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Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

MFN 08-833

Docket No. 52-010

October 31, 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. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116**

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 21.6-116 is addressed in Enclosures 1, 2 and 3.

Enclosure 1 contains GEH proprietary information as defined by 10 CFR 2.390. GEH customarily maintains this information in confidence and withholds it from public disclosure. Enclosure 2 is the non-proprietary version, which does not contain proprietary information and is suitable for public disclosure.

The affidavit contained in Enclosure 3 identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GEH. GEH hereby requests that the information in Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 10 CFR 9.17.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 08-629 Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 234 Related To ESBWR Design Certification Application,* dated August 5, 2008

Enclosures:

1. MFN 08-833 – Response to Portion of NRC Request for Additional Information Letter No. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116 – GEH Proprietary Information
2. MFN 08-833 – Response to Portion of NRC Request for Additional Information Letter No. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116 – Non-Proprietary Version
3. MFN 08-833 – Response to Portion of NRC Request for Additional Information Letter No. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116 – Affidavit

cc: AE Cubbage USNRC (with enclosures)
RE Brown GEH/Wilmington (with enclosures)
DH Hinds GEH/Wilmington (with enclosures)
eDRF 0000-0087-3468

Enclosure 2

MFN 08-833

Response to Portion of NRC Request for

Additional Information Letter No. 234

Related to ESBWR Design Certification Application

RAI Number 21.6-116

Non-Proprietary Version

NRC RAI 21.6-116

Applicability of BWR/4 uncertainty to ESBWR uncertainty

NEDE 33083P, Supp. 3: BWR/4 plant Turbine Trip Without Bypass Bounding as compared to ESBWR Behavior.

TRACG results for BWR/4 plant are given as examples of how important the uncertainty in a given parameter in terms of a safety parameter of interest. For example, in the C1AX Void Coefficient section in Chapter 5 (page 44), BWR/4 results are quoted for an [[ ]] uncertainty in void coefficient corresponds to a [[ ]] sensitivity in DCPR/ICPR for a turbine trip without bypass. Please provide results for ESBWR for this uncertainty in void coefficient. In addition, please explain if a BWR/4 plant AOO will always be bounding as compared to an ESBWR AOO, or not. Another example is void collapse in the same chapter. In BWR/4 pressurization event, the sensitivity to the interfacial heat transfer was found to be on the order of [[ ]] on the DCPR/ICPR. Again, please provide the ESBWR results for this sensitivity of interfacial heat transfer on DCPR/ICPR. Please explain if the BWR/4 pressurization event is always bounding relative to the ESBWR behavior for this same type of event, or not.

GEH Response

No assumption is made that a BWR/4 AOO bounds an ESBWR AOO. No Phenomena Identification and Ranking Table (PIRT) entry, no uncertainty or bias, and no part of the demonstration analysis is based on or affected by the presentation of the BWR/4 result. All phenomena that reference BWR/4 results were included in the ESBWR Monte Carlo uncertainty analysis in Section 8 of NEDE-33083P, Supplement 3. The results shown in Section 5.1 for BWR/4 are solely intended as an example of the BWR historical sensitivity that has been observed for a given phenomena.

Section 5.1 of NEDE-33083P, Supplement 3 will be modified to eliminate references to BWR/4 results as the BWR/4 results are not needed to support TRACG application for ESBWR transient analysis.

The requested ESBWR-specific results are presented in Section 8.4 of NEDE-33083P, Supplement 3. Figures 8-35 through 8-37 show the ESBWR individual uncertainty effects for void coefficient and interfacial heat transfer on DCPR/ICPR and bottom vessel pressure. Figure 3-38 shows individual uncertainty effects for interfacial heat transfer on minimum water level. Note that the evaluation of individual uncertainties are shown because they can provide insight into the specific sensitivities; however, the results are not used to reduce the set of phenomena used in the Monte Carlo analysis or reduce the importance of a phenomena.

DCD or LTR Impact

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

Changes to the subject LTR are shown in the attached markup.

Attachment

Revision Pages for NEDE-33083P, Supplement 3

A6 Mixing/Condensation/Void Collapse/Inlet Subcooling H

Condensation and void collapse in the lower plenum are controlled by liquid-side interfacial heat transfer. TRACG uses the Lee-Ryley correlation [8] for liquid-side heat transfer in bubbly flow regime. The bubble diameter used in the calculation of the interfacial area is based on a critical Weber number [8]. [[ ]] Following the procedure previously adopted for the AOO application [3] the magnitude of the interfacial heat transfer at the bubble surface was varied from [[ ]] of the nominal value with a log-normal probability distribution, [[ ]] For sub-cooling distribution see the E4 discussion related to azimuthal nodalization.

B1 Bypass Flashing, M

Void collapse or flashing is controlled by the liquid side interfacial heat transfer in the TRACG model. The uncertainty is defined in Item C4. The effect on the transient response was found to be negligible for a typical BWR/4 pressurization event., since the bypass void fraction is near zero. Significant Bbypass flashing can only occur for depressurization events and was only given a medium ranking for this event. -This PIRT parameter is considered in the ESBWR Monte Carlo analysis in section 8. For a pressurization event, there is no void in the bypass and the sensitivity to the interfacial heat transfer for a typical BWR/4 pressurization event is found to be 0.0 on the ΔCPR/ICPR.

B2 Bypass Two-Phase Level, M

The bypass two-phase level is controlled by the vapor generation and the relative velocity between the phases or void drift. Flashing and wall heat transfer determines the vapor generation and is controlled by the interfacial and wall heat transfer. The uncertainty in the interfacial heat transfer is defined in B1. The uncertainty in the wall heat transfer in defined in Items C1 and C2. The relative velocity between the phases is determined from the balance between buoyancy and interfacial shear. The uncertainty in the interfacial shear is defined in Item C2AX.

B6 Channel - Bypass Leakage Flow, H

[[ ]] The basis for this uncertainty is described in Item C11.

B13 Bypass Direct Moderator Heating, M

The direct moderator heating is the result of energy released into the moderator as the fast neutrons are slowed down and due to gamma absorption.

C1AX Void Coefficient, H

TRACG04 uses a 3-D neutron kinetics model based on the PANAC11 [7] neutronics parameters. The nodal reactivity is calculated [[ ]]. All of these parameters are correlated in terms of the moderator density. The infinite multiplication factor is also dependent on [[ ]]moderator density and nodal exposure.

The void coefficient biases and uncertainties are implemented in TRACG04 calculations [[

]]. Consider a representative in-channel void fraction of 40% and a core-average exposure of 15 GWd/ST. For $\alpha = 0.4$, Reference 4 indicates that the bias is around [[ ]]. The standard deviation from Reference 4 is [[ ]] at this condition. For low exposures, the uncertainties tend to be [[

]]. As the poison is burned and the bundles approach their peak reactivity and power, the void coefficient bias and uncertainty [[ ]].

TRACG04 internally models the response surfaces for the void coefficient biases and uncertainties in order to account for the known dominant dependencies due to relative moderator density and exposure [[ ]]. Cross sections are generated within TRACG04 using data from the lattice physics code that gets passed through via the PANAC11 wrap-up. Thus, the lattices are explicitly modeled. [[

]]. Thus, the normality of the [ ]] residual errors can be tested at each of these locations. This is what was done to get the P-values presented in Table 5-2. All the P-values except for one are significantly larger than the 0.05 threshold required to confirm normality and reach the conclusion that it is appropriate to assume that the residual errors are random [[

]]. The single set of [[ ]] points that fails the normality test produces a low P-value because the sample distribution is more centrally concentrated than what is expected for a normal distribution; therefore, it is conservative to model the sample distribution using an assumed normal distribution because that will predict wider scatter than the sample indicates.

TRACG04 input has been structured to allow the internally calculated uncertainties to be correlated [[

]].

For most fast pressurization events, the impact of not modeling the void coefficient biases is on the order of [[ ]] in calculated values of transient ΔCPR/ICPR. Whether the bias is conservative or not depends on the exposure distribution and the relative water density distribution in the core.

For sensitivity studies, a core-wide bias and uncertainty in void coefficient can be specified through the TRACG04 input. ~~As an example of the importance~~The effect of the void coefficient uncertainty in the ΔCPR/ICPR for the load reject with half bypass transient is presented in Figure 8-35.~~, consider that for a typical BWR/4 plant an [[ ]] variation in the void coefficient when~~

~~applied to all nodes in the core corresponds to a sensitivity of [[ ]] in the ΔCPR/ICPR for a turbine trip without bypass.~~

Table 5-2
Normality Test P-Values For The Void Coefficient Residual Errors

Void → Exp ↓	[[			]]	Avg	Stdev	Min
[[							
							]]
Avg	[[						
Stdev							
Min							]]

C1BX Doppler Coefficient, H

TRACG uses a 3-D neutron kinetics model based on the PANAC11 [7] neutronics parameters. Fuel temperature affects resonance absorption in uranium and plutonium. [[

]]

C1CX Scram Reactivity, H

[[

]] Sensitivity studies show that the distribution calculated by lattice physics codes provides conservative results compared to a flat power distribution.

C3CX Gap Conductance, H; C3BX Pellet Heat Transfer Parameters M, C26 Stored Energy H

The uncertainties in gap conductance, pellet power distribution and pellet conductivity are lumped into a single uncertainty in the pellet conductivity, while the nominal values for the gap conductance and pellet power distribution are used. The TRACG fuel rod model is based on the GESTR model [27]. The uncertainty in measured fuel centerline to coolant temperature differences is [[ ]] and includes uncertainty in gap size and conductance, pellet conductivity and power distribution. The uncertainties in pellet power distribution, pellet conductivity and gap conductance are lumped into a single uncertainty in the fuel conductivity, in qualifying the overall model against fuel temperature data. [[

]] By taking all the uncertainty in the pellet conductivity, the impact of the fuel thermal properties is conservatively maximized.

C8X Void Collapse, H

Void collapse or flashing is controlled by the liquid side interfacial heat transfer in the TRACG model. [[

]] Because there are no data to calibrate the magnitude of the interfacial heat transfer at the bubble surface, [[

]] This was judged to be a large enough range to study the effects of interfacial heat transfer on the ΔCPR. A [[ ]] distribution is chosen because it works well when the upper and lower bounds are the same factor applied to the base and will tend to not bias the result when the parameter is varied randomly. The effect on the transient response was found to be very small.~~,~~ Figure 8-35 shows the sensitivity of the interfacial heat transfer on ΔCPR/ICPR for the load rejection with half bypass transient.~~for a typical BWR/4 pressurization event the sensitivity to the interfacial heat transfer was found to be in the order of [[ ]] on the ΔCPR/ICPR~~. The small sensitivity of the parameter is such that further refinement of the distribution is not necessary.

C1 Nucleate Boiling Wall Heat Transfer, H

Nucleate and subcooled boiling heat transfer is calculated using the Chen correlation [8][50][51]. The Chen correlation has been correlated against a large database, and the standard deviation for the combined data set is [[ ]]. Figure 8-35 shows the sensitivity of the subcooled and nucleate boiling heat transfer coefficient on ΔCPR/ICPR for the load rejection with half bypass transient.~~For a typical BWR/4 plant, a [[ ]] variation in the subcooled and nucleate boiling heat transfer coefficient corresponds to a sensitivity of [[ ]] in the ΔCPR/ICPR for a turbine trip without bypass transient.~~

C2 Subcooled Boiling Wall Heat Transfer, H

C4 Flashing, H

Interfacial heat transfer is considered for subcooled voids through the uncertainty in the point of net vapor generation, void collapse in pressurization transients and flashing during depressurization transients. [[

]] Because there are no data to calibrate the magnitude of the interfacial heat transfer at the bubble surface, a sensitivity study was performed by ranging the value from [[ ]] of the nominal value. This was judged to be a large enough range to study the effects of interfacial heat transfer on the ΔCPR. A [[ ]] distribution is chosen because it works well when the upper and lower bounds are the same factor applied to the base and will tend to not bias the result when the parameter is varied randomly. The effect on the transient response was found to be very small,. Figure 8-35 shows the sensitivity of the interfacial heat transfer (C8X) on ΔCPR/ICPR for the load rejection with half bypass transient. for a typical BWR/4 pressurization event the sensitivity to the interfacial heat transfer was found to be in the order of [[ ]] on the ΔCPR/ICPR. The small sensitivity of the parameter is such that further refinement of the distribution is not necessary.

C8 Parallel Channel Flow Distribution, H

The flow distribution between parallel flow paths such as the fuel channels in the core is controlled by the hydraulic characteristics of the channels. [[

]]

C10 Void Distribution, H

[[

]]

C11 Channel - Bypass Leakage Flow, H

[[

Enclosure 3

MFN 08-833

Response to Portion of NRC Request for

Additional Information Letter No. 234

Related to ESBWR Design Certification Application

RAI Number 21.6-116

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, David H. Hinds, state as follows:

(1) I am General Manager, New Units Engineering, GE Hitachi Nuclear Energy ("GEH"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in enclosure 1 of GEH's letter, MFN 08-833, Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled "*Response to Portion of NRC Request for Additional Information Letter No. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116,*" dated October 31, 2008. The proprietary information in enclosure 1, which is entitled "*MFN 08-833 – Response to Portion of NRC Request for Additional Information Letter No. 234 – Related to ESBWR Design Certification Application – RAI Number 21.6-116 – GEH Proprietary Information,*" is delineated by a [[dotted underline inside double square brackets{3}]]. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GEH's design and licensing methodology. The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost to GEH.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate

evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 31st day of October 2008.

David H. Hinds
GE-Hitachi Nuclear Energy Americas LLC