis was adopted for Seabrook. The IDCOR analysis employed a SBO sequence with a seal LOCA and an isolation failure. The IDCOR analysis is a single puff release, which was converted to a three puff release. The start timing for the first puff is based on IDCOR analysis. The durations and start time for the remaining puffs is based on a sequence with a SLOCA and open 8" purge valves.

SE-2, Release S7B-R: This release category contains sequences involving a small containment bypass. The release path explicitly considered is a RHR pump seal failure due to over-pressurization of the RHR system as a result of failure of RCS/RHR MOV isolation valves. The failure results in the discharge of the RWST into the RHR vault at a rate greater than the 50 gpm capacity of the RHR vault sump pumps. The release will be scrubbed by a subcooled pool of water in this case. The release fractions are based on a realistic estimate of the decontamination factor of the pool. The start timing is based on the Seabrook specific MAAP analysis for the V-sequence.

SE-3, Release S2-R: This release category contains sequences where the containment fails with an early "Type-A" failure which progresses into a large late failure. Because long-term containment cooling is failed, Type A failures necessarily progress to a larger failure later since the initial opening is not large enough to arrest the pressure increase. The source term release fractions are based on sequences involving LLOCA without CBS or ECCS function. The noble gas release fraction for each puff is such that all noble gas is released. The start timing for the first puff is based on a transient without EFW available.

LL-5, Release S3-R: This release category contains sequences involving a dry cavity floor (no RWST injection) long term over-pressurization failure of the containment as a result of loss of containment heat removal. The release fractions are based on analysis of a SBO/seal LOCA sequence. The results of the IDCOR analysis for Zion station were used based on a design comparison between Zion and Seabrook. These MAAP generated results were modified to account for the additional Te release during core-concrete interactions and the reduction in Cs and I release as a result of the much longer containment failure time. The release start time was defined as the 70th percentile estimate of containment failure time, based on a weighted average of contributing sequences. The duration of one hour conservatively models a puff release at containment failure.

SAMA RAI 4f

4) Provide the following information concerning the Level 3 analysis:

  f. Section 2.6.1 of the ER indicates a year 2000 50-mile total population of 4,157,215 (Tetra Tech 2009a) while Table F.3.4.1-1 indicates a total population of 4,232,394. Clarify the discrepancy.

NextEra Energy Seabrook Response to SAMA RAI 4f

The choice of distribution centroids and differences in how populations within the 50-mile radius are calculated account for the discrepancy.

One reason for the discrepancy is that the population distribution in Section 2.6.1 was centered on the (longitude, latitude) coordinates for the Seabrook Station used in the SECPOP2000 coordinate data base (42°53'53" 70°51'05"). The Table F.3.4.1-1 population distribution was centered at the reactor (42°53'54" 70°51'03"). The difference in total 50-mile population as a result of this difference in the distribution centroid's locations is 0.09%.

More importantly, the 50-mile population in Section 2.6.1 was calculated using U.S. Census block group data and methodology consistent with the Environmental Justice analysis. When calculating the 50-mile population, block groups that are bisected by the 50-mile radius are clipped, and the percent of census block land area within the 50-mile radius is assumed to be equivalent to the percent of the census block population within the 50-mile radius (i.e., if 25 percent of the block group area was within the radius, the analysis calculated 25 percent of the total block group population as being within the radius).

SECPOP2000 data was used to determine the 50-mile population for the Level 3 analysis (Table F.3.4.1-1). SECPOP uses block group data, but assigns the entire block group population to a point corresponding to the centroid of the block. If the centroid of the block falls within the 50-mile radius the entire population of the block is included in the 50-mile radius. If the centroid falls outside the 50-mile radius, the entire population is excluded.

Finally, the SECPOP population was adjusted upward to account for transient populations in the MACCS2 analysis. Therefore, the 50-mile population in Table F.3.4.1-1 includes an estimate of the transient population, and Section 2.6.1 considers only residents.

In this case, the population used in the Level 3 analysis is 1.8% greater than that of Section 2.6.1.

SAMA RAI 4g

4) Provide the following information concerning the Level 3 analysis:

   g. The ER provides no discussion of the effects of sea-breeze circulation on radionuclide deposition and whether this sea-breeze effect was factored into the MACCS2 calculations. Clarify whether sea-breeze effects were considered in the SAMA evaluation and, if not, provide an assessment of the sea-breeze effect on the results of the SAMA evaluation.

NextEra Energy Seabrook Response to SAMA RAI 4g

Sea-breeze effects are considered in the SAMA evaluation to the extent they are included in the onsite meteorological data (used in the MACCS2 calculations). In response to this RAI, further consideration of sea-breeze effects at the site, as discussed below, are based on the quantitative description of sea-breeze and onshore gradient flow from the Seabrook UFSAR, Rev.12, Section 2.3, Meteorology, pages 32-37.

The two major mechanisms by which sea-breezes could affect the Level 3 MACCS2 calculations are the formation of a thermal internal boundary layer (TIBL) and a mixing front between the sea-breeze and inland winds. During the summer when the land surface is warmer than the air over the sea, air heated from contact with the land rises and is undercut by cooler denser breezes from the sea. The boundary between these two distinct air layers caused by this difference in air temperature (or density) is the thermal internal boundary layer (TIBL). When these onshore breezes meet inland wind fields, which differ in magnitude and direction from the sea breeze, those differences result in something akin to a weather front with increased turbulence (mixing) along the mixing front between the two wind systems.

Mixing Front - The mixing front results in increased plume mixing and dispersion which would, in turn, result in lower population dose. The UFSAR simulates increased mixing (decreased atmospheric stability) below the TIBL by resetting site measured stability classes E through G (most stable classes) to D (less stable) during times of TIBL occurrence. This stability simulation was not implemented for the SAMA evaluation, thus resulting in a conservative evaluation (less dispersion, greater doses).

Thermal Internal Boundary Layer (TIBL) - The minimum TIBL height is noted in the UFSAR reference as 93 meters (above ground level). The Level 3 release height (top of containment) is 54.6 meters. Thus, the severe accident release plumes would be trapped beneath the TIBL, resulting in limited vertical dispersion and increased ground concentrations (doses). A TIBL was present during 527 hours for the period April 1979 - March 1980 (the period analyzed in the UFSAR). 638 hours (7% of the year) of TIBL formation was found during 2005 (the met year used for the SAMA analysis) by applying the UFSAR's criteria (based on time of year, time of day, wind speed, wind direction and solar radiation) for TIBL formation.

Using additional MACCS2 runs, the effect of TIBL formation was bounded by assuming a summer mixing layer (both morning and afternoon) of 100 meters, the minimum allowable by MACCS2. Applying this restrictive lid to mixing during the entire summer (2190 hours) bounds the 638 hours of TIBL formation found for 2005. The resulting population dose and offsite economic cost risks were found to increase by 4% and 7% respectively compared to the baseline SAMA case. The sensitivity of the lid height was investigated by specifying a 110 meter height. This shows that a decrease of 10 meters (from 110 to 100 meters) increases the dose and offsite cost risks by 0.2% and 0.5%. A decrease from 100 meters to 93 meters would be expected to show a similar change.

Because the release plumes are trapped beneath the TIBL, no special effect (other than the trapping itself, which is reflected in the MACCS2 runs as described above) is expected on radionuclide deposition.

Given the conservatisms in the above analysis (no accounting for increased mixing with sea-breeze, assuming 25% of annual hours result in TIBL formation vs. 7% of annual hours demonstrated for 2005) and the conservatisms built into the baseline analysis (see RAI response 4c and especially the assumption of perpetual rainfall in the 40-50 mile ring), the potential effects of sea-breezes do not change the SAMA analysis.

SAMA RAI 4h

4) Provide the following information concerning the Level 3 analysis:

h. Table F.3.4.1-1 indicates that several sector populations extrapolate to zero population in year 2050. For example radius 3 mi to 4 mi, ENE population decreases from 788 to zero). This occurs in several other locations. Clarify why this occurs, and address the potential impact to the SAMA analysis if a more conservative approach were used for extrapolating negative population growths to earlier years.

NextEra Energy Seabrook Response to SAMA RAI 4h

The GIS land layers were not detailed enough to account for the existence of some small islands; GIS water sectors were projected as zero populations. Also, the direction distribution used in the 2050 projection was slightly offset from the existing population, resulting in some sectors considered all water (and thus zero population) when, in fact, a portion of them includes the coastline and therefore has a population. The population projections have been refined to account for the above and to include the most recent county population growth rates.

The centroid of the refined population distribution was taken as latitude 42°53'53" and longitude 70°51'05". These coordinates correspond with those from the SECPOP2000 coordinate data base for the site and are the same ones used in Section 2.6 of the ER (see RAI response 4f).

The table below (which is analogous to Table F.3.4.1-1) gives the refined year 2000 and projected 2050 population distributions. The total projected 2050 population shown in this Table, 4,991,410, is 96.3% of that in ER Table F.3.4.1-1.

A sensitivity run of the Level 3 model was performed, replacing the 2050 population distribution used in the ER (Table F.3.4.1-1) with that from the table above. The resulting total population dose and offsite economic risks were 5% and 6% less than the ER baseline risks. Accident category population dose risks declined between 4 and 6% and accident category offsite economic risks declined between 4 and 7% from those in the ER.

From Radius (miles)	To Radius (miles)	Direction	Code	2000 Population	Projected 2050 Population
0	1	N	1	24	34
0	1	NNE	2	0	0
0	1	NE	3	29	41
0	1	ENE	4	0	0
0	1	E	5	0	0
0	1	ESE	6	0	0
0	1	SE	7	163	228
0	1	SSE	8	68	95
0	1	S	9	139	195
0	1	SSW	10	65	91
0	1	SW	11	10	14
0	1	WSW	12	234	328
0	1	W	13	0	0
0	1	WNW	14	144	202
0	1	NW	15	0	0
0	1	NNW	16	12	17
1	2	N	17	54	76
1	2	NNE	18	36	50
1	2	NE	19	143	200
1	2	ENE	20	12888	18045
1	2	E	21	4257	5960
1	2	ESE	22	5149	7209
1	2	SE	23	188	263

From Radius (miles)	To Radius (miles)	Direction	Code	2000 Population	Projected 2050 Population
1	2	SSE	24	584	818
1	2	S	25	532	745
1	2	SSW	26	1074	1500
1	2	SW	27	1371	1904
1	2	WSW	28	474	664
1	2	W	29	546	764
1	2	WNW	30	410	574
1	2	NW	31	385	539
1	2	NNW	32	226	316
2	3	N	33	462	647
2	3	NNE	34	2007	2810
2	3	NE	35	2129	2981
2	3	ENE	36	1531	2144
2	3	E	37	83	116
2	3	ESE	38	13	18
2	3	SE	39	1104	1480
2	3	SSE	40	535	686
2	3	S	41	880	1140
2	3	SSW	42	1149	1426
2	3	SW	43	471	581
2	3	WSW	44	835	1085
2	3	W	45	5180	7253
2	3	WNW	46	122	171
2	3	NW	47	283	396
2	3	NNW	48	247	346
3	4	N	49	1452	2033
3	4	NNE	50	3328	4660
3	4	NE	51	3822	5351
3	4	ENE	52	788	1103
3	4	E	53	0	0
3	4	ESE	54	0	0
3	4	SE	55	475	586
3	4	SSE	56	17035	21030
3	4	S	57	824	1017
3	4	SSW	58	728	899
3	4	SW	59	414	511
3	4	WSW	60	493	613
3	4	W	61	390	546
3	4	WNW	62	163	228
3	4	NW	63	265	371
3	4	NNW	64	584	818
4	5	N	65	1290	1806
4	5	NNE	66	849	1189
4	5	NE	67	1981	2774
4	5	ENE	68	0	0
4	5	E	69	0	0
4	5	ESE	70	0	0
4	5	SE	71	907	1120
4	5	SSE	72	570	704
4	5	S	73	1624	2005

From Radius (miles)	To Radius (miles)	Direction	Code	2000 Population	Projected 2050 Population
4	5	SSW	74	481	594
4	5	SW	75	4119	5085
4	5	WSW	76	2924	3654
4	5	W	77	383	536
4	5	WNW	78	460	644
4	5	NW	79	197	276
4	5	NNW	80	640	896
5	10	N	81	4863	6809
5	10	NNE	82	11105	15548
5	10	NE	83	1837	2572
5	10	ENE	84	0	0
5	10	E	85	0	0
5	10	ESE	86	0	0
5	10	SE	87	0	0
5	10	SSE	88	8149	10060
5	10	S	89	8723	10769
5	10	SSW	90	13597	16786
5	10	SW	91	8972	11076
5	10	WSW	92	10774	13690
5	10	W	93	3490	4886
5	10	WNW	94	3040	4256
5	10	NW	95	12762	17868
5	10	NNW	96	6120	8569
10	20	N	97	18596	25561
10	20	NNE	98	37177	47033
10	20	NE	99	1257	1562
10	20	ENE	100	0	0
10	20	E	101	0	0
10	20	ESE	102	0	0
10	20	SE	103	2645	3265
10	20	SSE	104	6981	8618
10	20	S	105	24518	30269
10	20	SSW	106	25814	31868
10	20	SW	107	84691	104555
10	20	WSW	108	57568	75952
10	20	W	109	23379	32733
10	20	WNW	110	17017	23826
10	20	NW	111	9182	12859
10	20	NNW	112	26181	36792
20	30	N	113	48973	64004
20	30	NNE	114	13619	16372
20	30	NE	115	414	498
20	30	ENE	116	0	0
20	30	E	117	0	0
20	30	ESE	118	0	0
20	30	SE	119	4177	5157
20	30	SSE	120	27814	34338
20	30	S	121	196181	242194
20	30	SSW	122	132772	154381
20	30	SW	123	243547	272808

From Radius (miles)	To Radius (miles)	Direction	Code	2000 Population	Projected 2050 Population
20	30	WSW	124	67747	88542
20	30	W	125	67400	94038
20	30	WNW	126	21508	30253
20	30	NW	127	8059	11298
20	30	NNW	128	25886	36455
30	40	N	129	30662	37589
30	40	NNE	130	24595	29567
30	40	NE	131	1	1
30	40	ENE	132	0	0
30	40	E	133	0	0
30	40	ESE	134	0	0
30	40	SE	135	0	0
30	40	SSE	136	0	0
30	40	S	137	54682	69289
30	40	SSW	138	859576	942784
30	40	SW	139	162839	163980
30	40	WSW	140	146085	170127
30	40	W	141	103784	140850
30	40	WNW	142	95495	139943
30	40	NW	143	19164	28890
30	40	NNW	144	15379	22046
40	50	N	145	11555	14999
40	50	NNE	146	54548	65576
40	50	NE	147	158	190
40	50	ENE	148	0	0
40	50	E	149	0	0
40	50	ESE	150	0	0
40	50	SE	151	0	0
40	50	SSE	152	0	0
40	50	S	153	190470	218152
40	50	SSW	154	812351	879674
40	50	SW	155	123527	130780
40	50	WSW	156	52054	59636
40	50	W	157	27269	37002
40	50	WNW	158	37194	53875
40	50	NW	159	24562	37213
40	50	NNW	160	10562	15928
			Total	**4,236,469**	**4,991,410**

RAI Section 5

SAMA RAI 5a

5) Provide the following with regard to the SAMA identification and screening process:

a. ER section F.5.1 explains that "the current plant procedures and training meet current industry standards" and that there "were no additional specific procedures improvements identified that would affect the result of the HEP calculations" and that therefore "no SAMA items were added to the plant-specific list of SAMAs as a result of human actions with risk reduction worth greater than 1.005." Describe other mitigation options (besides procedure and training improvement) for addressing each of the human error events that appear in importance Tables F.3.1.1.1-2 and F.3.2.1-1 (e.g., installing or improving automatic control, additional alarms) and provide justification for not considering a non-procedure/training SAMA to address these basic events.

NextEra Energy Seabrook Response to SAMA RAI 5a

Level 1 Human Actions: The highest CDF-related risk reduction worth (RRW) basic event in Table F.3.1.1.1-2 is operator action HH.OSEP1.FA – Operator Fails to Close SEPS Breaker from MCR. The context of this operator action is loss of offsite power with failure of both EDGs and no immediate recovery of power. Once the breaker for SEPS is manually closed to align the bus, the load sequencer connects loads normally. Success of SEPS means that seal cooling has been re-established and the potential for RCP seal LOCA minimized/avoided. This basic event has a CDF RRW value of 1.0323. PRA case study OSEP1 was performed to evaluate the maximum dollar benefit assuming elimination of 100% of the risk of this basic event, i.e., basic event was set to guaranteed success (value of 0.0) from its nominal value of 3.1E-02. Based on this conservative PRA case study, the maximum benefit is $12.5K (nominal benefit at 7% discount rate) and $24K (upper bound benefit). A hardware change such as installing an automatic breaker control or installing an additional alarm or indication to improve the human action is estimated to cost >$100K. Based on this result and given that all other CDF-related human action basic events in Table 3.1.1.1-2 have a CDF RRW less than1.0323 (HH.OSEP1.FA), any hardware changes proposed to improve these human actions are judged not cost-beneficial.

Level 2 Human Actions: The highest LERF-related risk reduction worth (RRW) basic event in Table F.3.2.1-1 is operator action HH.XOEFW1.FA – Operator Establishes Feed Flow to Faulted Steam Generator Prior to Significant Release. The context of this operator action is a SGTR accident sequence with EFW available at the onset of core damage. Success of EFW flow to the ruptured SG will provide water inventory for release scrubbing. This basic event has a LERF RRW value of 1.1873. PRA case study XOEFW was performed to evaluate the maximum dollar benefit assuming elimination of 100% of the risk of this basic event, i.e., basic event was set to guaranteed success (value of 0.0) from its nominal value of 3.9E-02. Based on this conservative PRA case study, the maximum benefit is $4.1K (nominal benefit at 7% discount rate) and $7.8K (upper bound benefit). Any hardware changes such as installing an automatic means to maintain/re-establish faulted SG inventory or installing an additional alarm or indication to improve the human action is estimated to cost >$100K. Based on this result and given that all remaining LERF-related human action basic events in Table 3.2.1-1 have a LERF RRW less than 1.1873 (HH.XOEFW1.FA), any hardware changes proposed to improve these human actions are judged not cost-beneficial. Refer to RAI 2f response for additional evaluation of Level 2 basic events.

SAMA RAI 5b

5) Provide the following with regard to the SAMA identification and screening process:

b. Importance Tables F.3.1.1.1-2 and F.3.2.1-1 are not linked to SAMA options except by associated SAMA category (e.g., AC Power SAMAs, Containment SAMAs). It is not always clear, however, how the identified SAMAs address the specific basic events listed (for example, basic events CCE17A.GL and CCE17B.GL. For each basic event identified in the importance lists, identify the specific SAMA(s) that address each event and describe how the SAMA(s) address the basic event. For any basic event for which no SAMA is identified, provide justification for not identifying a SAMA(s).

NextEra Energy Seabrook Response to SAMA RAI 5b

Tables F.3.1.1.1-2 and F.3.2.1-1 of the SAMA Report provided a link between each basic event and an associated SAMA item "functional" category. For example, basic event FWP37A.FR, "Turbine Driven Pump FW-P-37A Fails to Run" is identified with SAMAs related to Feedwater & Condensate. In the SAMA report, a specific SAMA candidate was not identified to address each basic event due to the basic event's relatively low RRW importance, corresponding low cost-benefit, and the basic event's relationship to the functional SAMA category. In response to this RAI, each basic event was reviewed from a SAMA/cost-benefit perspective. The top 15 basic events related to CDF are provided in the table below. These basic events have an RRW ranging from a high of 1.1713 to a low of 1.0223. Based on a Phase II type assessment of these basic events, no new SAMAs are identified as cost-beneficial. Also, based on the cost-benefit of basic event #15, having an RRW of 1.0223 and a nominal cost benefit of ~$31K and upper bound of $60.6K, it is judged that SAMA candidates associated with basic events having an RRW less than 1.0223 are not cost-beneficial given the minimum estimated cost of $100K to implement plant hardware changes.

The top ranked basic events related to LERF are the same basic events addressed in NextEra response to RAI 2f.

Seabrook Station – SAMA Review of Top 15 RRW Basic Events							
Basic Event	Basic Event Description	RRW	Associated SAMA Category	Associated SAMA	SAMA PRA Case Study	Disposition based on Upper Bound Cost Benefit	Disposition
#1 FWP37A.FR	Turbine Driven PUMP FW-P-37A fails to run	1.1713	Feedwater & Condensate SAMAs	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#2 DGDG1A.FR3	DG-1A fails to run for 24 hours	1.0774	AC Power SAMAs	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#3 DGDG1B.FR3	DG-1B fails to run for 24 hours	1.0694	AC Power SAMAs	#9, #10, #14, #155	NOSBO	$155K (nominal benefit) $295K (UB benefit) OECR Red: ~14% Min. Cost: >$500K	Not cost beneficial based on assumed elimination of all EDG failures
#4 EDESWG6.FX	4KV BUS E6 fault	1.0442	AC Power SAMAs	Improve Bus E6 reliability, eliminate / reduce potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#5 ZZ.SY1.FX	Loss of Offsite Power subsequent to plant trip	1.0391	AC Power SAMAs	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power

Seabrook Station – SAMA Review of Top 15 RRW Basic Events							
Basic Event	Basic Event Description	RRW	Associated SAMA Category	Associated SAMA	SAMA PRA Case Study	Disposition based on Upper Bound Cost Benefit	Disposition
#6 ZZ.SY2.FX	Loss of Offsite Power subsequent to LOCA initiator	1.0387	AC Power SAMAs	#13, #156, #160	NOLOSP	$335K (nominal benefit) $638K (UB benefit) OECR Red: ~43% Min. Cost: >1M	Not cost beneficial based on assumed elimination of all risk associated with loss of offsite power
#7 FWP37A.FS1	Turbine Driven Pump TURBINE FW-P-37A fails to start on demand	1.0376	Feedwater & Condensate SAMAs	#163	TDAFW	$100K (nominal benefit) $190K (UB benefit) OECR Red: ~7% Min. Cost: >$250K	Not cost beneficial based on assumed elimination of all TDEFW pump failures
#8 SEPSDG2A.FR3	1-SEPS-DG-2-A fails to run within 24 hours	1.0324	AC Power SAMAs	#9, #14, Improve SEPS DG reliability, eliminate potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#9 SEPSDG2B.FR3	1-SEPS-DG-2-B fails to run within 24 hours	1.0324	AC Power SAMAs	#9, #14, Improve SEPS DG reliability, eliminate potential for SEPS failure	SEPES	$39.8K (nominal benefit) $75.8K (UB benefit) OECR Red: ~2% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#10 HH.OSEP1.FA	OPERATOR fails to close SEPS breaker from MCB	1.0323	See text Section F.5.1	#9, #14, Provide auto-start and load for SEPS DG	OSEP1	$12.5K (nominal benefit) $23.9K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures
#11 HH.OHPR3.FA	OPERATOR fails to close SEPS breaker from MCB, given SI signal	1.0307	See text Section F.5.1	#9, #14, Provide auto-start and load for SEPS DG	OSEP1	$12.5K (nominal benefit) $23.9K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all SEPS failures

Seabrook Station – SAMA Review of Top 15 RRW Basic Events							
Basic Event	**Basic Event Description**	**RRW**	**Associated SAMA Category**	**Associated SAMA**	**SAMA PRA Case Study**	**Disposition based on Upper Bound Cost Benefit**	**Disposition**
#12 RCPCV456B.RS	PORV RC-PCV-456B fails to reseat	1.0300	ECCS SAMAs	Improve reliability of PORV reseat function, eliminate PORV re-seat failure	PORVRS	$22.8K (nominal benefit) $43.4K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all PORV reclose failure potential
#13 EDESWG5.FX	4KV BUS E5 fault	1.0279	AC Power SAMAs	Improve Bus E5 reliability, eliminate / reduce potential for bus fault	E6S	$39K (nominal benefit) $74.1K (UB benefit) OECR Red: ~2% Min. Cost: >100K	Not cost beneficial based on assumed elimination of all risk associated with Bus fault
#14 RCPCV456A.RS	PORV RC-PCV-456A fails to reseat	1.0265	ECCS SAMAs	Improve reliability of PORV reseat function, eliminate PORV re-seat failure	PORVRS	$22.8K (nominal benefit) $43.4K (UB benefit) OECR Red: ~1% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of all PORV reclose failure potential
#15 HH.ORWMZ1.FA	OPERATOR minimizes ECCS flow w/ recirc. failure	1.0223	See text Section F.5.1	Provide hardware change for automatic ECCS flow control,	ORWS	$31.8K (nominal benefit) $60.6K (UB benefit) OECR Red: ~5% Min. Cost: >$100K	Not cost beneficial based on assumed elimination of the human failure risk

SAMA RAI 5c

5) Provide the following with regard to the SAMA identification and screening process:

c. Importance Tables F.3.1.1.1-2 and F.3.2.1-1 combine the importance of internal, fire, and seismic events, so that it is not possible to determine the relative importance of each basic event for each hazard category. As a result, the SAMA identified to address each event may not address the more important initiator (e.g., fire). Provide a Level 1 and 2 importance list for each hazard category (internal, fire, and seismic) and identify which SAMA(s) address each event. For any basic event for which no SAMA is identified, identify and evaluate a new SAMA.

NextEra Energy Seabrook Response to SAMA RAI 5c

The Risk Reduction Worth (RRW) importance values provided in Tables F.3.1.1.1-2 and F.3.2.1-1 represent the basic event's total importance contribution to CDF/LERF from all hazards. The basic event RRW contribution to individual hazards will be a subset of the total RRW. Based on the response to RAI 5b, it is judged that hardware changes proposed to address individual hazard contributors would not be cost-beneficial based on a conservative minimum cost for a hardware change of $100K.

SAMA RAI 5d

5) Provide the following with regard to the SAMA identification and screening process:

d. Importance Tables F.3.1.1.1-2 and F.3.2.1-1 identify only one event (i.e., COTK25.RT – Condensate Storage Tank CO-TK-25 ruptures/excessive leakage) to be related to seismic fragility (based on the basic event descriptions presented). SAMA 162, "Increase the capacity margin of the condensate storage tank (CST)," appears to have been identified to address this event. However, it is not clear that this SAMA addresses the seismic fragility of the CST since the SAMA is described as increasing the capacity margin of the CST. Provide an assessment of a SAMA to increase the seismic fragility of the CST.

NextEra Energy Seabrook Response to SAMA RAI 5d

The CST is seismically qualified and is protected from external events by a rugged, seismic structure. The CST has a median seismic fragility of 1.65g and a high confidence low probability of failure (HCLPF) of 0.65, without giving credit to the concrete shield structure surrounding the CST, which is judged to have a median seismic capacity of greater than 2.5g. A Phase 2 PRA case study was performed to assess the potential cost-benefit of possible seismic upgrades to the CST. The PRA case (QCSTS) sets the seismic-induced failure of the CST to guaranteed success (assumes CST does not structurally fail during all seismic initiating events. The following results were obtained from PRA case QCSTS:

Nominal Cost-Benefit: ~$1K

Upper Bound Cost-Benefit: ~$2K

% Reduction in OECR: <1%

Cost of SAMA: The engineering analysis costs and cost of potential upgrades to increase the seismic capacity of the CST are estimated to exceed $100K.

Based on this case study, any modifications to further increase the seismic capacity of the CST would exceed the upper bound cost-benefit of $2K and thus are judged not cost-beneficial.

SAMA RAI 5e

5) Provide the following with regard to the SAMA identification and screening process:

e. SAMA 92, "Use the fire water system as a backup source for the containment spray system," was screened in Table F.6-1 because the containment spray function is not important early. Yet, RCPCV456A.FC and RCPCV456B.FC (Spray Valves fail to open on demand) appear on the LERF importance Table F.3.2.1-1 and may also provide benefit in late releases. In light of this, provide an assessment of this SAMA.

NextEra Energy Seabrook Response to SAMA RAI 5e

LERF Importance Table F.3.2.1-1 basis events RCPCV456A.FC and RCPCV456B.FC refer to modeling of the pressurizer Power Operated Relief Valves (PORVs), and not the containment spray valves. The descriptions of basic events RCPCV456A.FC and RCPCV456B.FC inadvertently referred to these valves as PORV spray valves. The PORV function is unrelated to the containment spray function. Therefore, no SAMA assessment of PORV contribution to containment spray is necessary.

SAMA RAI 5f

5) Provide the following with regard to the SAMA identification and screening process:

f. SAMA 143 (Upgrade fire compartment barriers) was screened in Table F.6-1 because the Seabrook Station plant design includes 3-hour rated fire barriers. Clarify how additional barriers for fire areas were considered and assess the impact that adding additional barriers would have on the SAMA results.

NextEra Energy Seabrook Response to SAMA RAI 5f

Additional barriers for fire areas were screened out based on the Seabrook Station plant design with 3-hour rated fire barriers. In addition, a review of the fire risk by location in the most recent update supports this screening that additional fire barriers would not significantly impact fire risk. Assessment of specific fire barriers is provided in the table below.

Seabrook Station – Assessment of Important Fire Barriers		
Fire Location	**Contribution to Fire CDF**	**Assessment of Additional Fire Barriers**
Control Room	52 %	Additional fire barriers are not physically possible in the CR.
Essential Switchgear Rooms	41 %	These rooms are train separated. These scenarios involve fire in a single Essential Switchgear room, with subsequent fire-independent hardware failures. Additional barriers would have no impact on these scenarios.
Turbine Building	5 %	The key contribution to fire risk from the Turbine Bldg is the potential for loss of offsite power. In addition, fire in the TB is a minor contribution to overall fire CDF. Thus, additional barriers would no significant impact on fire risk.
Primary Auxiliary Building	2 %	While PCC pumps are in the same area in the PAB, additional fire barriers would do little to reduce the overall fire CDF. This is due to the detailed fire modeling performed for this area.
Ocean Service Water Pumphouse	1 %	While SW ocean pumps are in the same area in the SW pumphouse; additional fire barriers would do little to reduce the overall fire CDF. This is due to the redundant SW cooling tower pumps, physically separated from the ocean pumps.
Electrical Tunnels (ET)	<1 %	These tunnels are train separate.

SAMA RAI 5g

5) Provide the following with regard to the SAMA identification and screening process:

g. SAMA 79, "Install bigger pilot operated relief valve so only one is required," was screened in Table F.6-1 because the intent of the SAMA has already been implemented. However, the Phase I Disposition column explains that 2-of-2 PORVs is needed for intermediate head Safety Injection. In light of this success criteria, provide an assessment of this SAMA.

NextEra Energy Seabrook Response to SAMA RAI 5g

The context of SAMA #79 is to increase the capacity of the pressurizer PORVs such that opening of only one PORV would satisfy the feed and bleed success criteria for all loss of feedwater-type sequences. At Seabrook, only one PORV is needed for feed and bleed if feed is provided by one of two high head charging pumps. However, opening of two PORVs is needed if feed is provided by one of two safety injection (SI) pumps. A Phase II PRA case study was performed to assess the potential cost-benefit of possible upgrades/replacement of the PORVs to increase their capacity such that opening of only one PORV would satisfy the feed and bleed success criteria under all combinations of feed. The PRA case (FW01) conservatively eliminates loss of feedwater events and this reduces the risk contribution from failure to feed and bleed. The following results were obtained from PRA case FW01:

Nominal Cost-Benefit: ~$73K

Upper Bound Cost-Benefit: ~$140K

Reduction in OECR: ~6%

SAMA Cost: Modifications to the PORVs and associated safety analysis to increase their flow capacity is estimated to exceed $250K.

Based on this case study, any modifications and safety analysis needed to increase the flow capacity of the PORVs is judged to exceed the upper bound cost-benefit of $140K and thus are judged not cost-beneficial.

SAMA RAI 5h

5) Provide the following with regard to the SAMA identification and screening process:

h. SAMA 64, "Implement procedure and hardware modification for a component cooling water header cross-tie," was screened in Table F.6-1 because a cross-tie already exists to support a maintenance activity. Clarify whether exiting plant procedures provide for the cross-tie between divisions A and B of the PCCW system in the event of a loss of cooling water and, if not, provide an assessment of a SAMA to develop and implement a procedure to perform the cross-tie.

NextEra Energy Seabrook Response to SAMA RAI 5h

Seabrook Plant Operations Procedures provide explicit instructions for alignment of the PCCW A and B cross-tie. The cross-tie alignment is primarily used during maintenance activities; however it could be used during an extreme off-normal event involving a failure of heat sink in one division with failure of frontline components in the opposite division, provided that adequate time is available. The cross-tie is not currently modeled in the PRA and is judged to not provide a significant benefit if it were to be considered in the PRA.

SAMA RAI 5i

5) Provide the following with regard to the SAMA identification and screening process:

i. SAMA 127, "Revise emergency operating procedures to direct isolation of a faulted steam generator," is screened in Table F.6-1 using Criterion B. However, the explanation provided in the Phase I Disposition column, "Faulted SG refers to Steam line break and Ruptured SG refers to SG rupture," does not explain why this is not a viable SAMA candidate. Clarify whether the existing emergency operating procedures (EOPs) implement this SAMA and if the EOPs distinguish between a faulted steam generator and a ruptured steam generator.

NextEra Energy Seabrook Response to SAMA RAI 5i

The context of SAMA #127 is to have specific emergency operating procedures for isolation of a steam generator for the purpose of reducing the consequences of a steam generator tube rupture. Seabrook Emergency Operating Procedures currently direct specific operator actions to diagnose a steam generator tube rupture and to perform its isolation. The Reactor Trip or Safety Injection EOP requires operators to check if SG U-tubes are intact. SG tube integrity is determined based on monitoring of main steamline radiation, condenser air evacuation radiation, steam generator blowdown radiation, and SG narrow range level – no uncontrolled increase. This procedure transfers to the Steam Generator Tube Rupture EOP, which provides specific steps, beginning at Step 3, for isolation of a "ruptured" steam generator. It is also noted plant EOPs specifically provide actions for the identification and isolation of a "faulted" steam generator (e.g., steam line break). These actions are delineated in the Reactor Trip or Safety Injection and Faulted Steam Generator Isolation procedures.

Based on the above, SAMA #127 was screened in Phase 1 – intent met.

SAMA RAI 5j

5) Provide the following with regard to the SAMA identification and screening process:

   j. SAMA 82, "Stage backup fans in switchgear rooms," and SAMA 84, "Switch for emergency feedwater room fan power supply to station batteries," are screened in Table F.6-1 as not applicable to the Seabrook Station. However, the explanation in the Phase I Disposition column does not appear to preclude the viability of these SAMAs. Provide further justification for screening out these SAMAs or provide an evaluation of each.

NextEra Energy Seabrook Response to SAMA RAI 5j

SAMA #82 - The context of SAMA #82 is to enhance the availability/reliability of ventilation to the essential switchgear rooms in the event of a loss of switchgear room ventilation. This SAMA was initially judged as "not applicable" to Seabrook Station in Phase I screening. A more accurate Phase I screening criterion for SAMA #82 is "intent met". Switchgear room compensatory ventilation procedures exist for maintaining acceptable room temperatures when ventilation components become unavailable. Switchgear room high temperature alarm response procedures recommend several actions to restore ventilation including monitoring of room temperatures, opening of doors, and the set up portable fans to supply external cooling.

SAMA #84 - The context of SAMA #84 is to enhance the availability/reliability of ventilation to the EFW pump house in the event of a loss of pump house ventilation by switching the pump house ventilation fan(s) power supply to station batteries. This SAMA was initially judged as "not applicable" to Seabrook Station in Phase I screening. Further evaluation of this SAMA is provided below.

EFW pump house ventilation is needed only for long term sequences involving EFW SG inventory control due to the relatively slow heat-up rate of the pump house. EFW pump house compensatory ventilation procedures exist for maintaining acceptable room temperatures when ventilation components become unavailable. EFW pump house high temperature alarm response procedures recommend several actions to restore ventilation including the monitoring of pump house temperature and to provide portable ventilation as required. These compensatory actions are credited in the PRA and as a result, failure of the ventilation system, which is reliable, is not a significant contributor to core damage frequency.

The EFW pump house ventilation system consists of two trains of ventilation fans and associated damperss. The ventilation fan trains use AC power for fan motive power, not DC power. To operate the ventilation fans using DC motive power would require a redesign of the system with the possibility of requiring a new, larger capacity station battery. Conceptually, a conservatively low cost of these modifications is estimated at >$250K. A Phase II PRA case study was performed to assess the potential cost-benefit of possible upgrades to the EFW ventilation system. The PRA case (OEFWVS) conservatively assumes guaranteed success of EFW ventilation. The following results were obtained from PRA case OEFWVS:

Nominal Cost-Benefit: <$1K

Upper Bound Cost-Benefit: <$1K

Reduction in OECR: <1%

SAMA Cost: Hardware or procedural modifications aimed at improving EFW pump house ventilation reliability, particularly redesigning the system for DC motive power, is >$100K.

Based on this case study, the proposed SAMA is judged not cost-beneficial.

SAMA RAI 5k

5) Provide the following with regard to the SAMA identification and screening process:

k. The SAMA identification process (ER Section F.5) did not appear to include a review of the cost-beneficial SAMAs identified for other Westinghouse 4-loop plants for which license renewal applications have been submitted. Provide an itemized review of the cost-beneficial SAMAs identified in the following recent license renewal applications for Westinghouse 4-loop plants: Salem, Diablo Canyon, Vogtle, Indian Point 2/3, and Wolf Creek. In the response, provide a Phase I screening of each and, if not screened, provide a Phase II evaluation.

NextEra Energy Seabrook Response to SAMA RAI 5k

Evaluation of candidate SAMAs found to be potentially cost-beneficial at Salem, Diablo Canyon, Vogtle, Indian Point 2/3, and Wolf Creek plants is provided below.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
Salem Station		
SAMA #1	Enhance Procedures and Provide Additional Equipment to Respond to Loss of Control Area Ventilation.	Screened Phase 1, Criterion B – Intent Met. Seabrook currently has a specific abnormal procedure for implementing compensatory actions for loss of control room ventilation or air conditioning. A compensatory procedure for loss of Essential Switchgear Room ventilation also exists (as addressed in Seabrook SAMA #82).

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
SAMA #2	Re-configure Salem 3 to Provide a More Expedient Backup AC Power Source for Salem 1 and 2.	Screened Phase 2, Not Cost-Beneficial. Seabrook Station is a single unit site with no other onsite power generation capability (except for onsite emergency and supplemental diesel generators). Installation of additional onsite power generation capability was evaluated in Seabrook SAMA #13 (buried offsite power source), SAMA #14 (gas turbine), and SAMA #156 (install alternate offsite power source). These SAMA candidates were judged not cost-beneficial in Phase 2.
SAMA #3	Install Limited EDG Cross-tie Capability Between Salem 1 and 2.	Screened Phase 1, Criterion A – Not Applicable. Seabrook Station is a single unit site with no other onsite power generation capability (except for onsite emergency and supplemental diesel generators). Phase 1 screening is consistent with Seabrook SAMA# 12, Create AC Cross-tie Capability with Other Unit (multi-unit site).
SAMA #4	Install Fuel Oil Transfer Pump on "C" EDG & Provide Procedural Guidance for Using "C" EDG to Power Selected "A" and "B" Loads.	Screened Phase 1, Criterion B – Intent Met. This SAMA is similar to Seabrook SAMA #11 and SAMA #17. Seabrook currently has 2 EDGs that are dedicated to their respective emergency bus. In addition, Seabrook has a third diesel generator unit - supplemental emergency power supply (SEPS), which can be aligned to either emergency power division. In addition, Seabrook has the capability to cross-tie the divisional EDG fuel oil tanks.
SAMA #5	Install Portable Diesel Generators to Charge Station Battery and Circulating Water Batteries & Replace PDP with Air-Cooled Pump.	PDP Replacement - Screened Phase 2, Not Cost-Beneficial Replacement of PDP and installing a diesel generator for motive power is similar to Seabrook SAMA #26 (install additional high pressure injection pump with independent diesel). This SAMA was shown to be not cost-beneficial. Portable Battery Charger – Not screened – Potentially Cost-Beneficial – however, similar to Seabrook SAMA #157 Installing portable diesel generator for charging batteries is similar to Seabrook SAMA #157 (provide independent AC power source for battery chargers). This SAMA was shown to be potential cost beneficial to extend main station battery life during long term SBO sequences. Regarding switchyard DC control power, Seabrook has an 8 hour switchyard battery system, independent of the main station batteries. If switchyard batteries become depleted, Seabrook switchyard breakers can be operated locally/manually without DC control power. This local/manual action is accounted for in the PRA by assuming an additional hour is needed to recover offsite power during long term SBO sequences. Removal of the additional hour for local action is judged to have a negligible positive impact on SBO core damage risk.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	SAMA Description	Seabrook Evaluation
SAMA #5A	Install Portable Diesel Generators to Charge Station Battery and Circulating Water Batteries.	Not screened – Potentially Cost-Beneficial – however, similar to Seabrook SAMA #157 Installing portable diesel generator for charging batteries is similar to Seabrook SAMA #157 (provide independent AC power source for battery chargers). This SAMA was shown to be potential cost beneficial to extend main station battery life during long term SBO sequences. Regarding switchyard DC control power, Seabrook has an 8 hour switchyard battery system, independent of the main station batteries. If switchyard batteries become depleted, Seabrook switchyard breakers can be operated locally/manually without DC control power. This local/manual action is accounted for in the PRA by assuming an additional hour is needed to recover offsite power during long term SBO sequences. Removal of the additional hour for local action is judged to have a negligible positive impact on SBO core damage risk.
SAMA #6	Enhance Flood Detection for 84' Aux Building and Enhance Procedural Guidance for Responding to Service Water Flooding.	Screened Phase 1, Criterion B – Intent Met. Flood alarms, sump alarms, response procedures and associated operator actions were reviewed as part of updated internal flooding assessment. Current alarm response procedures judged adequate and are reflected in assessment.
SAMA #7	Install "B" Train AFWST Makeup Including Alternate Water Source.	Screened Phase 2, Not Cost-Beneficial This SAMA involving long term makeup to the CST is similar to Seabrook SAMA #162 (increase capacity of the CST) and SAMA #164 (modify 10" condensate filter flange to have 2-1/2-inch female fire hose adapter with isolation valve). These SAMAs were shown to be not cost-beneficial. In addition, it is noted that the time to empty the CST is approximately 17 hours. Seabrook currently has several means of making-up water inventory to the CST. These include alignment of the Demineralized Water (DW) system pumps or alignment of the gravity drain of the Demineralized Water Storage Tanks to the CST, makeup from the condenser hot well spill or by use of the cooling tower portable pump. Therefore, the intent of the Salem SAMA is judged to be met regardless of cost-benefit.
SAMA #8	Install High Pressure Pump Powered with Portable Diesel Generator and Long-term Suction Source to Supply the AFW Header.	Screened Phase 1, Criterion B – Intent Met. This SAMA is similar to Seabrook SAMA #66 and SAMA #75. Seabrook currently has the capability to connect several water sources to supply the EFW suction header. These include: the fire system using a diesel-driven fire pump; the portable diesel-driven pump with suction connected to the fire main; and the cooling tower portable makeup pump using either the cooling tower basin or Browns River. In addition, the water contents in the DWST can be gravity drained to the CST.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
SAMA #9	Connect Hope Creek Cooling Tower Basin to Salem Service Water System as Alternate Service Water Supply.	Screened Phase 1, Criterion B – Intent Met. Seabrook is a single unit site. Seabrook is currently equipped with a four-train (two-division) Ocean Service Water System. The alternate service water supply is provided by the service water cooling tower, which consists of two pump divisions and a cooling tower water basin with a capacity of greater than 3M gallons. The cooling tower service water supply is independent of the ocean supply.
SAMA #10	Provide Procedural Guidance for Faster Cooldown on Loss of RCP Seal Cooling.	Screened Phase 1, Criterion B – Intent Met. RCS cooldown and depressurization procedures are addressed in Seabrook SAMA #50. Seabrook's emergency procedures include actions to cooldown and depressurize the RCS at a rate of 30 to 50 F/hr while maintaining adequate subcooling margin and to establish conditions for operation of RHR shutdown cooling. These actions are currently modeled in the PRA and any changes to further enhance the procedures are judged to have negligible benefit on the accident sequences.
SAMA #11	Modify Plant Procedures to Make Use of Other Unit's PDP for RCP Seal Cooling.	Screened Phase 1, Criterion B – Intent Met. Seabrook's charging system design includes two centrifugal charging pumps A and B and a single positive displacement pump (PDP). The PDP is powered from a non-safety electrical power source and requires component cooling from PCCW train B. The PDP is credited for seal injection in the loss of RCP seal injection initiating event in the PRA. Replacement of this pump with a centrifugal pump was evaluated as Seabrook SAMA # 170.
SAMA #12	Improve Flood Barriers Outside of 220/440VAC Switchgear Rooms.	This SAMA is applicable to Seabrook SAMA #192, installation of flow limiting device in Control Building fire protection piping. Refer to Seabrook response to RAI 1a.
SAMA #14	Expand AMSAC Function to Include Backup Breaker Trip on RPS Failure.	Screened Phase 2, Not Cost-Beneficial. Seabrook SAMA #174 is judged similar to this Salem Station SAMA for ATWS mitigation. SAMA #174 evaluated the cost-benefit of providing an alternate scram button to remove power from the MG-sets to the control rod drives. This change was judged not cost-beneficial in the Seabrook Phase 2 assessment.
SAMA #17	Enhance Procedures and Provide Additional Equipment to Respond to Loss of EDG Control Room Ventilation.	Screened Phase 1, Criterion A - Not Applicable. Seabrook Station does not have EDG control rooms or EDG control room ventilation systems.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	SAMA Description	Seabrook Evaluation
SAMA #24	Provide Procedural Guidance to Cross-tie Salem 1 and 2 Service Water Systems.	Screened Phase 1, Criterion B – Intent Met. Seabrook is a single unit site. Seabrook is currently equipped with a four-train (two-division) Ocean Service Water System. The alternate service water supply is provided by the service water cooling tower, which consists of two pump divisions and a cooling tower water basin with a capacity of greater than 3M gallons. The cooling tower service water supply is independent of the ocean supply.
SAMA #27	In Addition to the Equipment Installed for SAMA 5, Install Permanently Piped Seismically Qualified Connections to Alternate AFW Water Sources.	Screened Phase 1, Criterion B - Intent Met. This SAMA, involving seismic connections to alternate AFW water sources, is similar to the current Seabrook capability. At Seabrook, the CST is seismically qualified and is protected from external events by a rugged, seismic structure. A permanent, seismically qualified flanged connection exists to allow connection of an alternate water supply to the EFW turbine driven pump suction and/or refill of the CST.
Diablo Canyon		
SAMA #12	Improve Fire Barriers for ASW and CCW Equipment in the Cable Spreading Room.	Screened Phase 1, Criterion B – Intent Met. Additional barriers for fire areas were screened out based on the Seabrook Station plant design with 3-hour rated fire barriers. Also, a review of the fire risk by location in the most recent update supports this screening that additional fire barriers would not significantly impact fire risk (refer to RAI 5.f.)
SAMA #13	Improve Cable Wrap for the PORVs in the Cable Spreading Room.	Screened Phase 1, Criterion B – Intent Met. The Cable Spreading Room (CSR) at Seabrook was screened from detailed evaluation based on the absence of ignition sources and the fact that only small amounts of transient combustibles would likely be found in the area. Also, the area is equipped with fire detection and suppression. Cables for the two safety trains enter the room at different locations and are separated. Cables travel from the separate trays to the control room from through metal wire ways to the penetrations in the ceiling.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
SAMA #24	Prevent Clearing of RCS Cold Leg Water Seals.	Screened Phase 2, Not Cost-Beneficial. The context of this SAMA is that clearing of the water seals in the cold legs after core damage could result in a greater challenge to a SG thermally induced tube rupture (SGTI) due to the resulting unobstructed flow path of hot gas between the reactor vessel and SG(s). Thus, a procedure change to ensure that the cold legs are not cleared would reduce the SGTI challenge and reduce the associated release. To assess this SAMA for Seabrook, PRA case XSGTIS was run, which eliminated 100% of the potential for SGTI. The results of this case show that SGTI has minimal contribution to release. The reason SGTI does not contribute significantly to release is because successfully maintaining SG water inventory or depressurizing the RCS also effectively mitigate the SGTI tube rupture challenge. It is noted that the first two steps in Seabrook's Severe Accident Management Guideline (SAMG) diagnostic flow chart is to ensure SG water level greater than 10% narrow range and RCS pressure <285 psi. The associated nominal and upper bound cost-benefits of this SAMA are both less than $1K. This SAMA is judged not cost-beneficial based on the estimated cost for a procedure modification, which is in the range of $15 to $20K.
SAMA #25	Fill or Maintain Filled The Steam Generators to Scrub Fission Products.	Screened Phase 1, Criterion B – Intent Met. The context of this SAMA is for plant procedures to ensure that there is sufficient water level in the SGs (preferably a faulted SG) so that fission product release through a postulated tube rupture will be reduced by scrubbing effects. At Seabrook, procedures specifically address SG water level and isolation of a faulted SG to minimize the possibility of release. In addition, severe accident guidelines, which are entered before the onset of core damage (at 1100 °F), further address the importance to inject into the SGs and to maintain SG inventory for the purpose of: (1) protecting the SG tubes from creep rupture, (2) scrubbing fission products that could enter the SG from tube leakage, and (3) making the SGs available as a heat sink for the RCS.
Vogtle		
SAMA #2	Maintain full-time black start capability of the Plant Wilson combustion turbines.	Screened Phase 2, Not Cost-Beneficial. Seabrook Station is a single unit site with no other onsite power generation capability (except for onsite emergency and supplemental diesel generators). Installation of additional onsite power generation capability was evaluated in Seabrook SAMA #13 (buried offsite power source), SAMA #14 (gas turbine), and SAMA #156 (install alternate offsite power source). These SAMA candidates were judged not cost-beneficial in Phase 2.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
SAMA # 4	Prepare procedures and operator training for cross-tying an opposite unit DG.	Screened Phase 1, Criterion A – Not Applicable. Seabrook Station is a single unit site with no other onsite power generation capability (except for onsite emergency and supplemental diesel generators). Phase 1 screening is consistent with Seabrook SAMA# 12, Create AC Cross-tie Capability with Other Unit (multi-unit site).
SAMA #6	Implementation of a bypass line for the cooling tower return isolation valves.	Screened Phase 2, Not Cost-Beneficial. The purpose of this Vogtle SAMA is to reduce the likelihood of a Vogtle-specific SW failure mode that could lead to loss of EDG cooling following a LOSP event. The proposed modification is to install redundant, quick opening valves in parallel with existing cooling tower isolation valves, which are signaled to close and re-open during a LOSP event. Failure to re-open would result in loss of cooling to the respective EDG. Thus, redundant parallel valves would tend to increase the reliability of EDG cooling. The EDGs at Seabrook are also cooled by Service Water (SW). SW to each EDG is normally isolated by a closed AOV designed to fail open on loss of power or instrument air. The AOVs open automatically upon EDG demand and are not cycled closed and opened similar to the Vogtle design. The Seabrook AOVs have a history of reliable operation. As a result, installation of redundant, parallel SW valves would not significantly improve EDG reliability and would not be cost-beneficial based on inspection of PRA Case NOSBO (which is very conservative) and cost of implementation judged to be on the order of $500K. Detailed (less optimistic) evaluation would further show this option as being not cost-beneficial.
SAMA #16	Enhance procedures for ISLOCA response.	Screened Phase 2, Not Cost-Beneficial. This Vogtle SAMA did not identify any specific procedural changes to improve the risk of ISLOCA events. Vogtle simply calculated a decrease in risk assuming elimination of all ISLOCA risk. Seabrook PRA Case LOCA06 also quantified the risk benefit associated with elimination of ISLOCA risk. Based on this optimistic assessment, the UB benefit was determined to be on the order of $53K. Based on a review of procedures, any changes to procedures are judged not to have a significant impact on ISLOCA risk. The cost of procedure changes and training are judged to be in the range of $30 to $40K. Detailed (less optimistic) evaluation would further show this option as being not cost-beneficial.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
Indian Point		
SAMA #30	Provide a portable diesel-driven battery charger.	Not screened – Potentially Cost-Beneficial – however, similar to Seabrook SAMA #157 Installing portable diesel generator for charging batteries is similar to Seabrook SAMA #157 (provide independent AC power source for battery chargers). This SAMA was shown to be potential cost beneficial to extend main station battery life during long term SBO sequences.
SAMA #52	Open city water supply valve for alternative AFW pump suction.	Screened Phase 1, Criterion B – Intent Met. This SAMA is similar to Seabrook SAMA #66 and SAMA #75. Seabrook currently has the capability to connect several alternate water sources to supply the EFW suction header. These include: the fire system using a diesel-driven fire pump; the portable diesel-driven pump with suction connected to the fire main; and the cooling tower portable makeup pump using either the cooling tower basin or Browns River. In addition, the water contents in the DWST can be gravity drained to the CST.
SAMA #55	Provide hard-wired connection to one SI or RHR pump from the Appendix R bus (MCC 312A).	Screened Phase 1, Criterion B – Intent Met. Seabrook currently has two, separate Remote Safe Shutdown (RSS) panels, one panel for each division. The panels are located in the respective divisional emergency switchgear room. Each RSS division has the capability to use the associated EDG and emergency buses to control/stabilize RCS inventory using boric acid transfer pump and/or high head charging pump; perform plant cooldown using ASDVs and EFW, and initiate shutdown cooling using an RHR pump.
SAMA #61	Upgrade the Alternate Safe Shutdown System (ASSS) to allow timely restoration of seal injection and cooling.	Screened Phase 1, Criterion B – Intent Met. Seabrook's Remote Safe Shutdown (RSS) panels currently have the capability to provide both seal injection and cooling. Seal injection is provided using a high head charging pump. Seal cooling is provided using a thermal barrier cooling (TBC) pump with PCCW and SW pumps for heat sink.
SAMA #62	Install flood alarm in the 480VAC switchgear room.	This SAMA is applicable to Seabrook SAMA #192, installation of flow limiting device in Control Building fire protection piping. Refer to Seabrook response to RAI 1a.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	**SAMA Description**	**Seabrook Evaluation**
Wolf Creek		
SAMA #1	Permanent, Dedicated Generator for the NCP with Local Operation of TD AFW After 125V Battery Depletion.	Screened Phase 1, Criterion B – Intent Met. The context of this Wolf Creek SAMA is to reduce SBO RCP seal LOCA scenarios by installing an additional, dedicated diesel generator power source for the normal charging pump (NCP). Seabrook currently has 2 EDGs that are dedicated to their respective emergency bus. In addition, Seabrook has a third diesel generator unit - supplemental emergency power supply (SEPS), which can be aligned from the control room to either emergency power division. Once the breaker for SEPS is manually closed onto the aligned bus, the load sequencer connects the required loads. Because SEPS can be quickly aligned from the control room to re-energize an emergency bus, restoration of the thermal barrier cooling and seal injection functions is accomplished in time to preserve RCP seal integrity and avoid seal failure.
SAMA #2	Modify the Controls and Operating Procedures for Sharpe Station to Allow for Rapid Response.	Screened Phase 2, Not Cost-Beneficial. Seabrook Station is a single unit site with no other onsite power generation capability (except for onsite emergency and supplemental diesel generators). Installation of additional onsite power generation capability was evaluated in Seabrook SAMA #13 (buried offsite power source), SAMA #14 (gas turbine), and SAMA #156 (install alternate offsite power source). These SAMA candidates were judged not cost-beneficial in Phase 2.
SAMA #3	AC Cross-tie Capability.	Screened Phase 1, Criterion B – Intent Met. The context of this Wolf Creek SAMA is to provide enhanced capability to cross-tie the emergency 4kV buses. This SAMA is similar to Seabrook SAMA #11. Seabrook currently has 2 EDGs that are dedicated to their respective emergency bus. In addition, Seabrook has a third diesel generator unit - supplemental emergency power supply (SEPS), which can be aligned to either emergency power division.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	SAMA Description	Seabrook Evaluation
SAMA #4	Upgrade emergency procedures to direct local, manual closure of the RHR EJHV8809A and EJHV8809B valves if they fail to close remotely.	Screened Phase 2, Not Cost Beneficial. The context of this Wolf Creek SAMA is to provide a procedural enhancement for operators to locally, manual close RHR valves to isolate an ISLOC should the valves fail to close remotely. At Seabrook, ISLOCA events are postulated to occur in the RHR system due to: (1) multiple MOV failures in the RHR suction supply from the RCS hot legs, and (2) multiple check valve failures in the RHR injection lines to the RCS cold/hot legs. Remote manual isolation of an ISLOCA event in RHR is detailed in plant EOPs. From a PRA perspective, isolation of a postulated ISLOCA originating from the RHR suction valve failures is assumed not possible and thus is not credited in the PRA. Isolation of a postulated ISLOCA originating from RHR injection valve failures is possible via manual closure of valve RH-MOV-14 or RH-MOV-26. However, only limited isolation credit is given in the PRA for events when RHR relief valves are successful and RHR piping and heat exchanger pressure boundaries remain intact. Thus, ISLOCA leakage is a result of relief valve opening and RHR pump seal degradation. Failure of the operator action to isolate RHR valve 14 (26) has an RRW of only 1.0001. Given this extremely low risk reduction, the cost-benefit of making improvements to associated procedures or valve hardware will be well below the range of $28K to $53K, which assumed elimination of all ISLOCA risk in PRA Case LOCA06. Therefore, this SAMA is judged not cost-beneficial.
SAMA #5	Enhance procedures to direct operators to open EDG Room doors for alternate room cooling.	Screened Phase 1, Criterion B – Intent Met. The context of this Wolf Creek SAMA is to provide for alternate EDG room cooling during favorable outdoor ambient temperature conditions by opening room doors. At Seabrook, the diesel air handling (DAH) systems consists of a supply and exhaust fan and associated dampers for ventilating/cooling the respective diesel room. The DAH is included in the PRA model due to the relatively short heatup times. Note, however, that during a substantial time of the year, the outside temperature is low enough that ventilation may not be required. DAH compensatory ventilation actions exist for maintaining acceptable DG room temperatures depending on outdoor ambient temperatures when DAH components are unavailable. In addition, DG room high temperature alarm response procedures recommend several actions including monitoring of DG temperatures and providing portable fans to cool the affected room.

NextEra Energy Seabrook Evaluation of Other Plant SAMAs		
SAMA	SAMA Description	Seabrook Evaluation
SAMA #13	Alternative Fuel Oil Tank with Gravity Feed Capability.	Screened Phase 1, Criterion B – Intent Met. Seabrook currently has 2 EDGs that are dedicated to their respective emergency bus. The capability to cross-tie the divisional EDG fuel oil tanks exists. Fuel oil makeup to the respective EDG day tank is accomplished via the divisional fuel oil transfer pump. Gravity drain from the fuel oil storage tanks to the associated day tank is not practical. However, the discharge from each fuel oil transfer pump can be aligned to supply the opposite division EDG day tank. This provides flexibility to maintain day tank inventory should a problem develop with one transfer pump. In addition, as noted above, Seabrook has a third diesel generator unit - supplemental emergency power supply (SEPS), which can be aligned to either emergency power division. The SEPS has a dedicated fuel oil, independent of the EDG fuel oil.
SAMA #14	Permanent, Dedicated Generator for the NCP, one Motor Driven AFW Pump, and a Battery Charger.	Screened Phase 1, Criterion B – Intent Met. The context of this Wolf Creek SAMA is similar to Wolk Creek SAMA #1 but with increased diesel generator capacity to also operate a motor-driven AFW pump. As noted above, Seabrook has already installed a third diesel generator unit - supplemental emergency power supply (SEPS), which can be aligned from the control room to either emergency power division. Once the breaker for SEPS is manually closed onto the aligned bus, the load sequencer connects the required loads. Because SEPS can be quickly aligned from the control room to re-energize an emergency bus, restoration of the thermal barrier cooling and seal injection functions is accomplished in time to preserve RCP seal integrity and avoid seal failure. The SEPS diesel generator load is maintained at or below 5280kW. This is sufficient capacity to operate many important systems including: motor-driven EFW pump or the startup feedwater pump, SW pump, PCCW pump, battery charger, etc.

SAMA RAI 5l

5) Provide the following with regard to the SAMA identification and screening process:

1. SAMAs were identified for all basic events having a RRW greater than or equal to 1.005. Provide the maximum dollar benefit of a SAMA that eliminates 100% of the risk of a basic event having an RRW value of 1.005.

NextEra Energy Seabrook Response to SAMA RAI 5l

The maximum dollar benefit of a SAMA that eliminates 100% of the risk of a basic event having an RRW value of 1.005 is $2.5K (nominal benefit at 7% discount rate) and $4.8K (upper bound benefit). This benefit result is based on setting human action basic event HH.RDGL2Q.FL from its point estimate valve of 1.8E-01 to guaranteed success, a value of 0.0. Human action basic event HH.RDGL2Q.FL models operator failure to manually load needed pumps onto the EDG or SEPS given a seismic event with failure of the emergency power sequencer. This human action basic event has an RRW of 1.0057 as provided in Table F.3.1.1.1-2 of the SAMA report.

SAMA RAI 5m

5) Provide the following with regard to the SAMA identification and screening process:

m. Table F.5.6-1 identifies the source of 38 SAMAs as being plant-specific SAMAs based on review of the IPE, IPEEE, plant personnel, and expert panel. Identify the specific source for each of these SAMAs.

NextEra Energy Seabrook Response to SAMA RAI 5m

The primary source for each plant-specific SAMAs is provided in the table below.

SAMA Source	SAMA IDs
IPE	#155, #156, #157, #158, #159, #167, #168, #169, #174, #184, #185, #186, #187
IPEEE	#160, #171, #173, #175, #176, #177, #178, #179, #180, #181, #182, #183
Plant Personnel	#154, #162, #164, #165, #166, #188, #189, #190, #191
Expert Panel	#161, #163, #172, #170

SAMA RAI 5n

5) Provide the following with regard to the SAMA identification and screening process:

n. SAMAs 105 and 191 were screened as not applicable to Seabrook Station because they would violate the current licensing basis. This is not a valid basis for screening the SAMAs as not applicable. Provide further justification for why these SAMAs should not be considered in the Phase II evaluation.

NextEra Energy Seabrook Response to SAMA RAI 5n

SAMA #105 – Delay containment spray actuation after a large LOCA. The context of this SAMA is to extend Reactor Water Storage Tank (RWST) availability during a large LOCA event. This is interpreted as extending the RWST inventory during a large break LOCA so as to deplete the inventory at a reduced rate. This would provide operators with more time to complete the semi-automatic transfer to cold leg recirculation for large breaks. A Phase II evaluation was performed using PRA Case OLPRS. This case conservatively assumed guaranteed success of the operator action to complete/ensure the RHR/LHSI transfer to long term recirculation during large LOCA events. The results of this case study show that the operator action does not contribute significantly to core damage frequency. The following results were obtained from PRA case OLPRS:

Nominal Cost-Benefit: ~$7.2K

Upper Bound Cost-Benefit: ~$13.7K

% Reduction in OECR: <1%

Cost of SAMA: The engineering analysis costs to justify a delay in containment spray for large break LOCA events and corresponding changes to emergency and operating procedures is expected to exceed $100K.

Based on this case study, engineering analysis and modifications to justify a delay in containment spray for large LOCA events and increase operator action time is judged not cost-beneficial.

SAMA #191 – Remove the 135°F temperature trip of the PCCW pumps. The context of this plant-specific SAMA is to improve PCCW reliability by eliminating the potential for a spurious trip due to inadvertent actuation of the temperature switches. Each PCCW division is protected from high temperature with a 2-out-of-2 temperature element logic. It is noted that significant engineering re-analysis would be needed to ensure that elimination of this protective trip would not violate the PCCW system design basis. Spurious operation of this logic could fail the associated division of PCC by tripping off the pumps. A Phase II evaluation was performed using PRA Case PCTES. This case assumed elimination of 100% of the inadvertent failure of the redundant temperature element/logic as a failure mode of the associated PCC division for both loss of PCCW (A/B) initiating events (during the year) and loss of PCCW (A/B) mitigative function (mission time). The results of this case study show that inadvertent actuation of the temperature/element logic does not contribute significantly to the system unreliability. The following results were obtained from PRA case PCTES:

Nominal Cost-Benefit: <$1K

Upper Bound Cost-Benefit: <$1K

% Reduction in OECR: <1%

Cost of SAMA: The engineering analysis costs to justify a change in the design basis temperature and impacts to pipe stress and structural support is estimated to exceed $100K.

Based on this case study, engineering analysis and modifications to eliminate the high temperature trip and preserve the design basis are judged to exceed the upper bound cost-benefit and thus are judged not cost-beneficial.

SAMA RAI 5o

5) Provide the following with regard to the SAMA identification and screening process:

o. SAMAs 173 and 185 both are described as "improve procedural guidance for directing depressurization of RCS" and both are dispositioned as already implemented. Clarify the difference between these two SAMAs.

NextEra Energy Seabrook Response to SAMA RAI 5o

SAMA #173 and #185 are both related to improved procedure guidance for directing operators to perform RCS depressurization. Table F.6-1 provides the description of these SAMAs.

SAMA #173 - The context of SAMA #173 is to have adequate procedure guidance directing operators to depressurize the RCS before core damage, during SBO-type sequences with success of the turbine-driven EFW pump, to minimize loss of primary inventory due to RCP seal leakage. This action is modeled in the Level 1 PRA to prevent/delay core damage. The procedure guidance is explicitly provided in the EOP.

SAMA #185 - The context of SAMA #185 is to have adequate procedure guidance directing operators to depressurize the RCS after core damage to reduce the potential for a high pressure core melt ejection (HPME) and challenge to containment due to direct containment heating (DCH). This action is modeled in the Level 2 PRA prior to hot leg creep rupture and prior to RPV failure to prevent an energetic HPME event from occurring. The procedure guidance is explicitly provided in the EOP.

These SAMAs were identified from review of the Seabrook IPE and IPEEE and have been completed. The operator guidance provided in these procedures is judged adequate. Thus, both SAMAs were screened in Phase 1, Criterion B – intent met.

SAMA RAI 5p

5) Provide the following with regard to the SAMA identification and screening process:

p. ER Table F.5.6-1 Footnote A states that "Plant-specific SAMA candidates based on review of IPE, IPEEE, presentation and solicitation of plant personnel and expert panel " were the source for several non-industry or NEI SAMAs. Clarify that the RRW listing was used to identify SAMAs consistent with Tables F.3.1.1.1-2 and F.3.2.1-2.

NextEra Energy Seabrook Response to SAMA RAI 5p

The SAMA identification process specifically included a review of the top RRW basic events provided in Tables F.3.1.1.1-2 and F.3.2.1-2. As provided in Section F.5.1 of the Seabrook SAMA Report, the risk reduction worth (RRW) of the components in the baseline model was used to identify the basic events that could have a significant potential for reducing risk. Components with RRW >1.005 were identified as the most important components. A similar review was performed on a system basis. The components and systems were reviewed to ensure that each component and system was covered by an existing generic or plant-specific SAMA item based on a "functional" category. For example, basic event FWP37A.FR, "Turbine Driven Pump FW-P-37A Fails to Run" is identified with SAMAs related to Feedwater & Condensate. A specific SAMA candidate was not identified to address risk reduction of each basic event due to their relatively low RRW importance, corresponding low cost-benefit, and the basic event's relationship to the assigned functional SAMA category. Refer to Seabrook response to RAI 5b.

SAMA RAI 5q

5) Provide the following with regard to the SAMA identification and screening process:

q. ER Table F.5.6-1 presents SAMA 188 to modify "a containment ILRT 10-inch test flange to include a 5-inch adapter" that Table F.6-1 screen outs with an explanation in the Phase I Disposition column that "flange and procedure exists." The applicability of this disposition is unclear. Is there already a 5-inch adapter on the ILRT 10-inch flange to connect fire water?

NextEra Energy Seabrook Response to SAMA RAI 5q

The 10-inch flange with fire hose adapter has been pre-fabricated; is stored in a designated, controlled area and is available for attaching to the 10-inch ILRT flange for the purpose of containment flooding via Severe Accident Guideline instructions. The flange/adapter would be used to connect the fire system as one alternate means of performing containment flooding. The entire containment flooding evolution via the fire water hose connection is expected to take several days. Therefore, there is no significant time savings to be realized by pre-installation of the flange adapter.

SAMA RAI 5r

5) Provide the following with regard to the SAMA identification and screening process:

r. Section F.6 presents screening criteria used in the Phase 1 analysis. Neither screening criterion D (Excessive Implementation Cost) nor E (Very Low Benefit) is used in Table F.6.1. Phase II Table F.7.1 seems to use screening criterion D via Footnote 1: "Risk reduction not specifically evaluated because estimated cost exceeds the possible maximum averted cost-risk." Clarify that criterion D was used in Phase II and not Phase I and why. Also clarify why criterion E was not used at all?

NextEra Energy Seabrook Response to SAMA RAI 5r

Screening criteria A (not applicable), B (already implemented or intent met), or C (combined) were used as the primary Phase I criteria conceptually to force evaluation of more SAMA candidates under Phase II. Although criterion "D" or "E" could have been used under Phase I, an attempt was made to judge SAMA costs and benefits as part of Phase II instead of Phase I. In doing so, criterion D and E were not used.

SAMA RAI 5s

5) Provide the following with regard to the SAMA identification and screening process:

s. The IPE identifies an improvement to install an "alternate, independent emergency feedwater pump (e.g., diesel firewater pump hard piped to discharge of startup feed pump." SAMA 29, "provide capability for alternate injection via diesel-driven fire pump," was screened in Phase 1 as "implemented through alternate mitigation strategy." In addition, SAMA 163, "install third EFW pump (steam-driven)," was determined to not be cost-beneficial based on the estimated benefit of \$100K in the baseline analysis and \$190K in the uncertainty analysis, and a cost of >\$250K. Describe the alternate mitigation strategy that was the basis for screening SAMA 29 and, since SAMA 29 appears to be a lower cost alternative than SAMA 163 and would achieve much of the estimated benefit of SAMA 163, clarify why SAMA 29 should not be further considered in the Phase 2 evaluation.

NextEra Energy Seabrook Response to SAMA RAI 5s

SAMA #29, "Provide Capability for Alternate Injection via Diesel-driven Fire Pump", was screened in Phase I using Criterion B – Intent Met, implemented through alternate mitigation strategy. The capability to use the fire system (with diesel-driven fire pump) for injection to the steam generators exists and implementation instructions are provided in Seabrook's Severe Accident Management Guidelines. In addition, two portable diesel-driven pumps are also available to perform this function using (1) the suction from the fire protection system/hydrant, (2) the cooling tower basin, or (3) the Browns River. Use of the portable diesel-driven pump is also included in the Severe Accident Management Guidelines. Therefore, SAMA #29 was screened as intent met in Phase I and further consideration under Phase II is not necessary.

RAI Section 6

SAMA RAI 6a

6) Provide the following with regard to the Phase II cost-benefit evaluations:

a. Provide the % reduction in OECR for each SAMA evaluated in Table F.7-1 and any other SAMAs evaluated in response to RAIs.

NextEra Energy Seabrook Response to SAMA RAI 6a

The percent reduction in offsite economic cost risk (OECR) for each SAMA evaluated in Table F.7-1 is provided in the table below. The reduction in OECR is assumed to be the ratio of the SAMA's property damage savings to the maximum attainable property damage savings and is based on the base case (best estimate 7% discount rate).

SAMA #	SAMA PRA Case	Approximate OECR Reduction
#2, #20, #154, #161, #190	NOSBO	14%
#13, #14, #16, #24, #156	NOLOSP	43%
#21	BREAKER	1%
#41	LOCA01	2%
#25, #26, #39	LOCA02	49%
#28	LOCA03	22%
#35, #106	LOCA04	13%
#147	LOCA05	16%
#113, #115, #187	LOCA06	1%
#43	SW01	1%
#44, #59,	CCW01	19%
#55, #167, #168, #169, #170, #172	RCPLOCA	10%
#80	HVAC2	1%
#94, #186	CONT01	32%
#112, #114	CONT02	48%
#96, #108, #109	H2BURN	9%
#119, #121, #125, #126, #129	NOSGTR	14%
#130, #131, #133, #174	NOATWS	14%
#153	NOSLB	0%
#157, #159	INDEPAC	2%
#162, #164	CST01	0%
#163	TDAFW	7%
#165	NORMW	8%

SAMA #	SAMA PRA Case	Approximate OECR Reduction
#175	FIRE2	0%
#179	FIRE1	0%
#181	SEISMIC01	17%
#182	SEISMIC02	0%
#184	PURGE	0%
#189	1OF2SEPS	2%

SAMA RAI 6b

6) Provide the following with regard to the Phase II cost-benefit evaluations:

b. ER Section E.7.2 and Table F.7-1 state that an expert panel developed the implementation cost estimates for each of the SAMAs. Describe the level of detail used to develop the cost estimates (i.e., the general cost categories considered). Also, clarify whether the cost estimates accounted for inflation, contingency costs associated with unforeseen implementation obstacles, replacement power during extended outages required to implement the modifications, and maintenance and surveillance costs during plant operation.

NextEra Energy Seabrook Response to SAMA RAI 6b

The costs associated with implementation of SAMA candidates were determined based on the experience and judgment of plant staff serving as an independent, expert panel. In most cases, a detailed cost estimate was not performed because of the large margin between the individual SAMA cost-benefits and the judged cost associated with implementation. For procedure modifications, a minimum cost range of $15K to $40K was used for implementation of a procedure change depending on the type of procedure (AOP/EOP, etc.), extent of procedure change and with no engineering analysis required. For hardware modifications, a minimum cost of $100K was used for development and implementation of a non-complex hardware modification. These costs represent expert panel judgment for procedure and facility changes that affect risk significant systems or initiating events. No specific allowance is given for inflation, contingencies, implementation obstacles, replacement power, etc.

These lower bound cost estimates are comparable with industry experience as shown in other recent License Renewal / ER submittals for Indian Point, Duane Arnold, Pilgrim, Cooper, and Vermont Yankee.

SAMA RAI 6c

6) Provide the following with regard to the Phase II cost-benefit evaluations:

c. For certain Phase II SAMAs listed in Table F.7-1, the information provided does not sufficiently describe the associated modifications and what is included in the cost estimate. Provide a more detailed description of both the modification and cost estimate for SAMAs 44, 59, 94, 112, 114, 163, 186, and 187.

NextEra Energy Seabrook Response to SAMA RAI 6c

SAMA #44 – Eliminate ECC Pump Cooling Water Dependency - The context of this SAMA is to enhance ECCS pump reliability by eliminating a direct component cooling water dependency. Currently, the ECCS pumps require component cooling as follows: Safety Injection and Charging pumps need CCW for lube oil cooling; RHR pumps need CCW for cooling of the mechanical seal during RHR shutdown cooling and long term sump recirculation. The modifications needed to eliminate the CCW direct dependency would involve either a redesign/replacement of the ECCS pumps (6 pumps) or a redesign/replacement of CCW to incorporate independent cooling. It is noted that room cooling for these pumps also depends on CCW, thus complete elimination of the CCW dependency is judged not practical. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for the development and installation of an independent cooling mechanism or new pumps.

SAMA #59 – Install Additional CCW Pump - The context of this SAMA is to enhance CCW reliability by installing an additional CCW pump. Given the high reliability of the existing CCW system (each division of CCW has two pumps (four CCW pumps total), an additional pump would need to be completely independent of the existing pumps to maximize the reliability benefit. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for the development and installation of an additional pump. It is noted that a benchmarked plant estimated the cost of this type of modification to be in the range of $1.5M.

SAMA #94 – Install Containment Filtered Vent - The context of this SAMA is to eliminate containment overpressure failure events by removing decay heat from containment via a filtered vent which would retain fission products. The design concept for this SAMA improvement was provided in the industry SAMA tables as consisting of gravel bed filters or venture scrubber. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for the development and installation of a filtering system. It is noted that a benchmarked plant estimated the cost of this type of modification to be in the range of $5M to $6M.

SAMA #112 – Install Containment Isolation Valve Limit Switches - The context of this SAMA is to improve the containment isolation function by increasing containment isolation valve reliability. The design concept for this SAMA was provided in the industry SAMA tables as consisting of adding redundant and diverse limit switches to each containment isolation valve. At Seabrook, containment isolation valves are already equipped with limit switches. The limit switch function is primarily for valve position indication/verification and judged not to contribute significantly to the overall reliability of the containment isolation valves themselves. Adding yet additional limit switches is judged not practical and would not significantly improve reliability. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for concept development and installation of improved isolation valve limit switches.

SAMA #114 – Install Self-Actuated Containment Isolation Valves – The context of this SAMA is to improve the containment isolation function by increasing containment isolation valve reliability. The design concept for this SAMA was provided in the industry SAMA tables as consisting of installation of self-actuated containment isolation valves. At Seabrook, isolation of containment penetrations is typically performed using motor operated valves (MOV), air operated valves (AOV) and check valves (CV), and combinations of these valves, depending on the operational function and isolation requirements of the specific penetration. Check valves are considered to be self-actuated valves. MOVs and AOVs automatically close upon receipt of Engineered Safety Actuation Signals. Based on the conceptual SAMA description and Seabrook's current design features, a more accurate disposition of this SAMA is to screen it in Phase I, Criterion B – intent met. In addition, given that the conservative, upper-bound cost-benefit of this SAMA was limited to ~$379K, a detailed estimate of this proposed modification was not performed. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for development and installation of possible improved isolation design of containment penetrations.

SAMA #163 – Install Steam-Driven EFW Pump - The context of this SAMA is to improve the reliability of the EFW system by installing a second steam-driven EFW pump. Given that the conservative, upper-bound cost-benefit of this SAMA was limited to ~$190K, a detailed cost estimate of this proposed modification was not performed. The cost estimate of >$250K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of possible costs of design engineering, material procurement, installation, test, operations procedures, etc. Based on the Seabrook plant layout, the concept for adding a steam-driven EFW pump, while maintaining the design basis and reliability of other systems, e.g., impact of high-energy piping on existing SSCs, would include construction of a new building/structure to house the pump. The cost of design/engineering, construction, material procurement, procedures, training, testing and maintenance would clearly exceed the cost-benefit of this modification.

SAMA #186 – Install Containment Leakage Monitoring System - The context of this SAMA is to improve the reliability of containment performance by installing improved leakage monitoring systems that would reduce to potential for pre-existing leakage. Given that the conservative, upper-bound cost-benefit of this SAMA was limited to ~$310K, a detailed estimate of this proposed modification was not performed. The cost estimate of >$500K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of possible costs of design engineering, material procurement, installation, test, operations procedures, etc.

SAMA #187 – Install RHR Isolation Valve Leakage Monitoring System - The context of this SAMA is to improve the reliability of RHR isolation integrity and thus reduce the risk of ISLOCA events. Given that the conservative, upper-bound cost-benefit of this SAMA was limited to ~$53K, a detailed estimate of this proposed modification was not performed. The cost estimate of >$100K shown in Table F.8-1 was determined from expert panel judgment, based on the SAMA description and consideration of possible costs of design engineering, material procurement, installation, test, operations procedures, etc. needed to enhance the ability to monitor the integrity of individual RHR valves located both inside and outside of containment.

SAMA RAI 6d

6) Provide the following with regard to the Phase II cost-benefit evaluations:

d. The benefit and cost evaluation of SAMA 80, "Provide a redundant train or means of ventilation," assumes removal of HVAC dependency for cooling system (CS), safety injection (SI), residual heat removal (RH), and containment building (CB) spray pumps. It is possible that just one of these systems provides most of the benefit. Provide an assessment of a SAMA to remove HVAC dependency for just the highest risk system.

NextEra Energy Seabrook Response to SAMA RAI 6d

The baseline PRA assumes that all of the ECCS pumps require HVAC (via the emergency air handling – EAH) during sequences involving long term containment sump recirculation. The cost-benefit determination for SAMA #80 is based on PRA case study HVAC2. This PRA case conservatively assumed 100% elimination of the HVAC dependency of all ECCS systems during the long term recirculation sequences. This conservative assumption resulted in a maximum cost-benefit of $32K (nominal at 7% discount rate) and $61K (upper bound). An assessment of this SAMA to remove the HVAC dependency for just the highest risk ECCS system would result in the same or lower cost-benefit. Installation of a redundant HVAC train to either a single ECCS pump/system or to multiple ECCS pumps/systems is judged to cost >$500K, significantly more than the upper bound cost-benefit.

SAMA RAI 6e

6) Provide the following with regard to the Phase II cost-benefit evaluations:

e. The estimated cost of SAMA 65, "Install a digital feed water upgrade," is $30M while the estimate cost of SAMA 147, "Install digital large break LOCA protection system," is >$500K. Provide justification for the cost estimates for these two systems. In the response, address the reason for the large cost difference between what appear to be two similar modifications.

NextEra Energy Seabrook Response to SAMA RAI 6e

The $30M cost estimate for SAMA #65 is based on a detailed assessment of costs associated with Seabrook's long range plan for digital upgrade of BOP control systems including the feedwater control system. The >$500K cost estimate for SAMA #147 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of design engineering, material procurement, installation, test, operations procedures, etc. for concept development and installation of that system. Given that the conservative, upper bound cost-benefit is ~$196K, a detailed cost estimate of the digital LOCA protection system was not performed. It is noted that a benchmarked plant estimated the cost of this type of modification to be ~$2M.

SAMA RAI 6f

6) Provide the following with regard to the Phase II cost-benefit evaluations:

f. The estimated benefits for SAMAs 96, 108, and 109, which assume elimination of all hydrogen ignition/burns, are negative for the reduction in dose-risk (i.e., the dose-risk increases). Describe the reason for this anomalous result.

NextEra Energy Seabrook Response to SAMA RAI 6f

Hydrogen burns do not provide a significant challenge to the containment because of the robust design strength of Seabrook's containment building. Thus, from a risk perspective, hydrogen burns do not contribute to containment failure and there is no change (zero) in containment release when assuming that all hydrogen burns are eliminated. The % reduction in offsite dose in Table F.7-1 was inadvertently shown as a -0.05% due to round off and subtraction from the base case result. The correct % reduction in offsite dose for SAMA #96, 108 and 109 is 0.0%.

SAMA RAI 6g

6) Provide the following with regard to the Phase II cost-benefit evaluations:

g. The estimate cost for SAMA 113, "Increase leak testing of valves in ISLOCA paths," of $100K seems high for what does not appear to be a hardware modification. Provide justification for the cost estimate.

NextEra Energy Seabrook Response to SAMA RAI 6g

The >$100K cost estimate for SAMA #113 was determined from expert panel judgment, based on the SAMA description and consideration of potential costs of procedure changes and performance of more frequent inspections. Most of the candidate ISLOCA valves are located inside containment. Leak testing of the ISLOCA valves is typically done during plant refueling/cold shutdown conditions, when the valves are assessable and the systems can be aligned/configured to allow installation of test equipment and performance of the testing. Leak testing, as is currently done, but on a more frequent basis, would require costly plant shutdown. It is noted that a benchmarked plant estimated the cost of this type of modification to be ~$190K.

SAMA RAI 6h

6) Provide the following with regard to the Phase II cost-benefit evaluations:

h. It is unclear from the description of SAMAs 157 and 159 (SAMA Case INDEPAC) what changes were made to the PRA model to generate the estimated benefits. Provide a more detailed description of the PRA model changes made to evaluate these SAMAs.

NextEra Energy Seabrook Response to SAMA RAI 6h

SAMA #'s 157 and 159 are concerned with improving battery life of station batteries during SBO conditions when normal and emergency AC power is not available to charge the batteries. Alternate AC power to charge the batteries (#157) or a pre-charged, independent standby battery that could be aligned (#159) could improve long term SBO sequence by allowing more time to recover offsite power. Two modifications were made to the PRA model to estimate the potential cost-benefit of these SAMAs:

(1) Top Event ODC12, Operator Action to Shed DC Loads to Extend Batteries to 12 Hours: Operator action ODC12 was changed from its nominal value of 5.4E-03 to guaranteed success (value of 0.0). This ensures that DC battery 12 hour life is guaranteed successful provided that the DC buses, batteries and related equipment are available (have not previously failed randomly).

(2) Top Event ROSP, Recover Offsite Power: The following offsite power recovery split fractions were set from their nominal failure probability value (shown in parenthesis) to guaranteed success (value of 0.0):

Plant-related LOSP: ROSPPB (1.60E-02), ROSPPC (6.90E-03), ROSPP7 (8.30E-02)

Grid-related LOSP: ROSPGB (1.70E-02), ROSPGC (4.30E-03), ROSPG7 (1.92E-01)

Weather-related LOSP: ROSPWB (1.43E-01), ROSPWC (8.50E-02), ROSPW7 (3.63E-01)

These split fractions were chosen because they apply to SBO sequences that include 12 hour battery life and core damage does not occur until approximately 12 hours or greater. The 12 hour sequences are the relevant SBO sequences that would benefit from extending battery life beyond 12 hours by providing an independent ac power source (connection of the proposed portable generator) to charge the station batteries, thus allowing continued operation of the steam-driven EFW pump and ASDVs and extending the time available for recovery of offsite power before core damage occurs. Other sequences that result in core damage before approximately 12 hours would not significantly benefit from the proposed SAMA and the related PRA modeling split fraction values are maintained at there baseline value.

SAMA RAI 6i

6) Provide the following with regard to the Phase II cost-benefit evaluations:

i. The estimated cost of SAMA 157, "Provide independent AC power source for battery chargers," of $30K seems low for what is described as a hardware change. Provide justification for the cost estimate.

NextEra Energy Seabrook Response to SAMA RAI 6i

The estimated cost of SAMA #157 is based on expert panel judgment and includes: procurement of a small portable, non-safety related 480V generator, associated connection cables, and operation guideline. Cost considers that the portable generator would be stored in a convenient location on site (warehouse) and moved into position/connected if ever needed during an extended SBO event.

SAMA RAI 6j

6) Provide the following with regard to the Phase II cost-benefit evaluations:

j. The evaluation of SAMA 179, which assumed eliminating initiator FCRPL, resulted in a Table F.7-1 reduction in CDF of 0.69%, while Table F.3.1.1.1-1 reports the contribution to CDF from initiator FCRPL to be 1.00%. The evaluation of SAMAs 119, 121, 125, 126, and 129, which assume SGTR events do not occur, resulted in a Table F.7-1 reduction in CDF of 3.47%, while Table F.3.1.1.1-1 reports the contribution to CDF from initiator SGTR to be 4.00%. The evaluation of SAMAs 113, 115, and 187, which assume ISLOCA events are all eliminated, resulted in a Table F.7-1 reduction in CDF of 2.08%, while Table F.3.1.1.1-1 reports the contribution to CDF from initiator LOC1VS to be 2.30%. Clarify the reason for these, and any other, discrepancies and their impact on the SAMA analysis.

NextEra Energy Seabrook Response to SAMA RAI 6j

Each of the above differences in initiating event CDF contribution between Table F.3.1.1.1-1 and Table F.7-1 were reviewed. The difference in contribution result is due to rounding. Table F.3.1.1.1-1 was developed from internal PRA documentation and was intended to provide general knowledge of CDF contributions. Table F.7-1 results are judged more precise and these form the basis for SAMA. Therefore, there is no impact on the SAMA results.

SAMA RAI 6k

6) Provide the following with regard to the Phase II cost-benefit evaluations:

k. The ratio of the 95th percentile CDF to the mean value CDF was reported to be 1.9 in Section F.8.2 of the ER. While this is a "typical" result for internal event CDF, it seems quite low for the fire and seismic CDFs which generally have wider uncertainty bands than internal events. Describe how the uncertainty distribution was developed and discuss how and why the CDF distribution is different for internal, fire, and seismic CDF.

NextEra Energy Seabrook Response to SAMA RAI 6k

The Seabrook Station PRA model is an integrated model of both internal and external events. As stated in Section F.3.1 of the SAMA Report, the Seabrook Station baseline, at power CDF, including both internal and external initiators is 1.44E-5/yr (mean value). The CDF uncertainty for the integrated model is represented by the following distribution:

5th Percentile = 7.37E-6

50th Percentile = 1.26E-5

95th Percentile = 2.75E-5

This uncertainty distribution was developed based on a saved-sequence model with 1450 sequences at 1E-9 bin cutoff, and Monte-Carlo sample size of 10,000. This distribution includes the integrated contribution of all events, both internal and external. Use of the integrated 95th percentile to determine the upper bound ratio between mean and 95th provides a reasonable approximation of upper bound cost-benefit for PRA case results, which are based on the integrated model. This approach is consistent with industry guidance, NEI 05-01. Individual distributions for contributions of internal, fire and seismic CDF were not developed.

SAMA RAI 7

7) 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, discuss whether any lower-cost alternatives to those Phase II SAMAs considered in the ER would be viable and potentially cost-beneficial. Evaluate the following SAMAs (previously found to be potentially cost-beneficial at other plants), or indicate if the particular SAMA has already been considered. If the latter, indicate whether the SAMA has been implemented or has been determined to not be cost-beneficial at Seabrook Station.

a. Use a portable generator to extend the coping time in loss of AC power events (to power selected instrumentation and DC power to the turbine-driven auxiliary feedwater pump). This is an expanded version of SAMA 74.

b. Provide alternate DC feeds (using a portable generator) to panels supplied only by DC bus.

c. Purchase or manufacture of a "gagging device" that could be used to close a stuck-open steam generator safety valve for a SGTR event prior to core damage.

NextEra Energy Seabrook Response to SAMA RAI 7

Seabrook has a robust design and many plant safety enhancements have already been implemented at the station. The CDF is relatively low and the contribution to CDF is not significantly dominated by a single initiator. As a result, many SAMAs were screened in Phase I as intent met. Also, individual component contributions to core damage frequency are relatively low, making associated cost-benefits relatively low, even when assuming 100% of the component's contribution is eliminated. Based on inspection of the SAMA list, no new potentially cost-benefit SAMA candidates were identified.

Regarding Items 7a and 7b: Use of a portable generator to extend the SBO coping time by charging station batteries, which supply DC buses, is identified as a potentially cost-beneficial modification. Refer to SAMA #157.

Regarding Item 7c: Use of a gagging device for closing a stuck-open steam generator safety valve during a SGTR event prior to core damage - a Phase II evaluation was performed using PRA Case MSSVRS. This case assumed guaranteed success of main steam safety valve re-closure during a SGTR event, provided that operators were successful at controlling EFW flow, Safety Injection (SI) and RCS depressurization. If one of these actions is not successful, MSSV re-closure is assumed failed. The results of this case study show that MSSV failure to reclose does not contribute significantly to plant risk results. The following results were obtained from PRA case MSSVRS:

Nominal Cost-Benefit: <$1K

Upper Bound Cost-Benefit: <$1K

% Reduction in OECR: <1%

Based on this case study, implementation hardware and procedure changes are judged not cost-beneficial.