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Subject: Response to Portion of NRC Request for Additional Information ESBWR Severe Accident Management Design Alternatives Related to ESBWR Design Certification Application, RAI Numbers 19.4.0-1 S01, 19.4.0-1 S02 and 19.4.0-1 S03.

The purpose of this letter is to supplement the GE-Hitachi Nuclear Energy Americas LLC (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated December 8, 2005 (Reference 1) and responded to in Reference 2 on February 12, 2007. The information in the initial letter was provided to support NRC review of the GEH application for final design approval and standard design certification of the Economic Simplified Boiling Water Reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. This letter provides further discussion as requested by the NRC via email on May 31, 2007. The responses to those questions are addressed in Enclosure 1 as RAI Numbers 19.4.0-1 S01, 19.4.0-1 S02 and19.4.0-1 S03.

Should you have any questions about the information provided here, please contact me at 910-675-5057 or at jim.kinsey@ge.com.

Sincerely,

Kathy Sedney for

James C. Kinsey
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References:

1. MFN 05-156, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 3 for the ESBWR Design Certification Application,* December 8, 2005.

2. MFN 07-062, Letter from James C. Kinsey to U.S. Nuclear Regulatory Commission, ESBWR Severe Accident Management Design Alternatives, February 12, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.4.0-1 S01, 19.4.0-1 S02, 19.4.0-1 S03.

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)

eDRF Sections:	0000-0071-9729	For NRC RAI 19.4.0-1 S01
	0000-0071-9736	For NRC RAI 19.4.0-1 S02
	0000-0071-9714	For NRC RAI 19.4.0-1 S03

Enclosure 1

MFN 07-062 Supplement 1

Response to Portion of NRC Request for

Additional Information

Related to ESBWR Design Certification Application

ESBWR Probabilistic Risk Assessment

RAI Numbers 19.4.0-1 S01, 19.4.0-1 S02 and 19.4.0-1 S03

NRC RAI 19.4.0-1 S01

19.4-1 Supp A Section 6 of NEDO-33306 states that the list of severe accident mitigation design alternative candidates was compiled from the ABWR SAMA study, from a generic list compiled for License Renewal Environmental Reports and from Table 19.2-3 of DCD Tier 2 Chapter 19. Section 19.2.4.4 of Chapter 19 states that Table 19.2-3 summarizes the important initiating events, operator actions, common cause failures, SSCs, assumptions, and insights from importance, sensitivity, and uncertainty analyses. Please revise NEDO-33306 to describe the process used to develop Table 19.2-3 and demonstrate that all SSCs with high Fussell-Vesely and Risk Achievement Worth are addressed.

GEH Response:

NEDO-33306 has been revised to demonstrate that all SSCs with high risk importance are addressed in the severe accident mitigation alternatives evaluation.

DCD Tier 2 Chapter 19 Revision 3, Table 19.2-3 is a summary of plant-specific risk insights and assumptions for the ESBWR. The results encompass at-power and shutdown operating conditions, internal and external initiating events and, core damage and large release end states. The table summarizes the important initiating events, operator actions, common cause failures, SSCs, assumptions, and insights from the results of the comprehensive ESBWR PRA.

The insights found in Table 19.2-3 do not identify any additional design improvements with respect to severe accidents. This is consistent with the intention of the EPRI Utility Requirements Document (URD), which states that the safety design requirements go beyond the requirements of the Code of Federal Regulations, thereby providing additional safety assurance. The design for severe accident protection incorporates NRC policy level guidance and provides increased assurance of containment integrity and low leakage of radioactivity during a severe accident. This table has been deleted from NEDO-33306 Revision 1; however an evaluation of the dominant contributors has been added to Section 4 of NEDO-33306 to demonstrate that the SSCs with high risk significance are addressed in the evaluation.

NEDO-33306 Revision 1, Section 4 discusses the dominant severe accident sequence insights for the ESBWR design. Fussell-Vesely (F-V) importance values are evaluated for each basic event in the at-power internal events PRA. Insights from the external events and shutdown assessments are also considered, based on their contributions to CDF. The F-V importance values are a measure of relative risk improvement that account for the beneficial reduction in core damage frequency assuming that an SSC has perfect reliability. Risk Achievement Worth (RAW) importance values are a measure of relative risk increase, given that an SSC has failed. RAW is appropriate for evaluating the effects of taking equipment out of service, or for identifying the importance of defense-in-depth for safety functions. Since defense-in-depth is adequately incorporated into the ESBWR design, as reflected in the EPRI URD, RAW is not considered to be a useful measure for evaluating design enhancements, and F-V is considered to be the appropriate attribute.

The dominant F-V values from the at-power internal events basic events are common-cause failures of the control rods, common-cause failures of the GDCS injection lines check valves, and common-cause failures of the squib valves for GDCS and ADS. The largest F-V value is less than 0.5, which translates to a change in CDF of approximately 6 E-9/year. This represents the change in CDF if the components in a functional group are made perfect, which is the theoretical maximum benefit. Actual design improvements would yield lower changes in CDF.

Adding diversity would require significantly higher costs, with marginal benefit. For example, adding a second vendor to supply diverse squib valves would be costly because of the first-time engineering and qualification testing costs that would be incurred. The dominant F-V values from initiating events are also less than 0.5.

The dominant insight from the shutdown PRA is the need to close the lower drywell hatches during certain shutdown conditions following a LOCA. The net benefit would be a CDF reduction of approximately 1.5 E-9/year.

The insights from the external events and Level 2 analysis of severe accident sequences do not identify any other potential design enhancements that could significantly reduce risk. Overall, the maximum theoretical risk reduction from any design change is considered to be extremely low, and no further examination of cost-benefit is warranted.

DCD Impact:

No impact to the DCD.

Section 4 of NEDO-33306, Revision 1 has been revised to demonstrate that all SSCs with high risk importance are addressed in the severe accident mitigation alternatives evaluation.

NRC RAI 19.4.0-1 S02

19.4-1 Supp B Table 7.2-5 of NEDO-33306, Top Ten Cutsets Contributing to CDF, of NEDC-33201P identifies the following valve misposition actions: C12-XHE-MH-F013A, F013B, F015A and F015B. Please identify the maximum benefits of eliminating errors associated with the valve mis-position actions.

GEH Response:

NEDO-33201, Revision 2 has revised the naming convention for valve mispositioning events. For example, basic event C12-XHE-MH-F013A has been renamed to C1-BV_-RE-F013A. The renamed basic events still represent the valve mispositioning errors as they did in NEDO-33201, Revision 1. The following list contains the valve mispositioning events from the at-power internal events PRA (NEDO-33201, Revision 2.) Each valve mispositioning event is listed with its Fussell-Vesely (F-V) importance value, which represents the contribution of the basic event to CDF.

Basic Event	Description	F-V
C12-BV_-RE-F065	CST SUCTION TO CRD	0.124
G21-BV_-RE-F334	LPCI INJECTION TO RWCU	0.122
C12-BV_-RE-F013A	CRD INJECTION SUCTION HEADER	0.025
C12-BV_-RE-F013B	CRD INJECTION SUCTION HEADER	0.025
C12-BV_-RE-F015A	CRD INJECTION SUCTION HEADER	0.025
C12-BV_-RE-F015B	CRD INJECTION SUCTION HEADER	0.025
P21-BV_-RE-F050A	RCCW TO CRD HX OUTLET	0.019
P21-BV_-RE-F049A	RCCW TO CRD HX INLET	0.019
C12-BV_-RE-F021A	CRD INJECTION	0.019
P21-BV_-RE-F050B	RCCW TO CRD HX OUTLET	0.018
P21-BV_-RE-F049B	RCCW TO CRD HX INLET	0.018
C12-BV_-RE-F021B	CRD INJECTION	0.018
C12-BV_-RE-F003B	CRD PUMP SUCTION	0.006
C12-BV_-RE-F003A	CRD PUMP SUCTION	0.006
C12-BV_-RE-F064	COND/FW SUCTION TO CRD	0.006
G21-BV_-RE-F308	DISCHARGE TO SUPPR. POOL	0.002

The benefit of reducing or eliminating valve mispositioning errors is identified in the relationship between the F-V value and CDF. The largest F-V value of 0.124 translates to a reduction in CDF of 1.5 E-9/year, assuming that the probability of that human error could be eliminated.

DCD Impact:

No impact on the DCD.
NEDO-33201 has been revised as described above.

NRC RAI 19.4.0-1 S03

19.4-1 Supp C Reference Table 4 of NEDO-33306, SAMA Items for COL Holder Consideration. Please revise NEDO-33306 to address the Items for COL Holder Consideration more thoroughly: _ Identify those SAMAs that are not applicable or are not risk significant considering the ESBWR design (consistent with their disposition in Table 1)._ For the remaining SAMAs in Table 4, provide an estimate of the maximum benefit that would result if the error is eliminated and an estimate of the cost to implement the change.

GEH Response:

NEDO-33306 Revision 0, Table 4 "SAMA Items for COL Holder Consideration "was intended only to summarize actions that might be considered as good practices for addressing administrative or procedural controls relative to severe accident mitigation alternatives. None of the items in the table (that is, SAMA Items) involve design changes, and none are risk significant. The potential benefits offered by the administrative changes in Table 4 are significantly lower than benefits from the design modifications that are evaluated. Also, the costs of these non-design changes, such as engineering, procedure development, maintenance, and training, are likely to be substantial. Table 4 is not pertinent to the SAMDA evaluation and it has been deleted from NEDO-33306, Revision 1.

DCD Impact:

No DCD impact.
Table 4 has been deleted from NEDO-33306, Revision 1.