GE Hitachi Nuclear Energy

Jerald G. Head
Senior Vice President, Regulatory Affairs

PO Box 780 M/C A-18
Wilmington, NC 28402-0780
USA

T 910 819 5692
F 910 362 5692
jerald.head@ge.com

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 12-070

Docket number: 05200010

June 5, 2012

Attn: David Misenhimer
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: NRC Requests for Additional Information Related to the Audit of the Economic Simplified Boiling Water Reactor (ESBWR) Steam Dryer Design Methodology Supporting Chapter 3 of the ESBWR Design Control Document – RAI 3.9-282

In regard to the Requests for Additional Information transmitted in your May 1, 2012 Letter, Reference 1, to support the NRC ESBWR Steam Dryer Methodology Audit conducted March 21 – 23, 2012 Docket 5200010, please find attached the response for RAI 3.9-282.

Enclosure 1 contains proprietary information. The proprietary information is contained within brackets [[ ]] and designated in red and dotted underline text, to assist in identification. This RAI contains proprietary information identified by GE-Hitachi Nuclear Energy, Americas LLC, and should be protected accordingly. Enclosure 2 contains the response with the proprietary information redacted and is acceptable for public release. The affidavit provided in Enclosure 3 sets forth the basis for requesting that information identified in Enclosure 1 be withheld from the public. If you have any questions concerning this letter, please contact Peter Yandow at 910-819-6378.

D068
NRO

I declare under penalty of perjury that the foregoing information is true and correct to the best of my knowledge, information, and belief.

Sincerely,

for

Jerald G. Head
Senior Vice President, Regulatory Affairs

Commitments: None

Reference:

1. MFN 12-037 Letter from USNRC to Jerald G. Head, GEH, Subject: Requests for Additional Information Letter NO. 414 Related to ESBWR Design Certification Application (DCD) Revision 9, received May 1, 2012

Enclosures:

1. Response to RAI 3.9-282 - Proprietary version
2. Response to RAI 3.9-282 – Non-Proprietary version
3. Affidavit

cc: Glen Watford, GEH
Peter Yandow, GEH
Patricia Campbell, GEH
Mark Colby, GEH
eDRF Section 0000-0147-3907

Enclosure 2

MFN 12-070

Responses to RAI 3.9-282

Public Version

NON-PROPRIETARY VERSION

This is a non-proprietary version of Enclosure 1, from which the proprietary information has been removed. Portions of the document that have been removed are identified by white space within double brackets, as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS DOCUMENT

Please Read Carefully

The information contained in this document is furnished solely for the purpose(s) stated in the transmittal letter. The only undertakings of GEH with respect to information in this document are contained in the contracts between GEH and its customers or participating utilities, and nothing contained in this document shall be construed as changing that contract. The use of this information by anyone for any purpose other than that for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Response to Request for Additional Information
Mechanical and Civil Engineering Branch

RAI 3.9-282

During the audit, the staff reviewed Corrective Action Report (CAR) 57911 that pertains to a submodel that contained two unconnected nodes. The staff noted that the justification for the unconnected nodes was based on a study using [[ ]]. The staff requests justification based on applying the applicable dynamic flow induced vibration (FIV) loading, and the appropriate cut boundary conditions to the submodel mentioned in CAR# 57911.

GEH RESPONSE RAI Response Summary

To track the assumption that the stress prediction in the submodel with the unconnected nodes provides a conservative result as supported by the static analysis, Corrective Action Request (CAR) #57911 was issued. To confirm that assumption, FIV dynamic analyses were performed on a corrected submodel (all proper nodes connected). The dynamic FIV analysis results indicate that by merging the nodes, the maximum stress intensity encountered in the weld of interest decreases, as compared to the stress intensity in the original submodel analysis with the disconnected nodes. This result validates the assumption that the stress results provided by the original submodel analysis with the unconnected nodes are conservative (i.e., results indicate a higher stress with the unconnected nodes such that the steam dryer design would be such as to account for higher stress and thereby have additional margin to the stress limits).

Response

The model connectivity of Grand Gulf Nuclear Station (GGNS) global model and submodels was checked in the response to Grand Gulf Nuclear Station Round 5 Request for Additional Information (RAI)-08. Disconnected nodes were identified in the [[ ]] in two locations as shown in Figure 1. One set of disconnected nodes is located across the [[ ]] edge length; the other set is along the [[ ]]. In the response to GGNS Round 5 RAI 8, a static analysis has been performed on the revised submodel (with merged nodes) to provide justification that the original submodel results are conservative as assumed. This static analysis study was performed by [[ ]] on both the model with the unconnected nodes and the corrected model. The static analysis stress results were [[ ]]. The static analysis demonstrated that the difference is insignificant between the localized stress intensity between the submodels with disconnected nodes and with the all appropriate nodes connected. Further validation of that assumption was performed using a confirmatory Flow Induced Vibration (FIV) dynamic analysis, and is presented in response to this RAI.

To track the assumption that the stress prediction in the submodel with the unconnected nodes provides a conservative result as supported by the static analysis, Corrective Action Request (CAR) #57911 was issued. To confirm that assumption, FIV dynamic analyses were performed on a corrected submodel (all proper nodes connected) for [[ ]] These are the same load cases used in the original submodel FIV analysis.

Although all of the weld elements were scoped for the maximum stress, the location of interest is [[ ]]; the original submodel work identified that this weld sustains the most stress when compared to the rest of the welds in the submodel. This location is depicted in Figure 2 (weld elements are shown in the yellowish color). All of the time steps from the FIV analysis were scoped for maximum stress intensity in the weld elements. The scoping results demonstrate that the maximum stress intensity is observed for the [[ ]] case and occurs at [[ ]]. The original submodel maximum stress is in the same load case; however, the high-stress weld was located on the [[ ]]. The maximum stress occurs for a different load step as well, [[ ]] for the original submodel runs. Submodel benchmarking was performed to address these differences.

The benchmarking process included [[ ]] Results show that [[ ]] This indicates that no significant change in stiffness is introduced in the submodel by merging the additional nodes. By merging the disconnected row of nodes, the weld elements become fully connected to the adjoining components. This change in the local load path caused enough difference in the stress distribution to cause the maximum stress load step to shift slightly. In addition, the unconnected nodes effectively acted as a crack in the weld and provided a location of higher stress concentration.

As mentioned above, all load steps were scoped for the maximum stress in the weld elements. Table 1 provides a comparison between the maximum stress intensity in the original submodel welds and the maximum stress intensity in the corrected submodel weld material. The results show that [[ ]]. It is important to note that the stress distribution in the weld has changed for the revised submodel as well. The element stress intensity contour plots for both the original and revised submodel are depicted in Figure 3. As is evident in the contour plots, [[ ]]. Upon closer inspection of nodal stress distribution, the results indicate that [[

]]. The peak stress observed for the original submodel was [[ ]], as seen in Figure 3.

The dynamic FIV analysis results indicate that by merging the nodes, the maximum stress intensity encountered in the weld of interest decreases, as compared to the stress intensity in the original submodel analysis with the disconnected nodes. This result validates the assumption that the stress results provided by the original submodel analysis with the unconnected nodes are conservative.

DCD Impact

None.

Licensing Topical Report Impact

None.

Table 1: Maximum stress comparison between the original and corrected submodels. Percent Difference is calculated as the percent reduction in stress from the original (Unconnected) submodel.

[[			
			]]

[[

]]

Figure 1: The Two Regions of Nodes to be merged for the Submodel Revision.

[[

]]

Figure 2: [[ ]] and weld of interest geometry for the submodel analysis.

[[

]]

Figure 3: Element Stress Intensity Distribution for the weld of interest. The stress distribution for the revised submodel is seen on the left (merged nodes), while the original submodel is shown on the right (disconnected nodes).

Supplemental Information for the Response to RAI 3.9-282

During a May 23, 2012 phone conference with the NRC to discuss the DRAFT version of RAI 3.9-282, the staff asked that GEH include a discussion of the Finite Element (FE) model "QA procedure" in the response. The request reflects a concern that GEH has had problems in the past; the staff would like additional assurance that these problems will not occur for the ESBWR. The response by GEH below addresses that concern.

GEH Response

GEH performs design analyses using a NRC approved quality system [(1)]. The GEH quality procedures are based on the ASME NQA-1 standard and comply with 10 CFR 50 Appendix B requirements. Unfortunately, it is not uncommon for complex analyses (e.g., LOCA, stability, etc., as well as non-safety evaluations) to encounter problems that require corrective action, such as the subject of this Request for Additional Information (RAI) concerning disconnected nodes. When problems occur, they are evaluated and corrected. The preventative actions and lessons learned are incorporated back into the design process in the form of process improvements, such as computer program upgrades, enhanced documentation (technical design procedures), and updated quality checklists.

All structural FE models are representations of the actual physical structure of interest, which requires some level of choices by the modeler. The design assumptions and simplifications that are necessary to create a model are explicitly reviewed and verified as a standard practice. In many cases the model simplifications are unique to the problem of interest. However, regardless of the model, the process of FE modeling involves repeatable steps that are checked. Table 1 provides a list of items that are checked (by responsible engineers and verifiers) in order to complete a structural FE model for a steam dryer. Table 1 is adapted from a Design Verification Guide (DVG). DVGs are maintained by GEH Technical Leaders and are stored in design records along with the end results of the FE analysis.

Table 1 - FE Model Checklist Items

Item	Description of Check
ANSYS version	The controlled version of the software is used. Use of an uncontrolled version would be atypical and additional procedural requirements apply (e.g., validation testing).
Geometry	Geometry is checked and traceable to drawing references.
Model changes (additions)	Any new component or feature is checked to assure that it is (also) located correctly within the existing model. Also, the existing model is checked to assure that it was not changed and the boundary conditions are confirmed (either updated or not impacted by the change).
Units	Inputs are checked for correct and consistent units as appropriate.
Boundary conditions	Boundary conditions are checked to assure that they are (1) correct for the problem and (2) applied to the model correctly.
Mass	If mass is used in the model, it should be applied correctly.
Damping	Damping must be applied correctly. If the Rayleigh model is used, the "pin" points must be identified.
Material properties	Material properties are selected to be consistent with the structure as defined by drawings and specifications.
Plate, beam, and spring properties	ANSYS real constants are confirmed to be correct.

Node connectivity	Model connectivity is checked (e.g., 1-g "static" case or a modal analysis). This avoids erroneously disconnected nodes. The converse is also checked to assure that nodes were not merged or connected unintentionally.
Element connectivity	The model is checked for erroneously coincident elements.
Aspect ratios	The aspect ratio of elements (especially near stress concentrations) should be reasonable (e.g., < 2:1).
Convergence	A convergence study must be performed on the mesh density for displacements (modes) or stress, and documented.
Plate normal orientation	The plate normal vectors must be consistent (for pressure / force application).
Beam orientation	Beams must be properly oriented.
ANSYS warning messages	All ANSYS warning messages are reviewed, resolved, and/or justified.

is limited to the "mechanics" of FE modeling and is not meant to be a comprehensive list of everything that is verified for a particular analysis; other items associated with analyses must be verified and are included in other checklists (e.g., inputs, file naming conventions, post-processing data and output, weld information, etc.). As stated earlier, the design itself, including simplifications or approximations must be justified, such as the selection of a shell thickness for any solid-to-shell connections (note that this particular example must conform to the requirements in the GEH technical design procedure).

References

(1) NEDO-11209-A, **GE Hitachi Nuclear Energy Quality Assurance Program Description**, eDRF 0000-0126-6519, Rev. 9, August 2011.

Enclosure 3

MFN 12-070

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, **Edward D. Schrull, PE**, state as follows:

(1) I am the Vice President, Regulatory Affairs of GE-Hitachi Nuclear Energy Americas LLC (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 12-070, J. Head (GEH) to D. Misenhimer (NRC), "NRC Requests for Additional Information Related to the Audit of the Economic Simplified Boiling Water Reactor (ESBWR) Steam Dryer Design Methodology Supporting Chapter 3 of the ESBWR Design Control Document – RAI 3.9-282," dated June 5, 2012 The GEH proprietary information in Enclosure 1 of MFN 12-070 is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] GEH proprietary information in figures is 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 and determination 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 qualifies 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, 975 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (DC Cir. 1983).

(4) The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a and (4)b. Some examples of categories of information that 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 GEH and/or other companies.

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

c. Information that reveals aspects of past, present, or future GEH customer-funded development plans and programs, that may include potential products of GEH.

d. Information that discloses trade secret and/or potentially patentable subject matter for which it may be desirable to obtain patent protection.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to the 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, not been disclosed publicly, and not been made available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary and/or confidentiality agreements that provide for maintaining the information in confidence. The initial designation of this information as proprietary `information and the subsequent steps taken to prevent its unauthorized disclosure are as set forth in the following paragraphs (6) and (7).

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

(8) The information identified in paragraph (2) above is classified as proprietary because it communicates sensitive business information regarding commercial communications, plans, and strategies associated with future actions related to GEH's extensive body of technology, design, and regulatory information.

(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 5th day of June 2012.

Edward D. Schrull, PE
Vice President, Regulatory Affairs
Services Licensing
GE-Hitachi Nuclear Energy Americas LLC
3901 Castle Hayne Rd.
Wilmington, NC 28401
Edward.Schrull@ge.com