GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

PO Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910 819 6192
F 910 362 6192
rick.kingston@ge.com

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Subject: **Supplemental Information to Revised Response (Revision 1) to NRC Request for Additional Information Letter No. 411 Related to ESBWR Design Certification Application – Chapter 4 TRACG Analysis – RAI Number 6.2-202 Supplement 1**

The purpose of this letter is to submit supplemental information to the GE Hitachi Nuclear Energy (GEH) revised response (Revision 1) to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) 6.2-202 S01 sent by Reference 1. The revised response was provided via Reference 2. This letter addresses the questions posed in Reference 3 in regard to the TRACG analysis for the ESWBR DCD Tier 2, Chapter 4.

Enclosure 1 contains the responses to questions provided in Reference 3.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 10-146, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 411 Related to ESBWR Design Certification Application,* April 12, 2010
2. MFN 10-044 Supplement 1, Revision 1, Letter from Richard E. Kingston to U.S. Nuclear Regulatory Commission, Revised Response (Revision 1) to NRC Request for Additional Information Letter No. 411 Related to ESBWR Design Certification Application – Engineered Safety Features — RAI Number 6.2-202 Supplement 1, August 2, 2010
3. E-mail from Bruce Bavol (USNRC) to Tim Enfinger (GEH), *Chapter 4 FSER Question*, August 3, 2010

Enclosure:

1. Supplemental Information to Revised Response (Revision 1) to NRC Request for Additional Information Letter No. 411 Related to ESBWR Design Certification Application – Chapter 4 TRACG Analysis – RAI Number 6.2-202 Supplement 1 – GEH Response

cc:

AE Cubbage	USNRC (with enclosure)
JG Head	GEH (with enclosure)
DH Hinds	GEH (with enclosure)
TL Enfinger	GEH (with enclosure)
eDRFSection	0000-0121-3251

Enclosure 1

MFN 10-044 Supplement 2

Supplemental Information to Revised Response (Revision 1) to NRC Request for Additional Information Letter No. 411 Related to ESBWR Design Certification Application

Chapter 4 TRACG Analysis

RAI Number 6.2-202 S01

GEH Response

NRC Questions (from reference 3)

The staff's concern regarding the TRACG issue and how it relates to Chapter 4:

The concern is that we have no documented discussion that there will be absolutely no significant impact on core thermal hydraulic design calculations (core flow, pressure drop, void fraction, etc.) that are summarized in Tables 4.4-1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5, and 6. Since the same general conservation of mass, momentum, and energy equations are used regardless of the location in the core, piping, or containment, the concern is that discussion is needed to show that there is insignificant impact on core parameters.

Is there a difference in the TRACG code that was used for Chapter 6 and Chapter 4?

Is there a modeling difference? If so, would this impact the outcome for Chapter 4?

GEH Response

There is no significant impact on core thermal hydraulic design calculations (core flow, pressure drop, void fraction, etc.) summarized in Tables 4.4-1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5, and 6. This is because the hydrogen flow in the core and steam lines is very dilute and the mass flow of hydrogen is about six (6) orders of magnitude less than the steam mass flow. The following is from the "Summary and Results" section of GEH Proprietary Calculation eDRF 0000-0117-4372, eDRF Section 0000-0121-3251, "Hydrogen Content in RPV Water Prior to SCRAM":

> The generation rate of radiolytic hydrogen and oxygen has been determined post-shutdown per the guidance of SRP 6.2.5 and Reg Guide 1.7. The generation rate of hydrogen during steady state operation has been determined from direct measurements of hydrogen concentration in the off gas system of operating BWRs. The mole fraction of hydrogen for ESBWR is estimated to be no greater than 2.67×10^{-5}.
>
> The total amount of hydrogen gas dissolved in the RPV water would contribute only 0.033% to the total volume of hydrogen generated by radiolysis in the six-hour period following shutdown. Therefore, the contribution of dissolved hydrogen is not significant compared to the fraction of hydrogen that accumulate[s] in the ICS during a transient or a LOCA.
>
> Because the contribution of radiolytically generated hydrogen is many orders of magnitude below that of steam, the presence of hydrogen does not effect the core thermal hydraulic calculations (core flow, void fraction,

> pressure drop, etc), the results of which are reported in Chapter 4 of the ESBWR Design Control Document.
>
> [Furthermore, t]he TRACG code was qualified against data from the operating fleet of BWRs, all of which generate hydrogen during operation. Therefore, TRACG inherently includes the effects of hydrogen generation and no special modifications were necessary to perform evaluations of core thermal hydraulic parameters. Because the radiolytic generation rate is proportional to core power, the concentration of hydrogen relative to steam is very consistent throughout the operating fleet and remains consistent throughout the fuel cycle.

As stated above, the effects of hydrogen generation are not significant and no special modifications of the code or models of Chapter 4 are necessary to perform evaluations of core thermal hydraulic parameters.

There is no difference between the TRACG code applied in Chapters 4 and 6. The inputs used in Chapter 6 contain a source term for radiolytic gas because it is significant in 72-hour containment pressure calculations. The Chapter 4 inputs do not contain a source because it is not significant. Thus, the outcome for Chapter 4 is not impacted.

DCD Impact

None.