HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057

MFN 08-052

Docket No. 52-010

January 25, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Number 6.3-81**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI transmitted via the Reference 1 letter.

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 07-317, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application*, May 29, 2007

Enclosure:

1. MFN 08-052 - Response to Portion of NRC Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Number 6.3-81

cc:

AE Cubbage	USNRC (with enclosures)
DH Hinds	GEH/Wilmington (with enclosures)
GB Stramback	GEH/San Jose (with enclosures)
RE Brown	GEH/Wilmington (with enclosures)
eDRF	0000-0075-1304

Enclosure 1

MFN 08-052

Response to Portion of NRC Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application

Emergency Core Cooling Systems

RAI Number 6.3-81

NRC RAI 6.3-81:

The staff noted in the safety evaluation report pertaining to the applicability of TRACG to the LOCA in the ESBWR design that an uncertainty analysis had not been performed. The staff noted this as a confirmatory item to be addressed at the design certification phase. The staff noted in the acceptance letter pertaining to the ESBWR Design Certification Document that the confirmatory items had not been addressed for the LOCA analysis.

Please demonstrate how the LOCA analysis performed in support of the ESBWR design certification complies with the requirement of 10 CFR 50.46(a)(1)(i) that reads in part:

> *ECCS cooling performance must be calculated in accordance with an acceptable evaluation model ...and uncertainties in the analysis method and inputs must be identified and assessed so that the uncertainty in the calculated results can be estimated. This uncertainty must be accounted for, so that, when the calculated ECCS cooling performance is compared to the criteria set forth in paragraph (b) of this section, there is a high level of probability that the criteria would not be exceeded.*

The analysis that has been provided in the design certification document is based on a single calculation assuming limiting nominal conditions.

GEH Response:

Because there is no core uncovery and no core heatup for the ESBWR loss-of-ccolant accidents (LOCAs), a statistical analysis of the Peak Cladding Temperature (PCT) does not serve any useful purpose. The best estimate PCT and the 95/95 PCT would both be close to the saturation temperature corresponding to the peak steam dome pressure reached in the transient. For the case of ESBWR LOCAs, there is a margin of over 1600°F to the limit of 2200°F (acceptance criteria set forth in paragraph (b) of 10 CFR 50.46).

Since there is no core uncovery, the static head inside the chimney (in meters of water) is selected as the figure of merit for comparison and to evaluate the impact of uncertainties in model parameters and plant parameters. This collapsed level is defined as the equivalent height of water corresponding to the static head of the two-phase mixture above the top of the core. The TRACG model parameter uncertainties and plant parameter uncertainties have been identified (Reference 1, Sections 2.4 and 2.5.3). Sensitivity studies were performed by varying each of these parameters from the lower bound to the upper bound value. The impact on the chimney static head is between –0.3 m to +0.2 m (Reference 1, Section 2.4.4.2). For any of these parametric cases, there was no core uncovery or heatup. A statistical analysis could be performed for the minimum static head in the chimney. However, as seen in the parametric studies, the minimum static head in the chimney is of the order of > 1.5 m, while the sensitivities to the individual parameters are less than 0.3 m. Therefore, it is adopted that a simple calculation be made setting the most significant parameters at the

2-sigma values to obtain a bounding estimate of the minimum level (Reference 1, Section 2.6.1).

For the design certification calculations, an integrated TRACG input deck (i.e., combined the RPV and containment into one consistent and detail input deck (DCD Tier 2, Table 6.2-6a, Item #15)) is used for both the short-term and the long-term LOCA events. For the short term (2000 seconds), results show that the minimum static head inside the chimney is greater than 1 m for all breaks (DCD Tier 2, Revision 4, Table 6.3-5, and response to RAI 6.3-46 in MFN 07-049). For the long term (0 to 72 hours, and up to 30 days), the reactor pressure vessel (RPV) core is covered with water at a level of greater than 1 m above the top of the core (response to RAI 6.3-79 in MFN 07-377).

In addition, parametric study was performed to evaluate the impact on the minimum static head inside the chimney, due to the containment back pressure, the passive and active heat sinks, and indirectly the Gravity-Driven Cooling System (GDCS) actuation timing. The results (DCD Tier 2, Revision 4, Appendix 6C) show that the minimum static head inside the chimney is not sensitive (< 0.3 m) for a wide range of change in the containment back-pressure (~100 kPa in containment back pressure and 50 seconds in GDCS initiation timing).

The LOCA methodology has identified the uncertainties in the model and plant parameters. Sensitivity studies were performed by varying each of these parameters from the lower bound to the upper bound value. Since the impact on the chimney static head was small and there was no core uncovery or heatup for all cases, a simple approach is adopted by setting the most significant parameters at the 2-sigma values to obtain a bounding estimate of the minimum level. Results from LOCA analyses show that, for both the short term (0 to 2000 seconds) and the long term (0 to 72 hours and up to 30 days), the core is covered with water at a level of greater than 1 m above the top of the core. Results from parametric study also show that the minimum static head inside the chimney is not sensitive for a wide range of change in the plant parameters.

These LOCA results demonstrate that there is a high level of probability that there is no core uncovery or heatup. As a result, the PCT would be close to the saturation temperature corresponding to the peak steam dome pressure reached in the transient and there is a margin of over 1600°F to the limit of 2200°F (acceptance criteria set forth in paragraph (b) of 10 CFR 50.46).

Based on the above discussion, it can be concluded that the LOCA analysis performed in support of the ESBWR design certification complies with the requirement of 10 CFR 50.46, and there is a high level of probability that the criteria would not be exceeded.

Reference:

(1) GE Nuclear Energy, "TRACG Application for ESBWR," NEDC-33083P-A, Class III, (Proprietary), March 2005, and NEDO-33083-A, Class I (non-proprietary), October 2005.

DCD Impact:

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