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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 120 - Related to ESBWR Design Certification Application – RAI Number 21.6-106**

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 the Reference 1 NRC letter. GEH response to RAI Number 21.6-106 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

D068
NRO

Reference:

1. MFN 07-717, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 120 Related to the ESBWR Design Certification Application*, dated December 19, 2007

Enclosure:

1. MFN 08-338 – Response to Portion of NRC Request for Additional Information Letter No. 120 - Related to ESBWR Design Certification Application – RAI Number 21.6-106

cc: AE Cubbage USNRC (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
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Enclosure 1

MFN 08-338

Response to Portion of NRC Request for

Additional Information Letter No. 120

Related to ESBWR Design Certification Application

RAI Number 21.6-106

NRC RAI 21.6-106

Reconfirm that the 0.9 m submergence depth is still valid, and the final PCCS vent system would adequately condense steam and lead to saturated steam.

This RAI is concerning staff's evaluation of Confirmatory item No. 19 In NEDC-33083P-A, "TRACG Application for ESBWR," March 2005.

The pre-application SER "TRACG Application for ESBWR" (NEDC-33083P) reports the following under PIRT item WW3, on page 39.

"Based on available test data, GENE concluded that any steam entering the SP through the PCCS vent, based on the design presented for this review, will be condensed within the SP during the blowdown period of the accident." The staff's acceptance of the above statement during the pre-application phase was based on its review of the supplemental information including relevant experimental data provided by GEH through RAI 314.1 (MFN 03-115) regarding the PCCS performance during the blow-down. However, the staff is aware that even though there have been changes in the plant design since the pre-application (e.g., power level changed from 4000 MW to 4500 MW, possible use of spargers), the same 0.9m PCCS vent submergence depth as specified in NEDE-32176P Rev. 1 also appears in the latest Rev. 3.

Please reconfirm that the 0.9 m submergence depth is still valid, and the final PCCS vent system would adequately condense steam and lead to saturated steam, and not superheated steam, above the suppression pool.

GEH Response

In the pre-application SER, NRC staff accepted that the steam entering the suppression pool (SP) through the Passive Containment Cooling System (PCCS) vent during the blowdown period of the accident is condensed within the SP. This acceptance was based on a power level of 4000 MWt, 4 PCCS vents with 250 mm ID and a submergence of 0.9 m. For the current PCCS design, the initial conditions under which the PCCS vent steam condensation was evaluated have changed. An evaluation of these revised conditions was performed to determine their impact on the PCCS vent submergence depth. The following discussion provides basis to reaffirm that 0.9 m of PCCS vent submergence depth is still valid and bounding.

The current ESBWR power level is 4500 MWt, which amounts to a 12.5% increase in power from the 4000 MWt initial design. This increase in power level results in a corresponding increase in PCCS vent steam mass flow rate of the same percentage. However at the same time the number of PCCS vents was increased from 4 vents (References 1 and 2) to 6 vents (DCD, Tier 2, Subsections 1.1.2.7 and 6.2.2.1). This translates to an increase of the available vent area by 50%. The increase in PCCS vent area available reduces the steam mass flow rate through each PCCS vent by 25%.

The supplemental information for RAI 314.1 response (Reference 1) supports a PCCS vent submergence of 0.90 m into the SP as valid and bounding for a 4000 MWt power reactor that includes 4 PCCS vents of 250 mm ID and conservatively considered the submerged vent as a straight pipe. In the RAI 314.1 response a correlation was introduced to characterize the test

findings and support the evaluation. This correlation shows that the discharge steam flow rate (W) is directly proportional to the condensation length (L) and pipe diameter (D) see below:

$$W/\pi D^2 = KL^{1.5 \text{ to } 2}/D \text{ (or } W = \pi D KL^{1.5 \text{ to } 2})$$

Considering that the PCCS vent system mass flow rate for the current design of 4500 MWt with 6 PCCS vents is 75% of that at 4000 MWt and 4 PCCS vents, the submergence length of 0.9 m reported in the supplemental information for RAI 314.1 remains bounding for the current design of the same pipe ID.

As an additional enhancement to improve steam condensation discharged through the PCCS vents in the SP, the current ESBWR design includes spargers on each vent. It is expected that these spargers will contribute to the formation of smaller bubbles, reducing dynamic condensation loads, and improving condensation, fission product scrubbing, and suppression pool mixing.

The current design of 4500 MWt with 6 PCCS vents, has lowered steam mass flow rate through each of the PCCS vents, and added sparger enhancement, therefore, it is concluded that the same submergence length of 0.9 m stated in the supplemental information for RAI 314.1 continues to be bounding and that the PCCS vent system would adequately condense steam and lead to saturated steam, and not superheated steam above the suppression pool.

References:

1. NEDC-33083P-A, "TRACG Application for ESBWR," March 2005, Supplemental Information for RAI 314.1.
2. NEDO-32176, "TRACG Model Description", January 2008, Subsection 7.11.5.

DCD Impact

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