Entergy

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**Attachment 1 contains proprietary information.**

GNRO-2012/00018

March 21, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Response to Request for Additional Information Regarding
Extended Power Uprate
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:
1. Entergy Operations, Inc. letter to the NRC (GNRO-2010/00056), *License Amendment Request - Extended Power Uprate*, September 8, 2010 (ADAMS Accession No. ML102660403)
2. Entergy Operations, Inc. letter to the NRC (GNRO-2012/00016), Response to Request for Additional Information Regarding Extended Power Uprate, March 13, 2012

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) has requested additional information regarding the steam dryer discussed in the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 1). Entergy provided responses to the requests for additional information items 1, 4, 6, 7, and 9 requested by the Mechanical and Civil Engineering Branch in Reference 2. Responses to items 2 and 6 are provided in Attachment 1. RAIs 3 and 5 were dropped during the review.

GE-Hitachi Nuclear Energy Americas, LLC (GEH) considers portions of the information provided in support of the responses to the request for additional information (RAI) in Attachment 1 to be proprietary and therefore exempt from public disclosure pursuant to 10 CFR 2.390. An affidavit for withholding information, executed by GEH, is provided in Attachment 3. The proprietary information was provided to Entergy in a GEH transmittal that is referenced in the affidavit. Therefore, on behalf of GEH, Entergy requests Attachment 1 be withheld from public disclosure in accordance with 10 CFR 2.390(b)(1). A non-proprietary version of the RAI responses is provided in Attachment 2.

**When Attachment 1 is removed, the entire letter is non-proprietary.**

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 1) as a result of the additional information provided. There are no new commitments in this letter.

If you have any questions or require additional information, please contact Jerry Burford at 601-368-5755.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 21, 2012.

Sincerely,

MAK/FGB

Attachments:
1. Response to Request for Additional Information, Mechanical and Civil Engineering Branch, Steam Dryer (Proprietary)
2. Response to Request for Additional Information, Mechanical and Civil Engineering Branch, Steam Dryer (Non-Proprietary)
3. GEH Affidavit for Withholding Information from Public Disclosure

cc: Mr. Elmo E. Collins, Jr.
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NRC Senior Resident Inspector
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**Attachment 2**

**GNRO-2012/00018**

**Grand Gulf Nuclear Station Extended Power Uprate**

**Response to Request for Additional Information**

**Mechanical and Civil Engineering Branch, Steam Dryer (Non-Proprietary)**

This is a non-proprietary version of Attachment 1 from which the proprietary information has been removed. The proprietary portions that have been removed are indicated by double square brackets as shown here: [[ ]].

## Non-Proprietary

### Response to Request for Additional Information
### Mechanical and Civil Engineering Branch

By letter dated September 8, 2010, Entergy Operations, Inc. (Entergy) submitted a license amendment request (LAR) for an Extended Power Uprate (EPU) for Grand Gulf Nuclear Station, Unit 1 (GGNS). The NRC has requested additional information regarding the steam dryer to support the review of the steam dryer analysis report. The responses to items 1, 4, 7, 8 and 9 were provided in a letter dated March 13, 2012; responses to items 2 and 6 are provided below (note RAIs 3 and 5 were dropped during the review.)

**RAI 02 [Follow-up to Round 5 RAI 08]**

**Unconnected Nodes**

(a) The licensee states that there are [[ ]] in the GGNS replacement steam dryer (RSD). After correcting [[ ]], it reanalyzed the global model using the flow induced vibration (FIV) nominal loads. The licensee is requested to provide the following information:

(i) What is the minimum alternating stress ratio based on the reanalysis results?

(ii) What is the maximum non-conservative error introduced by the disconnected nodes? How this error may be affected by the FIV loads resulting from the consideration of the (+/- 10%) frequency shifts?

(iii) Why all [[ ]] were not corrected before performing the reanalysis? Is the finite element model mesh automatically generated using mesh generators or manually generated

(b) In response to Part (c) of the response to RAI 8, Round 5, the licensee states that the mesh convergence study was performed in low frequency range for the Susquehanna steam electric station (SSES) finite element model (FEM) to determine the adequacy of the mesh. The licensee is requested to explain whether a similar study was performed in high frequency range.

Entergy is requested to update their stress margin tables using the individual bias errors in Table 1 in their RAI response. They may *not* average the errors and add that value to their stresses – as the errors will naturally average to 0.

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**Response**

The Round 5 Request for Additional Information (RAI) 8 [1] notes that [[
]], and that only
[[ ]] prior to the reanalysis. In response to this RAI,
analyses were performed in which [[ ]]
The results of this evaluation are used to assess the impact of the [[ ]] to
the dryer stress analysis results.

Three load cases were run for both the low frequency (LF) and high frequency (HF) regimes (six cases total). The comparisons were performed for the [[
]] load cases. The [[ ]] case was run to determine the
overall impact of the [[ ]], and the other two load cases were investigated
because they had provided the [[ ]] for the vast majority of the dryer
components and, therefore, are the most relevant for assessing the impact on the Minimum Alternating Stress Ratio (MASR). Figures 1 and 2 provide bar charts depicting the differences in the maximum predicted stress intensity for each dryer component for the LF and HF regimes, respectively, for the [[ ]]
These comparisons show that the [[ ]] result in a relatively small difference in the calculated stress intensities. Power spectral density (PSD) plots for the limiting components (i.e., those with the lowest MASRs) were also compared to determine if the [[ ]] affected the dynamic response of the dryer. Comparison plots for the five components with the lowest MASR, the [[
]], are shown in Figures 3 through 7.
These plots show that the predicted frequency response of the steam dryer was not significantly affected by the [[ ]]

The following information addresses the specific questions of the RAI.

(a) As mentioned above, [[ ]] were connected in a corrected version of the global Finite Element Model (FEM). The FEM was exercised using the [[ ]] load cases for both the LF and HF regimes. The maximum stress was scoped in the corrected FEM for every component and all time steps. This maximum stress for the [[ ]] load cases for each component was compared to the respective stress result from the uncorrected Finite Element Analysis (FEA) to determine an [[ ]] for each component. The [[ ]] is assumed for the remaining six load cases. The [[ ]] results are tabulated in Tables 1 and 2. Table 1 provides the [[ ]] for the LF stress for all components, and Table 2 provides these [[ ]] for the HF stress for all the components.

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(i) The [[ ]] contained in Tables 1 and 2 are incorporated in the final MASR calculations and reflected in the final stress tables provided in the response to Round 6 RAI 06 (see below). The maximum stresses for each component and load case have been [[ ]] in the final stress calculations that are used to determine the MASR.

(ii) The [[ ]] for LF load cases and [[ ]] for HF load cases, and corresponds to the change in stress in the [[ ]] in both cases. The [[ ]] is the component with the lowest calculated stress in the dryer assembly. Components with an MASR predicted to be between [[ ]] in Round 4 RAI 05 [2] are highlighted in yellow in Tables 1 and 2. The [[ ]] for any of these components is [[ ]] for LF load cases and [[ ]] for HF load cases. These [[ ]] occur for the [[ ]] component for LF load cases and the [[ ]] component for HF load cases. The [[ ]] across the components highlighted in yellow for all load cases is colored tan.

(iii) The [[ ]] The finite element mesh has been manually generated for the replacement steam dryer global FEM for the GGNS analyses because some of the connections between the components are too complex for automatic mesh generators. Furthermore, manual mesh generation allows for better control of the FEM mesh quality.

Unlike the [[ ]] at different locations. The [[ ]] eluded standard detection methods and were difficult to find. Once a review for [[ ]] had been conducted and the [[ ]] identified, the re-analysis was performed. While this was on-going, an evaluation of the FEM was also being performed. This evaluation was to determine if the FEM contained any other errors. It was this evaluation that recognized the [[ ]] were corrected before performing the reanalysis documented in the response to this RAI.

(b) A mesh convergence study was not performed on the Susquehanna Steam Electric Station (SSES) FEM in the high frequency range. This was deemed unnecessary because the dryer [[ ]] The [[ ]] on the GGNS dryer is more significant, so a plant-specific high frequency mesh convergence study is performed. The response to Part (c) of RAI 8, Round 5 [1], demonstrated that the mesh size used in

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the GGNS FEM is consistent with the benchmarking study models. The mesh sensitivity is therefore accommodated by the assumed FEM [[ ]] from the benchmark. A limited mesh refinement study was performed in the high frequency range in response to part b of this RAI to address the adequacy of the mesh to provide a reasonably accurate stress prediction in the HF regime. This mesh refinement study was performed for the [[

]] Figure 8 provides a contour plot of the stress intensity at this location. The FEM mesh in this region is shown in Figure 9. The mesh was refined (see Figure 10) by reducing the [[ ]], thus reducing the element's [[

]]

The maximum stress intensity predicted for the [[ ]] in the [[ ]] in the refined mesh model and [[ ]] in the original mesh model. This is a [[ ]] in stress. The PSDs were calculated for the original and refined mesh at this location and are presented in Figure 11. The PSD comparison shows that the frequency response has not significantly changed. As mentioned above, the [[ ]] was also run with the refined mesh model. The [[ ]] PSD results are shown in Figure 12. Again, the frequency response of the stress is not significantly altered; however, the [[

]] Although this [[ ]] value, and both refined mesh stress predictions are lower than the [[ ]] predicted by the original mesh. This [[ ]] has been conservatively used (and adjusted as described in the response to RAI 2a above) in the stress table calculation. Based on this study, it was concluded that the mesh size in the current GGNS FE model is adequately resolved in the high frequency range.

The [[ ]] contained in Tables 1 and 2 will be applied individually to the respective component and load case when determining the final MASR.

**References**

[1] Entergy letter to the NRC dated February 20, 2012, *Response to Request for Additional Information Regarding Extended Power Uprate* (ML12054A038)

[2] Entergy letter to the NRC dated November 25, 2011, *Response to Request for Additional Information Regarding Extended Power Uprate* (ML113290137)

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**Table 1: LF Stress Adjustment Factors per Component per Load Case**

[[

**Table 2: HF Stress Adjustment Factors per Component per Load Case**

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**RAI 06**

**Updated GGNS Steam Dryer Stress Tables**

The licensee recalculated the stresses for some of the dryer components for GGNS as indicated in the responses to RAI 03, RAI 04, RAI 06 & RAI 12 of the Round #5 RAIs.

(a) The licensee is requested to provide an updated summary of the maximum fatigue stress and maximum alternating stress ratio (MASR) values (tables 4-1, 4-2, & 4-3 of attachment 11B) for the various steam dryer components at CLTP and EPU conditions (similar to Table 2 in response to audit action item #11, page 36 of 46 of Attachment 1 to GNRO-2011/00088).

(b) The licensee is also requested to update the dryer stresses (Table 4-4 of attachment 11B) for the ASME Normal, Upset, Emergency, and Faulted combinations to address the recently found errors (e.g., disconnected nodes, partial penetration welds, use of overlay) in the finite element model of GGNS RSD.

(c) The licensee is further requested to provide the updated limit curves, if necessary. Please confirm that the safety relief valve (SRV) tones, if appear, would be well captured by MSL measurements because two emerging tones [[ ]] that are present at CLTP would have been included in the benchmarking.

**Response**

(a) An updated summary of the maximum FIV fatigue stress and MASR values for the various steam dryer components at CLTP and EPU conditions is provided in Table 1 (update to Table 4-1 in Section 4.1 of NEDC-33601P). The updates of the bending plus membrane stress intensity and membrane stress intensity in Tables 4-2 and 4-3 in Section 4.1 of NEDC-33601P are provided in Tables 2 and 3 in this response, which will be used as input to the updated ASME load combination analysis. The updated results in these tables incorporate stress adjustments made for all of the RAIs, including Round #5 RAIs and current Round #6 RAIs. These adjustments include:

1) The adjusted stress intensities for [[ ]] to include the plate [[ ]] that was not modeled in the GGNS dryer FE model (Response to RAI 12, Round #5 [1]).

2) The adjusted stress intensity for the center bank tie bars to include the [[ ]] for undersized partial penetration welds (Response to RAI 06, Round #5 [2]).

3) The submodel stress results for the revised design of tie bar outer bank to middle bank and tie bar middle bank to center bank (Response to RAI 06, Round #4 [3]).

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4) The stress adjustments to correct the disconnected nodes in the GGNS replacement steam dryer FE model (Response to RAI 02, Round #6, above).

5) The uncertainty to account for the GGNS [[ ]] (Response to RAI 08, Round #6 [4]).

The results in Table 1 demonstrate that for all dryer components, using a load definition scaled to EPU conditions including the potential effects of SRV resonances, the MASR for all components is greater than 2.0. Therefore, these analyses demonstrate the acceptability of the GGNS replacement steam dryer design at EPU operating conditions.

(b) The GGNS replacement steam dryer was reanalyzed for the ASME Code load combinations (primary stresses) using the updated GGNS dryer FE model, which includes all the model modifications since the submittal of the Steam Dryer Analysis Report (SDAR) NEDC-33601P. Table 4 (update to Table 4-4 in Section 4.1 of NEDC-33601P) shows the summary of updated dryer stresses for the ASME Normal, Upset, Emergency, and Faulted condition load combinations. This updated stress table also presents the results for four additional components ([[
]]) that were not in the SDAR table. The stresses for all structural components are below the ASME Code allowable limits, that demonstrates the acceptability of the GGNS replacement steam dryer design at EPU operating condition.

(c) Table 1 shows that the lowest MASR for all the steam dryer components at EPU condition is [[ ]]. This value is higher than the limit curve factor of [[ ]] that was used in developing the current limit curves. Therefore, the limit curves do not need to be updated to reflect the updated FIV fatigue stress results.

The Safety Relief Valve (SRV) resonance signals will be captured by Main Steam Line (MSL) strain gage measurements that will be taken during power ascension to current licensed thermal power (CLTP). The two emerging resonances [[ ]] that were previously captured by the MSL measurements can be seen in the waterfall plots in SDAR Appendix G Figures 71-80 as well as the 100% CLTP PSDs for the individual MSL measurement locations in Figures 61-70. The SRV resonance signals present in the MSL measurements will be used in the GGNS benchmarking at CLTP.

In the GGNS replacement dryer analysis, the PBLE acoustic loads developed from the [[ ]] were combined with [[ ]] synthesized SRV resonance load adders at [[ ]] This load definition was then used in the finite element structural evaluation for the replacement dryer. By adjusting the [[ ]] in the four MSLs, the simulated SRV resonance loads were added in such a way that they provide excitation [[

]] and

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the projected [[ ]] SRV resonance frequencies that might be encountered at EPU conditions. Maximizing the loadings over all [[

]] The amplitude of the SRV resonance load adders were determined in such a way that the projected GGNS design basis loads at these [[ ]] SRV resonances bound the projected peak resonance loads from plants with [[ ]] Including the potential SRV resonance loads at [[ ]], exercises the FE model throughout the SRV resonance frequency range and provides the structural responses that are used as input to the F-factor methodology. In the benchmarking to be performed at CLTP, the stress contribution from the design SRV resonance load adders will be [[

]] The CLTP stresses will be compared to the on-dryer gage measurements to develop GGNS plant specific end-to-end bias errors and uncertainties.

The benchmarking evaluation is described in detail in the response to Round 6 RAI 9 [4]. If it is determined that a revised FE analysis is required, the load data will be based on CLTP data combined with the [[ ]] SRV adders, as is done in the current analysis.

**References**

[1] Entergy letter to the NRC dated February 20, 2012, *Response to Request for Additional Information Regarding Extended Power Uprate* (ML12054A038)

[2] Entergy letter to the NRC dated February 6, 2012, *Response to Request for Additional Information Regarding Extended Power Uprate* (ML12039A071)

[3] Entergy letter to the NRC dated November 25, 2011, *Response to Request for Additional Information Regarding Extended Power Uprate* (ML113290137)

[4] Entergy letter to the NRC dated March 13, 2012 GNRO-2012/00016, *Response to Request for Additional Information Regarding Extended Power Uprate*

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Table 1 Final Stress Intensity Table with Bias and Uncertainty

[[

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Table 2 FIV Bending Plus Membrane Stress Intensity with Bias and Uncertainty

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Table 3 FIV Membrane Stress Intensity with Bias and Uncertainty

[[

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Table 4 [[

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**Attachment 3**

**GNRO-2012/00018**

**Grand Gulf Nuclear Station Extended Power Uprate**

**Response to Request for Additional Information**

**Mechanical and Civil Engineering Branch, Steam Dryer**

**GEH Affidavit for Withholding Information from Public Disclosure**

# GE-Hitachi Nuclear Energy Americas LLC

# AFFIDAVIT

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

(1) I am the Vice President, Regulatory Affairs, Services Licensing, 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 letter, 173280-JB-062, "Grand Gulf Steam Dryer: Transmittal of Steam Dryer Responses to Requests for Additional Information 2 and 6," dated March 21, 2012. The GEH proprietary information in Enclosure 1, which is entitled "GEH Responses to GGNS Steam Dryer Requests for Additional Information 2 and 6, GEH Proprietary Information - Class III (Confidential)" is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] Figures, equations and some tables containing GEH proprietary information 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 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 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, resulting in potential products to 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 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 contains detailed GEH design information of the methodology used in the design and analysis of the steam dryers for the GEH Boiling Water Reactor (BWR). Development of these methods, techniques, and information and their application for the design, modification, and analyses methodologies and processes was achieved at a significant cost to GEH.

The development of the evaluation processes along with the interpretation and application of the analytical results is derived from the extensive experience databases that constitute 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 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 21st day of March 2012.

Edward D. Schrull, PE
Vice President, Regulatory Affairs
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