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MFN 08-223

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U.S. Nuclear Regulatory Commission
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Subject: **Response to NRC Request for Additional Information Letter Nos. 90 and 142 Related to the ESBWR Design Certification – Safety Analyses – RAI Numbers 15.4-13, 15.4-13S01, 15.4-32, 15.4-33 and 15.4-40**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letters dated January 29, 2007, and January 14, 2008, References 1 and 2, respectively. GEH responses to RAI Numbers 15.4-13, 15.4-13S01, 15.4-32, 15.4-33 and 15.4-40 are addressed in Enclosure 1. The "Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3, Revision 2 – March 2008" referred to in these responses was submitted to the NRC on April 2, 2008 via GEH letter MFN 06-466, Supplement 1.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-084, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 90 Related To the ESBWR Design Certification Application*, dated January 29, 2007.
2. MFN 08-032, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 142 Related To the ESBWR Design Certification Application*, dated January 14, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter Nos. 90 and 142 Related to ESBWR Design Certification Application – Safety Analyses – RAI Numbers 15.4-13, 15.4-13S01, 15.4-32, 15.4-33 and 15.4-40

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	eDRF	0000-0082-8928

Enclosure 1

MFN 08-223

Response to Portion of NRC Request for Additional Information Letter Nos. 90 and 142 Related to ESBWR Design Certification Application

Safety Analyses

RAI Numbers 15.4-13, 15.4-13S01, 15.4-32, 15.4-33, and 15.4-40

NRC RAI 15.4-13:

Proposed DCD, Tier 2, Revision 3, Section 15.4.4.5.2.2 (last paragraph) and Section 4.1.2.1, "Cesium Hydroxide," (CsOH) of the General Electric Licensing Topical Report, NEDE-33279, "ESBWR Containment Fission Product Removal Evaluation Model, October 2006,"(LTR) discusses the production and formation of CsOH stating that: "The cesium that is not in the chemical form of CsI is assumed to exist .... in the form of CsOH."

The staff believes cesium may also exist in the form of cesium compounds other than CsOH (i.e., cesium molybdate, cesium manganate). Cesium may enter containment in the form of CsOH,cesium borate or cesium iodide. Although CsOH is highly soluble in water and a strong base, by itself it is not sufficient to maintain pH in the containment pools above 7.

Given your statement that pH in the containment pool will remain alkaline due to sufficient amount of CsOH, provide a sensitivity analysis of pH to CsOH formation (zero to 100 percent formation).

GEH Response:

A detailed sensitivity study of the CsOH formation (0 to 100%) is provided in VTT-R-06771-07, "*Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3, Revision 2 – March 2008*", which was submitted to the NRC via MFN 07-466, Supplement 1 dated March 31, 2008. Sensitivity studies for the low-pressure bottom line break (AS-1) are provided in Section 7 of the "Part 3" report. Sensitivity studies for the high-pressure bottom drain line break (AS-2) are provided in Section 8, and the studies for the loss of AC power/loss of feedwater evaluation (AS-3) are provided in Section 9. Tabular results data are provided for all three Scenarios in Appendix D.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 15.4-13S01:

In the staff's request for additional information dated January 27, 2007 (ML0702303000), RAI 15.4-13, the staff asked the applicant to provide a sensitivity analysis of pH to CsOH formation (zero to 100% formation). However, sensitivity analyses were only provided for 100, 50, 24,and 10 percent formation. Please provide a sensitivity analysis for when there is 0% of CsOH formed inside containment for each of the three accident scenarios.

GEH Response:

A detailed sensitivity study of the CsOH formation is provided in VTT-R-06771-07, "*Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3, Revision 2 – March 2008*", which was submitted to the NRC via MFN 07-466, Supplement 1 dated March 31, 2008. The sensitivity runs provided contain sensitivity studies crediting 0% of CsOH. Sensitivity studies for the low-pressure bottom line break (AS-1) are provided in Section 7 of the "Part 3" report. Sensitivity studies for the high-pressure bottom drain line break (AS-2) are provided in Section 8, and the studies for the loss of AC power/loss of feedwater evaluation (AS-3) are provided in Section 9. Tabular results data are provided for all three Scenarios in Appendix D.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 15.4-32:

Licensing Topical Report NEDE-33279P, "ESBWR Containment Fission Product Removal Evaluation Model," page 4-3 states that the doses were conservatively increased by 10% for determining HCl for accident scenarios AS-2 and AS-3. Explain why this same assumption was not used for the total HNO_3 calculation. In addition, please discuss the reason(s) for using the 10% higher dose rate to determine the amount of HCl.

GEH Response:

The methodology used to determine both HNO_3 and HCl production were revised in Revision 2 of VTT-R-006671-07, "*Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3, Revision 2 – March 2008*", which was submitted to the NRC via MFN 07-466, Supplement 1 dated March 31, 2008. Hydrochloric acid generation is calculated based on the airborne dose rates in containment. The doses in containment were originally provided via NEDE-33279P, Revision 0, Table 1. These doses were increased by a factor of 1.25 to account for the difference in removal coefficients, and thus dose rates and doses, between Revisions 0 and 1 of NEDE-33279P. Specifically, the removal coefficients were slightly lower in Revision 1 of the LTR, thus more activity remained airborne resulting in higher containment dose rates (and subsequent HCl and [airborne] HNO_3 production). Additional details concerning the dose rates are provided in Revision 2 of the VTT Part 3 Report, Section 4.1, and details on the formation of HCl are presented in Section 5.1 of that report.

The generation of HNO_3 is determined in Revision 2 of the VTT "Part 3" Report using dose rates in the various water pools. Pool specific dose rates were calculated using the mass fractions of various radioisotopes obtained from the MELCOR results. The pool specific dose rates were then used to calculate HNO_3 production in the pool under evaluation. Detailed explanation of generation of the pool dose rates is included in Section 4.2 of the VTT Part 3 Report, Revision 2, and details concerning HNO_3 formation are contained in Section 5.2 of the report.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 15.4-33:

Research Report VTT-R-06771-07 (Part 3), Table E1 on page 6, provides the different times at which pH of the Gravity Driven Cooling System (GDCS) pool and the Lower Dry Well (LDW) become permanently less than seven (7) hours for the various cesium hydroxide (CsOH) fractions. Please provide similar hours calculations for the Reactor Pressure Vessel (RPV). In addition, please provide the time in number of days.

GEH Response:

Report VTT-R-06771-07, "*Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3 – March 2008*" which was submitted to the NRC via MFN 07-466, Supplement 1 dated March 31, 2008, contains the requested information in Table II.

DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 15.4-40:

GEH provided several pH calculations results in Parts 1, 2, and 3 of the associated VTT Reports. In Part 1 (October 2006), GEH provided pH calculation results for cases A (base case) through F with varying strong acid formation for scenario AS-1. In Part 2 (December 2006), GEH provided pH calculation results for the base case for scenarios AS-2 and AS-3. In Part 3 (August 2007), GEH provided pH calculation results and concentration tables for the base case for scenarios AS-1-A through AS-1-F. In addition, GEH provided pH calculation results along with some concentration tables for the CsOH sensitivity runs for scenarios AS-1-A, AS-2-A, and AS-3-A with HCl and HNO3 scaled formation rates. However, there appears to be some missing tables in Research Report VTT-R-06771-07 (Part 3):

1. Concentration tables for cases AS-2-A and AS-3-A similar to Tables 4 through 7.

2. Concentration tables for cases AS-1, AS-2, and AS-3 for the sensitivity runs with CsOH masses equal to 50%, 25%, 10% and 0%, similar to the tables in Appendix 2 of your Part 3 report. It is not clear to the staff which of the sensitivity runs/cases you are planning to use as part of your containment fission product removal evaluation. Please identify which case you plan to use and provide the tables described above.

GEH Response:

The requested information is included in Appendix D to VTT-R-06671-07, "*Estimation and Modeling of Effective Fission Product Decontamination Factor for ESBWR Containment – Part 3, Revision 2 – March 2008*", which was transmitted to the NRC via MFN 07-466, Supplement 1 dated Match 31, 2008. Sensitivity studies for the low-pressure bottom line break (AS-1) are provided in Section 7 of the "Part 3" report. Sensitivity studies for the high-pressure bottom drain line break (AS-2) are provided in Section 8, and the studies for the loss of AC power/loss of feedwater evaluation (AS-3) are provided in Section 9. Tabular results data are provided for all three Scenarios in Appendix D.

GEH will use the 50% CsOH case for each Accident Scenario as the licensing basis for the ESBWR. This value provides a conservative amount of CsOH, which assists in buffering. Due to the reactive nature of Cs and the quantity of Cs available post-accident, GEH feels it would be unreasonable to credit only a small amount of Cs for the formation of CsOH as this could lead to unnecessary licensing commitments and system modifications. Additional details concerning the 50% CsOH cases will be provided in the response to RAI 15.4-39, which is currently scheduled for submittal at the end of April 2008.

DCD Impact:

No DCD changes will be made in response to this RAI.