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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 180 Related to the ESBWR Design Certification – LOCA Containment Response – RAI Number 6.2-175 S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) responses to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated April 18, 2008 GEH response to RAI Number 6.2-175 S01 is addressed in Enclosure 1.

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

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 08-399, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 180 Related To ESBWR Design Certification Application*, dated April 18, 2008

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 180 Related to ESBWR Design Certification Application – LOCA Containment Response – RAI Number 6.2-175 S01

cc:	AE Cubbage	USNRC (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	eDRFs	0000-0090-4790

Enclosure 1

MFN 08-680

Response to Portion of NRC Request for Additional Information Letter No. 180 Related to ESBWR Design Certification Application

LOCA Containment Response

RAI Number 6.2-175 S01

NRC RAI 6.2-175 S01:

In response to RAI 6.2-175, GEH proposed to update DCD Tier 2 by including Appendix 6E to describe phenomena involved in LOCA containment response, please provide the following:

a) TRACG calculations for the MSLB bounding case show that only a portion (upper drywell region) of the non-condensable gas inventory is transferred to the wetwell during the blowdown (DCD Tier 2 Figure 6.2-14d1). However, the staff's MELCOR analysis showed that almost all non-condensable gas inventory is transferred to the wetwell during the blowdown. Provide the reasons for the non-condensable gas hold up in the drywell during blowdown in the TRACG calculation.

b) Proposed DCD Tier 2 Section 6E.2 states that vacuum breakers open around 550 seconds. This appears to be inconsistent with containment pressure shown on DCD Tier 2 Figure 6.2-14a3, which shows that the wetwell pressure does not exceed the dywell pressure until around 1650 seconds when vacuum breaker opening becomes possible. Please clarify.

c) Provide references for the validation effort or sensitivity assessment showing how GEH arrived at the current drywell and wetwell nodalization scheme.

d) Describe the conservative biases adopted for wetwell heat and mass transfer models.

e) Define the term "radiation heating" referred to as a contributing cause for the gradual pressure rise during the long term period.

f) Describe the phenomena that dominate the pressure rise during the long term period. Confirm whether conservative biases were implemented for uncertainties associated with the modeling of these phenomena. List the biases for the dominant models.

GEH Response:

a) The connection paths between the drywell (DW) head and the drywell are physically small and limited; see Reference 2, Figure 6.2-1. In addition, the connecting paths are out of the way for the DW steam/gas mixture entering into the PCCS. For these reasons, there is very limiting interaction between the gas mixture inside the (DW) head and the mainstream gas mixture in the (DW). Consequently, TRACG results show that it takes very long time to purge the non-condensable gases (NCG) in this hideout volume. The impact of this holdup of NCG on the long-term DW pressure is calculated, using the perfect gas law, by assuming all the holdup NC gases were transferred into the wetwell (WW).

Reference 2, Table 6.2-5, Footnote (++++), describes an adjustment to the DW pressure to account for the holdup. By factoring in additional NCG in the WW, a conservative bias has been applied to the Main Steam Line (MSL) break bounding case. Reference 1 has already examined the effects of DW head NCG holdup. The final conclusion is that the holdup of NCG in the DW head has no significant impact on the final long-term pressure. Therefore, the holdup of NCG in the DW head is not considered to be an important phenomenon with respect to the long-term pressure response of containment.

b) This issue will be addressed in detail in the GEH Response to RAI 6.2-188, Reference 3, which is scheduled for submittal on October 13, 2008.

c) Appendix 6B of Reference 4 provides a description of the TRACG nodalization. This appendix describes the method that was used to determine the final ESBWR TRACG model with respect to the containment and the reactor pressure vessel (RPV). All information in this appendix is from References 5,6, and 7. Reference 6 also provides an in-depth description of the early development of the TRACG ESBWR containment model and comparison testing.

d) All conservative biases in the TRACG model are described in detail in Section 3.4 of Reference 5. Table 3.4-1 in Reference 5 lists the biases applicable to the WW with respect to heat and mass transfer.

The free surface condensation/evaporation (WW4 in Table 3.4-1 of Reference 5) will impact the long-term air space temperature in the WW. PIRT7 in the TRACG model adjusts the interfacial heat transfer coefficient so that TRACG does not under-predict the WW airspace temperature. Figure 3.4-1 in Reference 5 shows that the WW airspace temperature remains above test data results when PIRT7 is properly adjusted.

Suppression pool (SP) stratification has an effect on long-term DW pressure. If the SP liquid phase is allowed to become fully mixed, the surface temperature of the pool would be lower than when stratification is assumed. When the SP is modeled as a stratified pool, the surface temperature increases. An increase in pool surface temperature increases the pressure inside of the WW and the pressure inside the containment. Thus, the higher pool surface temperature gives the analysis a conservative bias. See Reference 5, Section 3.4.1.

The airspace in the WW is also forced into stratification instead of being well-mixed. The long-term effect is the same; the local airspace temperature is higher with stratification and results in a higher containment pressure. See Reference 5, Section 3.4.1.

e) In the context of DCD Tier 2 Appendix 6E, "radiation heating" is synonymous to "decay heat".

f) The phenomena that dominate the pressure rise during the long-term period has been discussed in Reference 8 response Part A. For uncertainties associated with the modeling of these phenomena, the conservative biases were implemented by applying the specific PIRT values as TRACG input parameters. . A list of all phenomena affecting the long-term pressure rise in the containment is given in Reference 5, Table 3.4.1. All phenomena are given along with the uncertainty range.

As discussed in Reference 8, the key parameters that dominated the long term containment pressure following a postulated Loss-of-Coolant Accident (LOCA) in the ESBWR design are: the suppression pool surface temperature, the WW gas temperature, and the total amount of non-condensable (NC) gases transferred into the WW. Conservative biases for modeling suppression pool temperature and WW air space temperature are discussed in part (d) of this response. And as mentioned in Reference 8, radiolytic gas generation rate has been modeled conservatively even though there was no uncertainty range defined in Table 3.4-1 of Reference 5.

DCD Impact:

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

References:

1. MFN-08-011, dated January 9, 2008, "Response to RAI 6.2-98 S01"
2. ESBWR Design Control Document, Rev. 5, Chapter 6.2
3. Pending Response to RAI 6.2-188 to be submitted on October 13, 2008
4. ESBWR Design Control Document Rev. 5, Appendix 6B
5. NEDC-33083 P-A, March 2005. "TRACG Application for ESBWR"
6. NEDC-32725P Rev. 1, August 2002. "TRACG Qualification for SBWR"
7. NEDE-32176P Rev. 3, April 2006. "TRACG Model Description"
8. MFN 08-631, dated August 14, 2008, "Response to RAI 21.6-69 S01"