GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

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

T 910 675 6192
F 910 362 6192
rick.kingston@ge.com

MFN 08-086, Supplement 57

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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 174, Related to ESBWR Design Certification Application RAI Number 14.3-196, Supplement 1**

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 174, dated April 23, 2008 (Reference 1). The original RAI and response were transmitted in References 2 and 3.

Enclosure 1 contains the GEH response to RAI Number 14.3-196, Supplement 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

References:

1. MFN 08-435, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 174 Related To ESBWR Design Certification Application*, April 23, 2008.

2. MFN 08-086, Supplement 8. *Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application RAI Numbers 14.3-216, 14.3-217, 14.3-219, and 14.3-227.* March 5, 2008.

3. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, December 20, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letters No. 174, 189 and 199 Related to ESBWR Design Certification Application RAI Numbers 14.3-217, S01 (Letter 174), 14.3-251, S01 (Letter 174), 14.3-367, S01 (Letter 199) and 14.3-371, S01 (Letter 189)

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)
eDRF	0000-0085-3272

Enclosure 1

MFN 08-086, Supplement 57

Response to Portion of NRC Request for Additional Information Letter No. 174 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Number 14.3-196, Supplement 1

NRC RAI 14.3-196 (original)

NRC Summary:
Editorial comment

NRC Full Text:
DCD Tier 1, Section 2.2.4, SLCS, Table 2.2.4 –2

Why was ITAAC # 2c, "Accumulator tank with at least 12.5 wt% solution of boron content enriched to 94% of the Boron-10 isotope" deleted in DCD Revision 4? This item which verifies critical operating parameters of the system should be retained in the ITAAC. Please update DCD Tier 1 accordingly.

GEH Response *(original response)*

Table 2.2.4-6 of DCD Tier 1, item 22, Revision 4 gives the acceptance criteria for the total injection volume with a minimum boron concentration required to achieve cold shutdown. This AC replaces the AC specifying the required boron wt% and boron enrichment.

DCD Impact

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

NRC RAI 14.3-196, Supplement 1

NRC Summary:

ATWS Rule Compliance Verification

NRC Full Text:

Item # 7 of the SLCS ITAAC Table 2.2.4-6, Revision 4 verifies the 86 GPM equivalency required by the ATWS Rule. Provide the summary of the calculations performed to verify the 86 GPM equivalency in DCD Tier 2.

GEH Response

The requirements of 10CFR50.62(c)(4) are for a reference plant with concentration of 13% by weight of sodium pentaborate decahydrate solution (SPBS) with a natural abundance of the boron-10 isotope (19.8% natural abundance to boron-11) flowing into the core region at 86 gpm. These requirements apply to injection into a 251 inch diameter reference BWR vessel, whose mass of steam and water is 614,300 lbs. The product of the ratios of each parameter must be greater than or equal to one, in order to show compliance with the Regulation for a given vessel size at various combinations of borated solution makeup. Since the vessel of the ESBWR is larger than the reference vessel, its combined steam and water mass is inserted into the denominator of the equivalency equation, given below:

$$\frac{Q_{ave}}{86} \times \frac{M_{251}}{M} \times \frac{C}{13} \times \frac{E}{19.8} \geq 1$$

where:

- Q_{ave} = ESBWR average flow rate for the injection of the first 10.8m^3 of borated water solution (5.4 m^3 from each accumulator).
- M = Mass of steam and water for ESBWR.
- C = Percent by weight of the sodium pentaborate decahydrate solution to water.
- E = Boron-10 Enrichment for the ESBWR reference plant.

For ESBWR reference plant with 94% enriched SPBS:

Q_{ave} = 330 gpm,
M = 823,800 lbs,
C = 12.5%,
E = 94%

Substituting and solving:

$$\frac{Q_{ave}}{86} \times \frac{M_{251}}{M} \times \frac{C}{13} \times \frac{E}{19.8} \geq 1$$

$$\frac{330}{86} \times \frac{614{,}300}{823{,}800} \times \frac{12.5}{13} \times \frac{94}{19.8} \geq 1$$

$$3.84 \times 0.746 \times 0.96 \times 4.75 \geq 1$$

$$13.1 \geq 1$$

For ESBWR plant with SPBS with natural abundance of Boron-10 (nonenriched):

Q_{ave} = 330 gpm,
M = 823,800 lbs,
C = 12.5%,
E = 19.8%

Inserting and Solving:

$$\frac{Q_{ave}}{86} \times \frac{M_{251}}{M} \times \frac{C}{13} \times \frac{E}{19.8} \geq 1$$

$$\frac{330}{86} \times \frac{614{,}300}{823{,}800} \times \frac{12.5}{13} \times \frac{19.8}{19.8} \geq 1$$

$$3.84 \times 0.746 \times 0.96 \times 1.0 \geq 1$$

$$2.75 \geq 1$$

Conclusion:

Since the equivalency equation holds true, the ESBWR design satisfies the requirements of 10CFR50.62(c)(4).

DCD Impact

The average volumetric flow rate and the maximum injection time corresponding to the ITAAC Table 2.2.4-6, Item #7 acceptance criteria, was added to Tier 2, Table 9.3-5 for DCD, Revision 5 (reference chapter 9, change list item #216).

No additional changes are required to DCD, Revision 5, as a result of this RAI.