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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 08-757

Docket No. 52-010

October 08, 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. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 Supplement 1, 4.2-26 Supplement 1, 4.2-31 and 4.2-32

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 Numbers 4.2-24 Supplement 1, 4.2-26 Supplement 1, 4.2-31 and 4.2-32 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 08-689 Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 243 Related To Design Control Document (DCD) Revision 5,* dated September 4, 2008

Enclosures:

1. MFN 08-757 – Response to Portion of NRC Request for Additional Information Letter No. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32 – GEH Proprietary Information
2. MFN 08-757 – Response to Portion of NRC Request for Additional Information Letter No. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32 – Non-Proprietary Version
3. MFN 08-757 – Response to Portion of NRC Request for Additional Information Letter No. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32 – Affidavit

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF	0000-0084-2503/R3

Enclosure 2

MFN 08-757

Response to NRC Request for

Additional Information Letter No. 243

Related to ESBWR Design Certification Application

RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32

Non-Proprietary Version

NRC RAI 4.2-24 Supplement 1

Z-axis thickness

GEH's response focused on changes to the end cap radial dimensions. Staff was looking for an explanation as to why the end cap did not change in the z-axis but the capsule walls were modified to be thicker, in order to preclude excessive swelling. Provide a response focused on the z-axis thickness.

GEH Response

Section 2 of NEDE-33244P Rev. 1 states "As in the BWR/2-6 Marathon design, the ESBWR capsules use a crimped capsule end cap connection." Section 2 then goes on to list the six primary changes made to the BWR/2-6 Marathon design to arrive at the ESBWR Marathon design, including capsule geometry.

The basic design of the capsule end caps for the original Marathon, and ESBWR Marathon are the same: a short cylindrical shape with a flange at the top and two circumferential grooves to accept the mechanical crimp of the capsule body tube. [[

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It is also noted that the axial height (z-axis thickness) of the end caps is the same as the BWR/2-6 Marathon design. As the capsule crimp does not form a pressure boundary, no change to this dimension is needed.

DCD Impact

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

No changes to the subject LTR will be made in response to this RAI.

NRC RAI 4.2-26 Supplement 1

ESBWR Marathon Control Rod surveillance program

GEH's response indicates a new Marathon surveillance program has been submitted to the NRC via MFN 08-355 for the operating fleet. Please update the ESBWR surveillance program to provide a similar explanation as to how the sampling will occur, the type of testing to be employed, etc. The ESBWR surveillance program should contain similar details related to the Marathon-5S surveillance program.

GEH Response

The following surveillance program will be included in the final approved version of NEDE-33244P.

5. Surveillance

5.1 The four (4) fleet-wide, highest depletion, ESBWR Marathon control rods will be tracked.

5.2 These four (4) control rods will be visually inspected during each refueling outage, until they have achieved as close to nuclear end-of-life as practical (target minimum 90% of nuclear end-of-life).

5.3 During refueling outages in which the depletion of the lead ESBWR Marathon assemblies are less than 75% of design nuclear life, the four (4) highest depletion ESBWR Marathon control rods will be visually inspected in-core, with two diagonal fuel bundles removed. This will allow for inspection of four of eight control rod faces, one face from each wing. Alternately, the control rods may be moved and inspected in the buffer or spent fuel pool.

5.4 For refueling outages in which the depletion of the lead ESBWR Marathon assemblies are greater than 75% of design nuclear life, the four (4) highest depletion ESBWR Marathon control rods will be moved to the buffer or spent fuel pool, with a visual inspection of all eight faces of each control rod performed. Lead ESBWR Marathon control rods may exceed 75% depletion prior to the eight-face inspections planned in the buffer or spent fuel pool as long as those inspections are performed before the control rods are utilized in another fuel cycle.

5.5 The in-core and fuel pool visual inspections shall have sufficient resolution, lighting, and scan rate such that crack indications similar to those observed on BWR/2-6 Marathon control rods would be seen.

5.6 To confirm the end-of-life performance of the ESBWR Marathon control rod, the first twelve (12) control rods shall be visually inspected upon discharge, not to exceed four (4) control rods from any single plant. These visual inspections shall consist of an inspection of all eight faces of the control rod.

5.7 Should a material integrity issue be observed, GEH will (1) arrange for additional inspections to determine a root cause and (2) if appropriate, recommend a revised lifetime limit to the NRC based on the inspections and other applicable information available.

5.8 GEH will report to NRC the results of all ESBWR Marathon visual inspections at least annually.

DCD Impact

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

Section 5 of the final approved LTR will be updated with the text above.

NRC RAI 4.2-31

ESBWR Marathon control blade structural analyses

NEDE-33244P, the ESBWR Marathon control blade structural analyses employ a mixture of worst-case dimensions and nominal dimensions. An example includes the combined (external pressure + channel bow) lateral load calculation assumed nominal dimensions. Please provide results for these design assessments based on worst-case dimensions, for both irradiated and un-irradiated material conditions. For completeness, tabulate the inputs and assumptions, design criteria, and results for the control blade calculations.

GEH Response

A summary of the ESBWR finite element analyses (FEA) is included in the attached table. For two analyses, the results presented in Revision 1 to LTR NEDE-33244P are based on analyses using nominal dimensions: the combined external pressure + channel bow lateral load, and the pressurization stress on absorber tubes at allowable internal pressure.

Results for the combined external pressure + channel bow lateral load, using wost-case dimensions are shown in the following table. As shown, all results are less than material allowable values.

	Maximum Stress Intensity		Allowable Stress
	Nominal Dimensions [NEDE-33244P Rev. 1]	Worst-Case Dimensions	
Unirradiated Properties	[[		
Irradiated Properties			]]
	Maximum Strain Intensity		Allowable Strain
	Nominal Dimensions [NEDE-33244P Rev. 1]	Worst-Case Dimensions	
Irradiated Properties	[[		]]

Results for the principle stresses in the absorber tube at allowable internal pressure are shown for nominal dimensions in Table 3-18 of NEDE-33244P Revision 1. Results at worst-case dimensions are added in the following table. As shown, all stresses are less than the allowable stress.

Stess Component	Nominal Stress (ksi)	Worst-Case Stress (ksi)
S1 (Hoop)	[[	
S2 (Axial)		
S3 (Radial)		
Equivalent Stress		
Allowable Stress		]]

DCD Impact

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

No changes to the subject LTR will be made in response to this RAI.

Analysis Description	ESBWR Marathon NEDE-33244P Rev. 1 LTR Section	Marathon-5S (BWR/2-6) NEDE-33284P Rev. 1 LTR Section	Geometry Inputs	Applied Loads	Material Properties	Acceptance Criteria
Thermal Analysis: Determines the temperature of boron carbide during operation. Uses heat generation due to neutron capture.	3.6.3	3.6.3	Absorber tube and capsule geometries. Worst-case geometries (largest helium gap) used. Internal tube assumed by assuming no heat flux to adjacent tubes. Conservative crud build-up used.	Peak boron carbide heat generation rates from nuclear analyses.	Thermal conductivities from various sources.	Thermal Stress less than allowable.
Lifting Load: Determines stresses in the handle while lifting the control rod.	3.7	3.7	Worst-case geometry from handle drawings.	ESBWR: 3x control rod weight M-5S: 2x control rod weight	Unirradiated linear-elastic material properties.	Maximum stress intensity or equivalent stress is compared to material allowable stress.
External Pressure + Channel Bow Lateral Load: Determines stresses in the absorber tube due to lateral loads imposed by bowed fuel channels combined with RPV operating pressure.	3.4.3	3.4.3	ESBWR: ¼ affected tube plus ½ adjacent tube. Worst-case dimensions.[1] M-5S: ¼ affected tube. Worst-case dimensions.	Lateral loads from fuel channel bow studies.	ESBWR: Unirradiated elastic-plastic true stress-strain curves. Also checked using irradiated material properties. M-5S: Unirradiated linear-elastic material properties. Also checked using unirradiated elastic-plastic true stress-strain curves.	Maximum stress intensity compared to material allowable stress.
Internal Pressure: Determines maximum allowable absorber tube internal pressure.	3.6.4	3.6.4	ESBWR: Nominal tube dimensions. Worst-case dimensions are bounded by a [[ ]]scaling factor based on burst pressure test results. Also checked the first tube attached to the tie rod. M-5S: Uses worst-case tube dimensions and allowable surface defects. No scaling factor since burst pressure results exceed worst-case FEA results used. Also checked first tube attached to the tie rod (tie rod modeled as an empty tube).	Reactor pressure vessel internal pressure to exterior of tubes for 'hot' cases. Unirradiated property analyses determine maximum allowable internal pressure. 'Check' analyses apply this pressure as appropriate.	Unirradiated elastic-plastic true stress-strain curves. Also checked using irradiated material properties.	Burst pressure defined to be internal pressure at which the stress intensity at any location in the tube first reaches the true ultimate strength. Then, a factor of safety of 2.0 is used to determine an allowable pressure.
Pressurization Stress on Absorber Tubes: Finite element analysis is used to determine the radial, hoop, and axial stress in the absorber tube at allowable internal pressure.	3.6.4	3.6.4	ESBWR: Worst-case tube dimensions.[1] M-5S: Worst-case tube dimensions.	Maximum allowable pressure determined in internal pressure analysis.	Unirradiated elastic-plastic true stress-strain curves.	Combined stresses less than material allowable stresses.
Combined Internal Pressure + Fuel Channel Bow Induced Bending: Determines maximum stresses in the absorber tube to tie rod weld.	3.4.2	3.4.2	Worst-case absorber tube dimensions. ESBWR: Model consists of tie rod and first tube. M-5S: Model consists of tie rod and entire wing of absorber tubes.	Lateral loads from channel bow studies and seismic event limits.	Unirradiated elastic-plastic true stress-strain curves. ESBWR: Also checked using irradiated material properties.	Maximum stress intensity less than material allowable stress.

[1] Analyses using nominal dimensions are presented in NEDE-33244P rev. 1. Results using worst-case dimensions are presented in the response to RAI 4.2-31.

NRC RAI 4.2-32

Provide mechanical and material properties used in the Marathon design

NEDE-33244P, please provide the un-irradiated and irradiated mechanical and material properties (e.g. stress-strain curves) used in the Marathon design analyses. Please provide stress-strain plots of the as-modeled 304S material compared against experimentally determined 304S stress-strain data. Ensure that every version of the 304S material used in all the different finite element models of the design analyses is represented in a comparison plot.

GEH Response

Three sets of material property stress-strain curves are used for control rod absorber tube finite element analysis (FEA): irradiated material at operating temperature (550°F), un-irradiated material at room temperature (70°F), and un-irradiated material at operating temperature. These stress-strain curves are input to the FEA code via a table of values. The following discussion compares the FEA stress-strain curves to experimental data.

Irradiated Type 304S at 550°F

The FEA stress-strain curve for irradiated material is derived from experimental stress-strain curve data for irradiated type 304 stainless steel. A comparison of the FEA curve to the experimental curve is shown in Figure 4.2-32-1.

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Figure 4.2-32-1: Irradiated Material Property Stress-Strain Curves – 550°F

The correlation between the FEA curve and the experimental data is excellent through the onset of yield. As shown in the graph, [[

]].

This small difference will not affect FEA results [[
]].

Un-Irradiated Type 304S at 70°F and 550°F

True stress-strain curves for un-irradiated material are not developed from experimental stress-strain curves, but are instead developed using material specification minimum strength values, and an assumed elastic-plastic shape defined by the Ramburg-Osgood relationship.

A comparison between the FEA stress-strain curves and experimental stress-strain curves is shown in Figures 4.2-32-2 and 4.2-32-3. Experimentally derived stress-strain curves for type 304 stainless steel are used for this comparison. As the available data for type 304 has a different yield strength than type 304S, the curve is scaled to the minimum yield strength of type 304S. Stress-strain curves of the experimental data scaled to typical type 304S yield strengths are also shown.

Previous material specifications for type 304S required slightly lower strengths than the current specification. Some control rod FEA use stress-strain curves based on the previous values. However, since these strength values are slightly lower than the current specification, the analyses are conservative. Both previous and current stress-strain curves are shown in Figures 4.2-32-2 and 4.2-32-3.

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Figure 4.2-32-2: Un-Irradiated Material Property Stress-Strain Curves – 70°F

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Figure 4.2-32-3: Un-Irradiated Material Property Stress-Strain Curves – 550°F

For both the room temperature (70°F) and operating temperature (550°F) conditions, the FEA stress-strain curves show close correlation to the experimental curves. The differences are generally conservative, as the FEA curve is at typically slightly lower stresses than the minimum experimental curve, and certainly less than the typical curve.

DCD Impact

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

No changes to the subject LTR will be made in response to this RAI.

Enclosure 3

MFN 08-757

Response to NRC Request for

Additional Information Letter No. 243

Related to ESBWR Design Certification Application

RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32

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 08-757, Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled "*Response to Portion of NRC Request for Additional Information Letter No. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 Supplement 1, 4.2-26 Supplement 1, 4.2-31 and 4.2-32,*" dated October 8, 2008. The proprietary information in enclosure 1, which is entitled "*MFN 08-757 – Response to Portion of NRC Request for Additional Information Letter No. 243 – Related to ESBWR Design Certification Application – RAI Numbers 4.2-24 S01, 4.2-26 S01, 4.2-31 and 4.2-32 – 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 control rod 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 8th day of October 2008.

David H. Hinds
GE-Hitachi Nuclear Energy Americas LLC