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Subject: **Response to RAI Letter 142 Related to the ESBWR Design Certification – Safety Analyses – RAI Number 15.4-34**

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 letter dated January 14, 2008. GEH response to RAI Number 15.4-34 is addressed in Enclosure 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

Reference:

1. MFN 08-203, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 142 Related To ESBWR Design Certification Application*, dated January 14, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 142 Related to ESBWR Design Certification Application – Safety Analyses – RAI Number 15.4-34

cc: AE Cubbage USNRC (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
eDRF 0000-0082-2094

Enclosure 1

MFN 08-203

Response to Portion of NRC Request for Additional Information Letter No. 142 Related to ESBWR Design Certification Application

Safety Analyses

RAI Number 15.4-34

NRC RAI 15.4-34:

MFN 07-466 dated August 24, 2007:

Research Report VTT-R-06771-07 (Part 3), Tables 9, 11, and 13 provide the total amount of CsOH formed during accident scenarios 1, 2, and 3, respectively. According to the tables, most of the CsOH is formed in the Wet Well (WW), while different quantities are formed in other pools depending on the accident scenario. Please discuss why the majority of the CsOH is transported to the WW while in the other pools there is less or no CsOH.

GEH Response:

As stated in Regulatory Guide 1.183, Table 1, alkali metals are released into containment early in accident progression. In general terms, cesium enters the wetwell (WW) or suppression pool primarily via safety relief valves and the drywell primarily via depressurization valves. In the WW pool, CsOH is formed directly. Removal of cesium aerosol species and fission products from the containment atmosphere is accomplished by the passive containment cooling system (PCCS) heat exchangers. Fission products and Cs species are transported from the drywell to the PCCS heat exchangers with steam and non-condensable gases. Condensables and soluble chemical species, including CsOH, are transported to the gravity driven cooling system (GDCS) pool. Non-condensables in the PCCS heat exchangers are vented via sparger to the WW pool and other airborne materials may enter the WW pool through horizontal vents. The GDCS and suppression pools (WW pools) are thus the principal compartments for CsOH formation early in the course of an accident.

The WW pool accumulates and retains CsOH. The GDCS pool initially accumulates CsOH inventory that is later transferred to the reactor pressure vessel (RPV) and subsequently to the lower drywell (LDW) in scenarios with bottom drain-line breaks. In those scenarios, the LDW and RPV retain significant amounts of CsOH when compared to amounts retained in the suppression pool. Also, in those scenarios, significant fractions of the WW-pool CsOH inventory arise from condensate drainage from the upper drywell (UDW) walls. In the case of a high-pressure bottom drain line break, there is substantial early CsOH formation in the GDCS pool arising from fission products entering the drywell following dry out of the RPV lower head.

The 100% CsOH formation data that appear in Tables 9, 11, and 13 in the August 2007 revision of Research Report VTT-R-06771-07 – Part 3, appear in Tables 6, 10, and 14 of the Rev. 2 version of the same report, which was submitted to the NRC via MFN 07-466, Supplement 1 on March 31, 2008. Tables 23, 26, and 28 of the report provide information on the event timing for accident scenarios (AS) 1, 2, and 3. The report directly addresses CsOH formation for accident scenario AS-1 in Section 17.1; Section 17.2 for AS-2; and Section 17.3 for AS-3. Figures 90, 96, and 102 illustrate CsOH masses in water pools. The following extracts from the VTT-R-06771-07 Report, Revision 2, were prepared by the report authors, specifically in response to this RAI:

Accident Scenario 1, Low pressure bottom drain-line break with ADS: "About half of the Cs and CsI is transported to the Suppression Pool through SRV/ADS valves, horizontal top vent and PCCS vent. Cs is assumed to form CsOH in the MELCOR calculations. The instantaneous pool scrubbing decontamination factor for AS1 (without MSIV leak) during the main Cs release phase from the core (2500 – 4600 s) varies between 3 and 200 and during the phase (3800 – 8000 s) when the bulk of the CsOH is formed and accumulated in the Suppression Pool, the aerosol pool scrubbing DF in the Suppression pool is between 3 – 10000 (Fig. 89). Another important component to the CsOH mass in the Wetwell is that the Vertical Vents are included in the Wetwell pool inventory. The condensate flow from the Upper Drywell walls containing CsOH is drained into the Vertical Vent compartment. The condensate flow may contribute by 50 % to the total Wetwell CsOH mass. Figure 90 illustrates the CsOH mass distribution in different volume categories."

Accident Scenario 2, High pressure bottom drain-line break without ADS: "About 80 % of the CsOH formed in the Wetwell originates from the discharge through the SRV and SRV/ADS valves. The aerosol DF varies from 10 to 1000 during the main discharge phase through SRVs (3000 – 10000 s) (Fig 95). The condensate flow to the Vertical Vent volume contributes, similarly to the AS1 case the remaining 20 % of the CSOH inventory in the Wetwell pool. Due to initial failure of ADS the SRV flow carries relatively more cesium to the Suppression pool than in AS1 with ADS. Also due to the same reason the cesium discharge to the Upper Drywell through DPVs is much less than in AS1 and thus the condensate flow also adds relatively less CsOH to the Wetwell pools. The total CsOH masses in the different water pools in case AS2 is presented in Fig 96."

Accident Scenario 3, Loss of preferred power: "In AS3, practically all Cs released from the core is released into the Suppression Pool through SRVs. A total of 297 kg of Cs vapor is blown into Suppression Pool (Fig 102). The vacuum breakers open at about 4000 s and operate till about 18500 s. A total of 215 kg is collected into the Wetwell pool by fallout and condensate flow. Only a small amount of CsOH is carried over to the Lower Drywell by the condensate flow from the Upper and Middle Drywells. The Cs vapor is not scrubbed directly during discharge through SRVs because Cs is in vapor form due to high gas temperature in the RPV Upper Plenum. In the current version of MELCOR pool scrubbing is not calculated for other vapors, but elemental iodine. For aerosol, the pool scrubbing DF is relatively high ranging from 100 to 100000 (fig 101)."

DCD Impact:

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