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Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 3, the balance of this letter may be considered non-proprietary.

MFN 06-464 Supplement 9, Revision 1

Docket No. 52-010

February 26, 2010

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

Subject: **Response Revision 2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) revised response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) received from the NRC via Reference 2 (RAI 3.9-75S01). The GEH original revised response was submitted via Reference 1. This second response revision is the result of interactions with the staff to close RAI 3.9-75 S01. The GEH revised responses to RAI Number 3.9-75 S01 is contained in Enclosure 1.

Enclosure 2 contains the DCD changes to Tier 2 as a result of GEH's response to RAI 3.9-75 S01. Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box.

Enclosure 3 contains markups to GEH Proprietary LTR NEDE-33259P *ESBWR Reactor Internals Flow Induced Vibration Program.* Enclosure 3 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 4 contains the GEH nonproprietary version of Enclosure 3 suitable for public disclosure.

The affidavit contained in Enclosure 5 identifies that the information contained in Enclosure 3 has been handled and classified as proprietary to GEH. GEH hereby requests that the information in Enclosure 3 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17.

D068
NRO

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 06-464 Supplement 9, Letter from R. E. Kingston GEH to the U.S. Nuclear Regulatory Commission, *Revised Response to RAI 3.9-75 S01, Related to ESBWR Design Certification Application DCD Section 3.9 – Mechanical Systems and Components* dated July 28, 2008

2. EMail to GEH from Chandu Patel (NRC) 05/15/07

Enclosures:

1. Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components

2. Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components – DCD Markups

3. Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components – LTR NEDE-33259P Markups – GEH Proprietary Information

4. Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components – LTR NED0-33259 Markups – Public Version

5. Affidavit

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	HA Upton	GEH/San Jose (with enclosures)
	eDRF Sections	0000-0114-0456 R0 (RAI 3.9-75 S01, R1)

Enclosure 1

MFN 06-464, Supplement 9, Revision 1

Response Revision 2 to

RAI Number 3.9-75 S01 related to DCD Tier 2

Section 3.9 – Mechanical Systems and Components

NRC RAI 3.9-75 S01

RAI 3.9-75 S01 Comment on response to RAI 3.9-75:

The response of the applicant is acceptable because the use of terms has been made clear and a schedule for providing startup information at the time of COL application has been identified. RAI 3.9-75 is a COL action item. However, classification of the ESBWR, as a whole as Non-Prototype Category II, will not be considered until responses to all the open items are received

GEH Original Response

The applicant agrees with the Staff position. GE is completing work to support the Non-Prototype Category II classification.

DCD Original Impact

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

GEH Response (Revision 1)

NRC Regulatory Guide 1.20, Rev. 2 requires detailed information on a comprehensive vibration assessment program for reactor internals during startup testing. The information requested includes descriptions of an analytical program, and an extensive measurement and inspection program. The required information for the ESBWR was provided in Licensing Topical Report (LTR) Reactor Internals Flow Induced Vibration Program, NEDE-33259P revision 1 dated December 2007. With the submittal of the revised LTR and changes to DCD Tier 2 subsections, as noted below, GEH is providing information to support closure of open items associated with classifying ESBWR as a Non-Prototype Category II plant.

DCD Impact (Revision 1)

DCD Tier 2, Subsections 3.9.2.3, 3.9.2.6, 3L.1, 3L.5.3, 3L.5.5.1.3 and 3L.5.5.1.4 were revised in DCD rev 5 in response to this RAI.

LTR Impact (Revision 1)

LTR General Electric Company, "ESBWR Reactor Internals Flow Induced Vibration Program", NEDE-33259P, Class III (Proprietary), and NEDO-33259, Class I (Non-proprietary), were revised to revision 1, December 2007.

GEH Response (Revision 2)

Based on further discussions with the NRC, GEH has agreed to reclassify the ESBWR as a prototype, in accordance with Revision 2 of Regulatory Guide 1.20, for the reactor internals vibration program. Applicable sections of the DCD, NEDE-33259P and NEDO-33259 will be revised to reflect this change in classification.

DCD and LTR Impact (Revision 2)

DCD, Tier 2, Section 3L.1 will be revised as shown in the attached markup.

In NEDE-33259P and NEDO-33259, Sections 2.0, 5.1, 5.2, 5.3 and 5.4 will be revised and Table 7 will be added, as shown in the attached markups.

Enclosure 2

MFN 06-464, Supplement 9, Revision 1

Response Revision 2 to

RAI Number 3.9-75 S01 related to DCD Tier 2

Section 3.9 – Mechanical Systems and Components

DCD Markups

3L.1 INTRODUCTION

A flow-induced vibration (FIV) analysis and testing program of the reactor internal components of the ESBWR initial plant demonstrates that the ESBWR internals design can safely withstand expected FIV forces for reactor operating conditions up to and including 100% power and core flow. ~~Since ESBWR internals are similar to Advanced Boiling Water Reactor (ABWR) design,~~ ~~t~~The ESBWR FIV program is considered to be ~~non-~~a prototype ~~Category II~~ per Reference 3L-1. This will require analysis, ~~and~~ measurement ~~of selected components as necessary~~ and full inspection of reactor internals of the first plant. The ESBWR internals are similar to the Advanced Boiling Water Reactor (ABWR) internals; therefore, analyses and measurements from the ABWR FIV program are used to the extent possible. The~~is~~ ESBWR FIV program includes an initial evaluation phase that has the objective of demonstrating that the reactor internals are not subject to FIV issues that can lead to failures due to material fatigue. Throughout this part of the program, the emphasis is placed on demonstrating that the reactor components will safely operate for the design life of the plant. The results of this evaluation are shown in Reference 3L-1. This evaluation does not include the steam dryer since it is separately evaluated in References 3L-5, 3L-6, 3L-8 and 3L-9; however, an overview of the steam dryer evaluation program is explained in Section 3L.4. The second phase of the program is focused on preparing and performing the startup test program that demonstrates through instrumentation and inspection that no FIV problems exist. This part of the program meets the requirements of Regulatory Guide 1.20 with the exception of those requirements related to preoperational testing that are not applicable to a natural circulation plant.

Enclosure 4

MFN 06-464 Supplement 9, Revision 1

Response Revision #2 to RAI Number 3.9-75 S01

related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components –

LTR NEDE-33259P Markups

Public Version

2.0 SUMMARY

Based on the evaluations performed in this report, the components that are evaluated in greater depth and will be part of the ESBWR FIV prototype test program are: the shroud/chimney assembly, the chimney head/steam separator assembly, the chimney, steam dryer and the SLC lines. The steam dryer will be evaluated in separate reports. For the remaining components, it has been concluded that no further evaluations are necessary since they are not susceptible to FIV. ~~Due to the similarity of the ESBWR to the ABWR design, t~~The ESBWR FIV program is considered to be ~~non-~~a prototype ~~category II~~ per Reference 2. Under this program, ~~limited~~ analysis, ~~and~~ measurements ~~of selected components is necessary,~~ and full inspection of the reactor internals of the first plant ~~is~~are required. The ESBWR internals are similar to the ABWR internals; therefore, analyses and measurements from the ABWR FIV program are used to the extent possible.

5.0 SPECIFIC REACTOR INTERNAL COMPONENT EVALUATIONS

5.1 Chimney Head/Steam Separator Assembly

As shown in Table 7, the differential pressure across the ESBWR steam separator is 27% less than for the ABWR. However, t~~T~~he ESBWR Chimney Head and Steam Separator assembly differs from earlier BWR designs in that the Chimney Head geometry is now flat compared to the domed shape on the traditional Shroud Head. Note that in the ESBWR, it is called a chimney head /steam separator assembly compared to prior BWR product lines, which have called it the shroud head/steam separator assembly, since the chimney is an additional component in ESBWR to which the head now attaches.

Additionally, the steam separator standpipes are longer, which will result in a lower natural frequency. Due to this change, the chimney head/steam separator assembly is selected for further evaluation. Restraints in the separator/standpipe "forest" are designed to increase the natural frequency and to minimize vibration responses to flow conditions. Accelerometers will be provided for the ESBWR prototype FIV test to confirm the adequacy of the design.

5.2 Shroud/Chimney Assembly

As shown in Figures 1 and 2, there are differences between the major components forming the ABWR core circulation path compared to the ESBWR design. For ABWR, the major core structure components, starting from the bottom attachment to the reactor pressure vessel (RPV), are the shroud support, shroud, top guide assembly, and the shroud head /steam separator assembly. These components form a complete assembly that is a freestanding structure, which has a full circumferential support between the RPV and the shroud. Also, there are bolted connections between the shroud and top guide assembly and also between the top guide assembly and shroud head/steam separator assembly.

In comparison to the ABWR, the ESBWR design has shroud support legs (12), shroud support ring, shroud, top guide, chimney, and chimney head/steam separator assembly. This assembly is also a freestanding structure; however, there are also eight lateral restraints at the top of the chimney structure that provide translational and torsional restraint that transmit loads through the RPV. Also, the support of the shroud involves the use of 12 support legs, each laterally braced, that provide a load path from the shroud to the RPV. For the ESBWR, there are bolted connections at the shroud to top guide, top guide to chimney, and chimney to chimney head.

The shroud/chimney/steam separator assembly is essentially an axisymmetric structure and the flow is also axisymmetric. Hence, no significant torsional excitation is expected. Any minor torsional forces from the non-axisymmetric structural elements, such as chimney internal partitions and separator structural ties, can be readily resisted by the lateral torsional restraints. Also, since the ESBWR flow is more uniform than the ABWR, any torsional fluid forces would be even smaller than in an ABWR. This more uniform flow behavior, in addition to the lateral torsional restraint at the top of the chimney, will result in an ESBWR torsional response that is less than the comparable ABWR response.

Because of the addition of the upper lateral restraint within the vessel, the ESBWR shroud/chimney calculated fundamental natural frequency is higher than that of the ABWR in spite of the ESBWR shroud/chimney/separator structure being taller. Table 5 shows that the fundamental frequency of the ABWR shroud/separator is [[ ]], while that of the ESBWR shroud/chimney/separator structure is [[ ]]. Because the flow velocity in the annulus between the RPV and the shroud for the ESBWR is higher due to a narrower annulus width, the pressure forces are also higher. Furthermore, due to the presence of the chimney, the total pressure force on the ESBWR shroud/chimney/separator structure is higher than that for the ABWR. These higher forces are partially compensated by the presence of the upper lateral restraint in the shroud/chimney/separator structure. In spite of the higher pressure forces, the calculated shroud/chimney/separator structure response is relatively small. In addition, as shown in Table 7, the differential pressure across the ESBWR shroud is 33% less than for the ABWR. Pertinent information comparing the ESBWR and ABWR shrouds, which supports the above statements, is shown in Table 5. Details of the analyses are provided below.

5.2.1 Shroud/Chimney Structure Dynamic Model and Response

Because of the essentially axisymmetric nature of the shroud chimney structure, the stiffening effects of the chimney/separator head, the top guide, and core plate, the shell modes of the shroud/chimney structure are greatly attenuated. Furthermore, the axisymmetric nature of the flow and related flow forces results in the beam response modes being dominant. Thus, a beam model of the structure is used to determine its FIV response. Two beam models, one for the ABWR and one for the ESBWR, have been created for comparison purposes. A comparison of the natural frequencies and dynamic responses of the ESBWR and the ABWR is provided in Table 5, which shows that the fundamental frequency of the ABWR shroud/separator is [[ ]], while that of the ESBWR shroud/chimney/separator structure is [[ ]].

To calculate the FIV response of ESBWR Shroud/Chimney/Separator structure, measured pressure time histories in the ABWR RPV-Shroud annulus were suitably scaled to define pressure time histories in the ESBWR RPV-Shroud/Chimney annulus. The scale factors were computed as the square of the ratio of ESBWR annulus fluid velocity to the corresponding value for the ABWR. Both the ABWR shroud and the ESBWR Shroud/Chimney structures were then analyzed using fluid forces resulting from the corresponding annulus pressure time histories to determine comparative responses of the Shroud/Chimney/Separator structure. During the prototype ABWR FIV test, the movement of the top guide was measured together with the shroud. The pressure time history was further normalized such that the calculated ABWR response would be equal to the measured ABWR response.

Using the results of these dynamic analyses, the accelerations and stresses at two locations along the shroud were obtained and are tabulated in Table 5. The ESBWR shroud stress is [[ ]] at the top guide elevation and is [[ ]] at the core plate elevation. These stresses are negligible compared to the allowable value of 68.9 MPa. The calculated forces and moments along the entire shroud/chimney/separator structure are used for calculating stresses as described below.

5.2.1.1 FIV Stress Analysis Results and Evaluation

Using the forces and moments derived from the dynamic model, maximum bending stresses in the Chimney Head & Steam Separator Assembly were calculated. The maximum predicted stress, including a fatigue strength reduction factor of [[ ]], is [[ ]], which occurs in the standpipes at the Chimney Head end. The calculated alternating peak stress intensity due to vibratory loads, which are continually applied during normal operations, is limited to 68.9

MPa for stainless steel. Thus, it is concluded that the FIV stresses are well below allowable values.

5.2.1.2 ESBWR Shroud Support Legs

The forces and moments obtained from the time history dynamic response analyses of the shroud/chimney/separator structure were used for obtaining maximum bending stresses in the support legs. The value computed is [[ ]]Mpa, which is much below the allowable limit of 68.9 MPa. A similar calculation for shroud support leg lateral braces shows that the maximum stress in the braces is [[ ]]Mpa, which is even less that that in the legs.

5.2.2 ESBWR Startup Instrumentation

The ABWR shroud was instrumented with strain gages during the ABWR prototype FIV test. The movement of the shroud was measured with displacement sensors located on the OD of the top guide. For the ESBWR, [[ ]] accelerometers, [[ ]] apart, will be placed near the calculated maximum acceleration elevation to measure the radial and tangential motion of the shroud/chimney/separator assembly. The maximum acceleration location is near the separator support ring. In addition, [[ ]] additional accelerometers, [[ ]] apart, will be placed at the midpoint of the chimney to measure chimney motion. A summary description of these sensors is contained in Table 6.

5.3 Top Guide Assembly

The ESBWR top guide is made from a solid forging that is the same as the ABWR design in the arrangement and size of the cells. The thickness of the Top Guide is 152.4 mm. In the dynamic model of the RPV and Internals, the Top Guide was modeled as a spring-mass system to account for the potential effect of its own natural frequency for FIV response. The spring, which represents the lateral stiffness of the Top Guide, connects the node representing the Top Guide to the node on the shroud at the elevation of the Top Guide. The dynamic analysis of the RPV and Internals model, under fluid-induced loads, was performed to obtain the maximum force in the spring representing the Top Guide. This force was determined to be [[ ]] and used in a subsequent detailed stress analysis of the Top Guide. The subsequent resulting peak stress value is considerably lower than the allowable value of 68.9 MPa. As shown in Table 7, the differential pressure across the ESBWR top guide is 71% less than for the ABWR.

5.4 Core Plate Assembly

The ESBWR core plate assembly is a similar design to the ABWR and BWR/6. The ESBWR Core Plate is a 210 mm stiff structure. In the dynamic model of the RPV and Internals, the Core Plate, like the Top Guide, was modeled as a spring-mass system to account for the potential effect of its own natural frequency for FIV response. The spring, which represents the lateral stiffness of the Core Plate, connects the node representing the Core Plate to the corresponding node on the shroud at the elevation of the Core Plate. The dynamic analysis of the RPV and Internals model, under fluid-induced loads, was performed to obtain the maximum force in the spring representing the Core Plate. This force was determined to be [[ ]]and used in a subsequent detailed stress analysis of the Core Plate. The subsequent resulting peak stress is considerably lower than the allowable value of 68.9 MPa. As shown in Table 7, the differential pressure across the ESBWR core plate is 82% less than for the ABWR.

Table 7:
Comparison of ESBWR and ABWR Pressure Differentials at Normal Plant Operation

Component	**ABWR Pressure Differential (Mpa)**	**ESBWR Pressure Differential (Mpa)**	**Pressure Differential Comparision**
Top Guide	[[		ESBWR is 71% less than ABWR
Core Plate			ESBWR is 82% less than ABWR
Shroud			ESBWR is 33% less than ABWR
Steam Separator		]]	ESBWR is 27% less than ABWR

MFN 06-464 Supplement 9, Revision 1

Enclosure 5

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Larry J. Tucker, state as follows:

(1) I am the Manager, ESBWR Engineering, GE Hitachi Nuclear Energy ("GEH"), 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 3 of GEH letter MFN 06-464 Supplement 9, Revision 1, Mr. Richard E. Kingston to U.S. Nuclear Regulatory Commission, entitled *Response Revision 2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components,* dated February 26, 2010. The GEH proprietary information in Enclosure 3, which is entitled *Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components – LTR NEDE-33259P Markups – GEH Proprietary Information* and 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. Non-proprietary versions of this information is provided in Enclosure 4 *Response Revision #2 to RAI Number 3.9-75 S01 related to DCD Tier 2 Section 3.9 – Mechanical Systems and Components – LTR NED0-33259 Markups – Public Version*

(3) In making this application for withholding of proprietary information of which it is the owner, 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 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, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, 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), above, is classified as proprietary because it identifies detailed GEH ESBWR design information. GEH utilized prior design information and experience from its fleet with significant resource allocation in developing the system over several years at a substantial cost.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GEH asset.

(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 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 26th day of February 2010.

Larry J. Tucker

Larry J. Tucker
GE-Hitachi Nuclear Energy Americas LLC