Enclosure 2

MFN 16-062

APPLICANT'S SUPPLEMENTAL ENVIRONMENTAL REPORT – AMENDMENT TO STANDARD DESIGN CERTIFICATION (ABWR RENEWAL DOCKET 52-045)

GE Hitachi Nuclear Energy

REVISION STATUS SHEET

Document Title: APPLICANT'S SUPPLEMENTAL ENVIRONMENTAL REPORT – AMENDMENT TO STANDARD DESIGN CERTIFICATION (ABWR RENEWAL DOCKET 52-045)

Type: Report

Safety-Related Classification Code: N/A MPL No.: A90-3240G

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Rev #	Date (MM/YYYY)	Responsible Engineer	Status	Revision Summary (or ECO #)
0	11/2010	JF Galtman	Verified	Initial Issue (RMCN18694)
1	08/2016	PL Campbell	Verified	Changed title to agree with 10 CFR 51.55(b); updated to include amendments to the ABWR DCD based on renewal of design certification (ECO-0026732)
2	08/2016	PL Campbell	Verified	Reformatted to capture complete table of review items.

IMPORTANT NOTICE REGARDING THE CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished for the purpose of supporting the NRC review of the ABWR design certification renewal, with the information here being used as ABWR DCD supporting reference material. The only undertakings of GE Hitachi Nuclear Energy (GEH) with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

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1.0 SCOPE

This supplemental environmental report supplements the Advanced Boiling Water Reactor (ABWR) technical support document (i.e., environmental report) that provided an assessment of severe accident mitigation design alternatives (SAMDA) submitted December 21, 1994 (Reference 1), for the original ABWR design certification. The NRC issued a Final Environmental Assessment (EA) for the ABWR design certification (Reference 2).

This supplement is in support of the GE Hitachi Nuclear Energy (GEH) ABWR design certification renewal application submitted December 7, 2010, in accordance with 10 CFR 52.57(a). This section provides the purpose, background, and scope of the supplement.

1.1 PURPOSE OF ASSESSMENT

This supplemental environmental report is being provided to satisfy the requirements of 10 CFR 51.55(b), and evaluates the impact of the design changes in the renewal application on the original assessment of SAMDAs for the ABWR design. Section 51.55(b) states:

> Each applicant for an amendment to a design certification shall submit with its application a separate document entitled, “Applicant's Supplemental Environmental Report-Amendment to Standard Design Certification.” The environmental report must address whether the design change which is the subject of the proposed amendment either renders a severe accident mitigation design alternative previously rejected in an environmental assessment to become cost beneficial, or results in the identification of new severe accident mitigation design alternatives that may be reasonably incorporated into the design certification.

Specifically, this supplemental environmental report provides the results of a review to determine whether any of the SAMDAs previously rejected is rendered cost-beneficial by the design changes or results in the identification of a new SAMDA that reasonably may be incorporated into the ABWR design certification. As discussed below, the design changes do not cause a previously rejected SAMDA to become cost beneficial or result in the identification of new SAMDAs that may be reasonably incorporated into the ABWR design.

1.2 ORIGINAL SAMDA ASSESSMENT FOR ABWR DESIGN CERTIFICATION

The original SAMDA assessment for the ABWR design certification concluded that:

1. For the ABWR design, all reasonable steps have been taken to reduce the occurrence of a severe accident involving substantial damage to the core and to mitigate the consequences of such an accident should one occur;
2. No cost-effective SAMDAs to the ABWR design have been identified to prevent or mitigate the consequences of a severe accident involving substantial damage to the core;

3. No further evaluation of severe accidents for the ABWR design, including SAMDAs to the design, is required in any environmental report, environmental assessment, environmental impact statement or other environmental analysis prepared in connection with issuance of a combined license for a nuclear power plant referencing a certified ABWR design.

In the EA for the design certification, the NRC concluded that, based on review of the SAMDA assessment, that the evaluation provides a sufficient basis to conclude that there is reasonable assurance that the ABWR design will not exclude SAMDAs for a future facility that would have been cost beneficial had they been considered as part of the original design certification application.

As explained in the NRC EA, the ABWR has a low risk, with the core-damage frequency (CDF) calculated to be 1.6E-7 per reactor year. The NRC acknowledges that, with the low CDF, any modifications costing more than a few dollars would not be cost effective, even if the design modification totally eliminated the severe accidents or their consequences. The NRC recognized that the ABWR standard design includes design features that reduce risk, including risk from severe accidents, and that certain design changes had been made based on results of the PRA. To evaluate the design alternatives described in the SAMDA report, the NRC staff values for the cost/benefit comparison are based on the conservative assumption that each design improvement would eliminate all of the residual risk over the 60-year plant life, and concluded that none of the modifications evaluated would be cost effective (even when considering the updates to the NRC regulatory analysis guidelines that were adopted prior to design certification of the ABWR). The NRC EA concludes that the NEPA evaluation of the issues considered as part of the original design certification application is considered resolved for the ABWR design. The original SAMDA conclusions continue to apply to the ABWR design and this supplemental assessment is for the purpose of assessing those design changes that are made in the amendment associated with the renewal application.

1.3 SCOPE OF ASSESSMENT

1.3.1 Aircraft Impact Assessment

This supplemental environmental report to the SAMDA assessment addresses the requirements of 10 CFR 50.150, the Commission's aircraft impact assessment (AIA) rule, and other design changes that are associated with the renewal application amendments to the ABWR DCD.

The AIA rule, issued in 2009 (Reference 3), requires applicants for new nuclear power reactors to perform a design-specific assessment of the effects of the impact of a large, commercial aircraft. The applicant is required to use realistic analyses to identify and incorporate design features and functional capabilities to show, with reduced use of operator actions, that either the reactor core remains cooled or the containment remains intact, and either spent fuel cooling or spent fuel pool integrity is maintained. The ABWR DCD is revised to describe the results of such an assessment of the certified ABWR design and identifies and incorporates design features and functional capabilities to show, with reduced use of operator actions, that the reactor core remains cooled and spent fuel pool

integrity is maintained. Because the NRC has accepted an approach that follows NRC and industry guidance, and the NRC verifies conformance through inspection, the design changes are considered as adding features that address an event and would mitigate the risk of the specific event (i.e., aircraft impacts) if such an unlikely event were to occur. Certain design changes are made (largely in Appendix 3H for structural and in Appendix 9A for fire barriers) to incorporate the assessment inputs. The key design features are added to DCD Appendix 19G, but no changes are made to the PRA.

1.3.2 Design Changes Other than AIA

As part of the NRC review of the ABWR design certification renewal application, certain other design changes have been identified through responses to NRC requests for additional information or other items and have resulted in amendments to the ABWR DCD. Those amendments have been reviewed and are described in this report. None of the proposed design changes either renders a severe accident mitigation design alternative previously rejected in an environmental assessment to become cost beneficial, or results in the identification of new severe accident mitigation design alternatives that may be reasonably incorporated into the design certification.

2.0 APPLICABLE DOCUMENTS

2.1 REFERENCES

The following documents are referenced in this report:

1. Letter from J. F. Quirk (GE) to R.W. Borchardt (NRC) titled "NEPA/SAMDA Submittal for the ABWR" dated December 21, 1994 which transmitted "Technical Support Document for the ABWR", 25A5680, which includes the SAMDA assessment and Attachment A, “Evaluation of Potential Modifications to the ABWR Design,” ADAMS Accession No. ML100210563.
2. “Final Environmental Assessment, By the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Relating to the Certification of the U.S. Advanced Boiling Water Reactor Design, Docket No. 52-001.” ADAMS Accession No. ML11231A786.
3. 74 Fed. Reg. 28,112 "Consideration of Aircraft Impacts for New Nuclear Power Reactors" dated June 12, 2009.
4. Letter from D. Matthews (NRC) to J. Head (GEH), “GE-Hitachi Nuclear Energy – United States Advanced Boiling-Water Reactor Design Certification Renewal Application,” July 20, 2012. ADAMS Accession No. ML12125A385.

2.2 CODES AND STANDARDS

None.

2.3 REGULATIONS AND REGULATORY REQUIREMENTS

The following regulations apply to this report.

2.3.1 U.S. Nuclear Regulatory Commission Regulations

a) 10 CFR Part 52, Subpart B, Standard Design Certifications.

b) 10 CFR 51.55(b).

2.3.2 U.S. Nuclear Regulatory Commission Guidance

a) Advanced Boiling Water Reactor Design Certification Renewal Applications: Draft NRC Staff Views on Application Content and Draft Staff Review Guidelines, Revision 3, December 1, 2010 (ADAMS Accession Number ML103140050).

3.0 SUMMARY DESCRIPTION

The original ABWR design certification rule is based on DCD Revision 4. The design changes that are identified in the ABWR DCD revisions subsequent to Revision 4 are reviewed for their impact on the NRC's assessment of SAMDAs for the ABWR design. A two-step evaluation process was used to determine the impact of each design change on the SAMDA assessment. This two-step process is modeled on the process used in other design certification supplemental environmental reports.[1]

1. The design change is evaluated to determine if there is a change to an ABWR Probabilistic Risk Assessment (PRA) modeled Structure, System, or Component (SSC). The term "PRA-modeled SSC" is defined as an SSC that is currently modeled in the ABWR PRA, or an SSC that, after evaluation, should be modeled in the ABWR PRA.
   a. A response of "No" eliminates the design change from further consideration.
   b. A response of "Yes" identifies the design change for further evaluation
2. A design change identified for further evaluation in 1.b (above) is qualitatively evaluated for PRA (severe accident) impact. Expert judgment is used to determine whether the change has an impact on severe accident mitigation, such as prevention or mitigation of vessel failure, containment failure, or offsite release.
   a. A design change with no severe accident impact is not considered for further evaluation. This conclusion is that the current SAMDA basis remains bounding.
   b. A design change that affects the design or performance of severe accident mitigation features is a candidate for cost-benefit analysis.

Table 1 summarizes the results of the review of the evaluated design changes for PRA/severe accident impacts.

[1] See NRC ADAMS Accession Number ML072670541 and ML093170455.

4.0 CONCLUSIONS

The conclusions from the review are that none of the design changes have an impact on ABWR severe accident risk. Because the ABWR PRA will not be modified as a result of this review, and consequently the ABWR PRA results will not change, the ABWR SAMDA assessment documented in Reference 1 remains valid and applicable to the amended ABWR DCD. Furthermore, the bases for the previously analyzed SAMDAs are not changed and new SAMDAs need not be considered and SAMDAs that were previously rejected in the environmental assessment for the ABWR (Reference 2), or otherwise considered (Reference 1), did not become cost beneficial due to the design changes.

Table 1 Design Change Review Results

Change Description	Related RAI or NRC Item[2]	PRA/Severe Accident Impact[3]	Comments
Dynamic Bearing Capacity	Item 1	None.	Information on the ABWR dynamic bearing capacity is added to the DCD, as related to establishing site parameters.
Hurricane Winds and Missiles	Item 2	None.	DCD changes involve terminology only, and there are no changes to forces or physical structures.
CRAC Computer Code	Item 3	None.	The DCD changes are text changes only in direction to COL applicants to use an appropriate severe accident consequences code, such as MACCS2, for determining site acceptability for severe accidents.
Maximum Groundwater Level	Item 4	None.	The DCD change adds information to identify the reference that is the basis for the maximum groundwater level site parameter. Design basis groundwater level is not modeled by the PRA.
Minimize Contamination	Item 5	None.	DCD changes involve text changes to cross-reference design features that address minimizing contamination under 10 CFR 20.1406.
Condensate Storage Tank (CST) Doses	Item 6 RAI 12.02-2	None.	Features are added to the DCD to minimize the effects of CST doses and leakage (e.g., adding COL Item for shielding; adding a berm around the tank). Dose rate and leakage of the CST do not impact the DCD PRA.
Source Term Tables	Item 7 RAI 12.02-1 RAI 12.02-3	None.	The DCD changes involved correcting errors in source term tables in Tier 2 and adding "Design Acceptance Criteria" to Tier 1 tables for plant shielding and monitoring.
Off-Gas System (OGS) Components	Item 8 RAI 11.04-1	None.	The DCD changes add references to Regulatory Guide 1.143 for the OGS components housed in the nonsafety-related Turbine Building. The off-gas system is not modeled by the PRA.

[2] NRC to GEH (J. Head), "GE-Hitachi Nuclear Energy – United States Advanced Boiling-Water Reactor Design Certification Renewal Application," July 20, 2012, Attachment: "Advanced Boiling Water Reactor Design Certification Renewal Design Changes For GE-Hitachi Nuclear Energy's Consideration." Items 14, 15, 16, 21, 24, and 25 did not result in changes to the DCD.

[3] Risk improvements are considered as having no impact.

Change Description	Related RAI or NRC Item[2]	PRA/Severe Accident Impact[3]	Comments
ECCS Suction Strainers	Item 9 RAI 06.03-1 RAI 06.03-2	None.	The DCD changes address generic concerns regarding suction strainer issues. The changes would be enhancements to the previous suction strainer design. The changes would not impact the PRA results, which are not sensitive to changes in strainer blockage probabilities.
ABWR DCD Gas Accumulation Locations - Addition of vent lines to RPV head spray nozzle	Item 10	None.	These programmatic changes are implemented to reduce or prevent the impact of possible accumulation of gases in important piping systems. There are no specific instances with adverse impact which would indicate a design deficiency. Therefore, PRA pumps and piping systems are expected to behave as modeled. The programmatic enhancements should increase pump and piping system reliability; however, their impact is reflected in the PRA model by failure rates, which would not change due to these enhancements. The design changes theoretically should decrease the probability of non-condensable gases disabling a safety-related system either due to gas binding or a potential hydrogen detonation. This change has no impact on the ABWR design certification PRA. The changes do not impact the SAMDA items or result in identification of new SAMDAs.
Spurious Actuations	Item 11 RAI 09.01.05-1	None.	DCD changes include a COL Item for the evaluation of multiple spurious actuations to ensure that spurious actuations due to fire are limited to one safety division and localized damage. This is consistent with the existing fire PRA.
Operating Procedures – Low Level Reactor Coolant	Item 12	None.	A COL Item is added to develop operating procedures to respond to prolonged low-level reactor coolant leakage below technical specification limits. This is a plant-specific item and has no impact on the ABWR PRA.
Overhead Heavy Load Handling System Cranes	Item 13	None.	The DCD changes add a commitment to ASME NOG-1 as an acceptable approach to meeting NUREG-0554 criteria for the design of overhead heavy load handling system cranes. The heavy load handling system is not modeled by the ABWR PRA.
Emergency Procedure and Severe Accident Management Guidelines	Item 17	None.	Implementing the emergency procedures and severe accident management guidelines consistent with NEI 91-04 is an activity that will be completed prior to plant operation. This does not impact the ABWR standard design certification PRA.
Seismic / Structural Analysis (reactor core seismic and LOCA loading)	Item 18(a)	None.	The ABWR standard design certification PRA assumed that the reactor core is designed to meet seismic and LOCA loading requirements, so the DCD changes to add a specific COL Item do not impact the PRA.

Change Description	Related RAI or NRC Item[2]	PRA/Severe Accident Impact[3]	Comments
Seismic / Structural Analysis (structural, dynamic, impact, and criticality analyses of fuel storage racks)	Items 18(b), 19, 20	None.	The DCD is modified to include COL Items for a spent-fuel rack design analysis that will address the structural and dynamic impacts and the criticality analyses of the plant-specific fuel storage racks. In addition, a design change removes the new fuel storage vault from the ABWR standard design. The removel of the new fuel vault for storing new fuel has no safety implications. Storing new fuel in the new fuel storage rack is not necessary to achieve the underlying purpose of safely storing new fuel. Spent fuel storage is outside the ABWR standard design PRA.
Ganged withdrawal sequence error correction	Item 22	None.	The DCD changes are error corrections and no analytical changes are involved.
Diesel Generator fuel oil transfer system tunnel structures	Item 23	None.	DCD changes provide additional details in describing design information for the tunnel structure, but do not involve design changes and there is no impact on the PRA.
Mitigating Strategies, Fukushima Recommendation 4.2	Item 26	None.	Design changes to address this recommendation include adding a new Alternating Current Independent Water Addition (ACIWA) subsystem to Residual Heat Removal (RHR) Loop B, including connection to the Fire Protection system (FP) and external hose connection for fire trucks. The added redundancy in ACIWA does not impact the ABWR DCD PRA, which conservatively
Spent Fuel Pool Wide Range Level Instrumentation, Fukushima Recommendation 7.1	Item 27 RAI 01.05-1	None.	The ABWR standard design is modified to include two safety-related wide range spent fuel pool level instruments. The SFP is outside of the scope of the standard design PRA. Therefore, there is no impact on ABWR standard design PRA.
Emergency Preparedness, Fukushima Recommendation 9.3	Item 28	None.	DCD changes include a new COL Item for addressing emergency preparedness and communications. These operational programs are not modeled in the ABWR standard design PRA.
Revised Containment Analysis and Vent System	RAI 06.02.01.01.C-1 RAI 06.02.01-1	None.	The design changes to correct certain errors include (1) a revised containment analysis for modeling of the drywell connecting vents for the FWLB and MSLB and the modeling of decay heat; (2) increased RHR heat exchanger overall heat transfer coefficient to satisfy the Utility Requirements Document (URD) commitments of refueling outage duration of 17 days. The changes do not impact the SAMDA items or result in identification of new SAMDAs.

Change Description	Related RAI or NRC Item[2]	PRA/Severe Accident Impact[3]	Comments
NRC Bulletin 2012-01 on Open Phase Circuit	RAIs: 08.02-1 and 08.02-2	None.	The bulletin identifies a design vulnerability related to compliance with NRC regulations in 10 CFR Part 50, Appendix A, GDC 17 (offsite power systems) and 10 CFR 50.55a(h) (protection systems). Because these regulatory requirements are design bases related, they do not directly impact the SAMDA for the ABWR. Also, addressing any specific design vulnerability would tend to be a risk mitigation enhancement rather than a potential impact on a severe accident. This design change in conjunction with other design/operating commitments decrease the probability of losing offsite power to all of the safety-related divisions. The changes do not impact the SAMDA items or result in identification of new SAMDAs.
Technical Support Center (TSC) Habitability	RAI 13.03-1	None.	The DCD changes are to clarify commitments to NUREG-0696 for the TSC to have post-accident habitability that is consistent with the Main Control Room. There is no change to the PRA.
Aircraft Impact Assessment to Meet 10 CFR 50.150	RAIs: 19-1 through 19-9	None.	The design changes being made to address the aircraft impact assessment result in a decrease in the probability of a severe accident occurring as a result of an aircraft impact. Although the design changes have this positive impact on potential consequences, there is no change in the probability of the event itself.
Containment Overpressure Protection System (COPS) Size Correction	None	None.	The ABWR DCD is revised to specify a larger pipe size and rupture disk to ensure that the COPS can achieve the minimum flowrate assumed in the DCD analysis. Because this is a correction to meet minimum requirements assumed in the DCD analysis, there is no change to the PRA. .
Review of Generic Safety Issues (GSI) and Operating Experience	None	None	The reviews of GSIs and operating experience resulted in changes to document design features that address the issues identified. The changes in the DCD do not modify the standard design features themselves, and there is no impact on the PRA.