Entergy

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Attachment 1 and Enclosure 1 contain proprietary information.

GNRO-2011/00088

October 10, 2011

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

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

REFERENCES:
1. NRC Steam Dryer Audit (September 19-20, 2011)
2. License Amendment Request, Extended Power Uprate, dated September 8, 2010 (GNRO-2010/00056, NRC ADAMS Accession No. ML102660403)

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) requested additional information (Reference 1) regarding certain aspects of the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 2). Attachment 1 provides responses to the additional information requested by the Mechanical and Civil Engineering Branch as related to the Steam Dryer analysis.

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 to withhold Attachment 1 and Enclosure 1 to Attachment 1 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.

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 2) as a result of the additional information provided. There is a new commitment provided in Attachment 4.

When Attachment 1 and Enclosure 1 are removed, the entire letter is proprietary.

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 October 10, 2011.

Sincerely,

MAK/FGB/dm

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
4. List of Regulatory Commitments

cc: Mr. Elmo E. Collins, Jr.
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U. S. Nuclear Regulatory Commission
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Attachment 2

GNRO-2011/00088

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). By letters dated March 30, 2011 and July 6, 2011 (U.S. Nuclear Regulatory Commission (NRC) ADAMS Accession No. ML110900275 and ML111880138, respectively), Entergy submitted responses to requests for additional information (RAI) from the Mechanical and Civil Engineering Branch related to the steam dryer. Subsequently, on September 19-20, 2011, the NRC staff performed an audit of the steam dryer analysis in which the NRC identified the need for additional information associated with the following action items. Entergy's response to each item is provided below.

Action Item # 1

[[ ]] inaccuracies in acoustic model: The licensee is requested to submit GEH's quantitative assessment of the impact of the [[ ]] errors on the GGNS dryer loads.

Response

In the GGNS replacement dryer reanalysis (performed in May 2011), [[

]]. These GGNS dryer loads were used to perform the flow induced vibration (FIV) reanalysis for the fatigue evaluation. In addition, the final stress results of the reanalysis were adjusted by using the original QC2 PBLE MSL bias and uncertainty (B&U) (Reference 1).

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In order to evaluate the impact of the [[ ]] on GGNS dryer loads, the following steps were taken:

1. [[
   ]]
2. [[ ]]
3. QC2 PBLE MSL B&U [[
   ]]
4. GGNS dryer loads used in the reanalysis (May 2011) [[
   ]]
5. Bias term was calculated to characterize the influence [[
   ]]
6. The GGNS final reconciled stress table incorporates the impact of the [[
   ]]

The outcome of these revisions is presented in Tables 1 and 2:

[[ ]]

[[
]]

Table 1 presents both the previous (Reference 1) and the revised [[ ]] The last two columns represent the difference in the bias and uncertainty.

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[[
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Table 1 - QC2 PBLE MSL Bias and Uncertainty Values by Region
Impact of [[ ]]

[[

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Table 1 Notes:
w/ QC2 Tx R0: Benchmark performed with the original [[
]]
w/ QC2 Tx R1: Benchmark performed with the revised [[
]]

GGNS Dryer Loads: [[ ]]

[[

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The percent difference values (bias) are presented in Table 2. The bias is calculated as:

[[ ]]

where 'Loads R0' is the GGNS dryer loads calculated with the [[ ]] (R0) and 'Loads R1' is the GGNS dryer loads calculated with the [[ ]] (R1).

[[

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Table 2 - GGNS Dryer Loads Bias [[
]]

[[

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Tables 1 and 2 are provided as inputs to adjust the final GGNS reanalysis steam dryer stress table. The correction factors from these tables are combined with the correction factors determined in the responses to the other NRC action items in the final reconciled stress table.

References:

1 ESBWR Steam Dryer - Plant Based Load Evaluation Methodology Supplement 1, NEDC-33408 Supplement 1 P-A, Rev 2, October 2010.

2 ESBWR Steam Dryer - Plant Based Load Evaluation Methodology NEDC-33408P-A, Rev 1, October 2010.

Action Item # 2

Acoustic Model [[ ]] Term: The licensee is requested to provide a justification on why the use of [[ ]] is conservative for all other dryers, citing previously accepted ESBWR SER.

Response

Supplement 1 to the Economic Simplified Boiling Water Reactor (ESBWR) Steam Dryer – PBLE Methodology Licensing Topical Report (LTR) and the associated NRC safety evaluation report (SER) (References 1 and 2) support the adequacy of using the [[ ]] term for the ESBWR. The technical development of that position discusses the general applicability to other operating boiling water reactor (BWR) steam dryers, which are evolutionary steps toward the ESBWR design (Reference 3).

For current BWR designs, in the transition region at the nozzle between the vessel and any MSL, a turbulent, two-phase saturated steam flow is present (with a significant acceleration pressure drop, which affects the acoustic wave propagation). [[

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]] As stated in the section 3.1.2 of Reference 1:

[[

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The EPU MSL steam flow velocities for [[

]].

Therefore, the [[

]]. So far, there are still no plants with MSL flow velocities [[ ]]; however, if that situation were to arise, the [[ ]]. The [[ ]] is described in Section 3.1.2 of Reference 1. The corresponding NRC review is documented in Section 3.3.1 of Reference 2.

At present, the PBLE methodology is not generically approved. Each application of the PBLE method is expected to be supported (justified) and will be subject to NRC review. For GGNS, GEH has implemented the recommendation provided in Reference 4. [[

]], a minimum alternating stress ratio of 2.0 has been maintained. This additional margin should provide adequate conservatism to offset any deficiencies introduced through the PBLE methodology.

References:

1. NEDC-33408P-A Supplement 1, ESBWR Steam Dryer – Plant Based Load Evaluation Methodology, Rev. 2, October 2010.

2. NRC SER for NEDC-33408P-A, ESBWR Steam Dryer – Plant Based Load Evaluation Methodology, Rev. 1, October 2010.

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3. NEDC-33436P, GEH Boiling Water Reactor Steam Dryer – Plant Based Load Evaluation, Rev. 0, November 2008.

4. MFN 11-230, "Clarification of Intent on Methodologies for Demonstrating Steam Dryer Integrity for Power Uprate – GE-Hitachi Nuclear Energy," Robert Nelson (NRC) to Jerald Head (GEH), September 14, 2011.

Action Item # 3

Load mapping – Structural vs. Acoustic models: The licensee is requested to show integrated total forces and moments over selected dryer regions, and edges, as a function of frequency (for the same frequencies and regions used in Bias and Uncertainty Factor (BUF) narrow-band calculations).

Response

In the GEH steam dryer FIV analysis process, acoustic pressure loads on the dryer are calculated using the PBLE methodology. [[

]] The evaluation process can be described as follows:

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1. First, the FE models are “cut” into four quadrants. Components from a single quadrant are separated into three (natural or logical) sub-regions as shown in Figures 1 through 3, making 12 pairs of sub-regions for the outer hood, inner hoods, and skirt.

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Figure 1 - [[ ]]

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Figure 2 - [[ ]]

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Figure 3 - [[ ]]

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Bias and uncertainty calculations can be performed for a more quantitative assessment of [[

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Figure 4:[[ ]]

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References:

1. NEDC-33601P, “Engineering Report Grand Gulf Replacement Steam Dryer Fatigue Stress Analysis Using PBLE Methodology,” Revision 0, Class III, September 2010, submitted as Attachment 11 to the GGNS EPU LAR dated September 8, 2010.

2. Nuclear Energy Corrective Action Request, CAR 49314, Evaluation of ANSYS load mapping error on steam dryer FIV analysis

3. MFN 09-509 Letter to NRC, “Response to Portion of NRC RAI Letter No. 220 and 399 Related to ESBWR Design Certification Application -- DCD Tier 2 Section 3.9 --Mechanical Systems and Components, RAI Numbers 3.9-213 and 3.9-217 S01,” July 31, 2009.

Action Item # 4

Structural FE models: The licensee is requested to provide a write-up on FE structural meshing procedure and a justification that GGNS meshing procedures are conservative with respect to SSES benchmarks.

Response

The GGNS finite element model mesh is identical to the SSES mesh. For a description of the mesh refinement process used for the SSES FEM mesh, refer to Attachment 11 of the GGNS EPU LAR Appendix E Paragraph 5.1.2 (NEDC-33601P) (NRC ADAMS Accession No. ML102660407). The GGNS replacement dryer FEM was generated directly from the replacement dryer FEM used for the SSES benchmark (i.e., they are essentially the same model). The only notable differences between the SSES benchmark FEM and the GGNS FEM are those to accommodate:

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- The additional skirt length
- Inside and outside water level
- The dryer bracket mount point quantity (six brackets for the GGNS dryer versus four brackets for the SSES dryer)
- The additional hold-down structures at the 0^o and 180^o azimuths of the dryer
- The addition of the four lifting rods and collar sets for the confirmatory analysis FEM
- Refined the trans-brace bracket elements to eliminate a local point of singularity on the baseplate

With regard to these changes, the mesh size of the revised or additional feature is equal to or less than the adjoining feature(s). For this reason, as well as those stated above, the stress convergence study performed on the SSES benchmark FEM is valid for the GGNS replacement steam dryer FEM.

Action Item # 5

Structural FE models: The licensee is requested to provide a write-up on the methodology, including a description of how the [[
]], for transition from shell element to solid element, are determined.

Response

The steam dryer FEM is primarily made of shell elements. There are dryer components, such as the [[ ]], which are modeled using solid elements. The shell elements have three translational and three rotational Degrees of Freedom (DOF) on each node. However, the solid elements do not have rotational DOFs. In order to properly transfer the moments between the shell elements and solid elements, [[ ]] are used to model the transition interface between the two types of elements.

The GGNS replacement steam dryer design is based on the valid BWR/4 prototype replacement steam dryer. For the GGNS evaluation, modeling procedures were applied in a consistent manner with the prototype dryer model, in order to maintain consistency with the prototype end-to-end benchmarking results. Any significant changes in the modeling would potentially require a re-evaluation of the benchmark. The GGNS replacement dryer FEM was generated directly from the prototype replacement dryer FEM with only minor modifications due to design. The [[ ]] was kept the same as in the prototype dryer model for consistency.

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As part of GEH's continuous improvement program, efforts have been applied to refine, standardize, and document the steam dryer analysis process. To this end, a study was performed to provide a firm basis for the appropriate [[ ]] applied in dryer finite element models. [[

]].

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Figure 1 - Cantilever Beam Finite Element Model

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Figure 2 - Thickness of Overlay Shells

The results from the study (as shown in Figure 2) validate the [[ ]] used in the GGNS model. For example, [[ ]] transition elements were applied in the [[ ]], which is also consistent with prototype replacement dryer model. [[ ]]. Because the overlay shell thickness is most sensitive and critical to the predicted stresses at the high stress (limiting) location, which is [[ ]], the [[ ]] baseplate thickness was used as "plate thickness" in Figure 2. [[ ]], Figure 2 gives [[ ]]. This result confirmed the applicability of the [[ ]] used in the GGNS flow induced vibration analysis.

Action Item # 6

Measured dryer pressures, strains, accelerations; bias errors and uncertainties: The licensee is requested to submit benchmarking of limited set of [[ ]] at several power levels, prove that [[ ]].

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Response

The response to this request will consist of two parts,

- Comparison of delta pressure data vs. corresponding external pressure for QC2 and SSES;
- Comparison of the bias and uncertainty using the limited delta pressure data available for the benchmark plants vs. B&U presented in NEDC-33408 Supplement 1P-A (Reference 1),

Both the QC2 and SSES replacement dryers were instrumented with a significant number of on-dryer pressure sensors. [[

]]. The time history data for matching sensors, exterior minus interior, was computed and converted into a delta pressure PSD. These delta pressure PSDs were then plotted with the individual sensor PSDs for comparison. Figures 1 through 6 show the PSD comparison plots for the two benchmark plants at various power levels. [[

]].

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Figure 1 - QC2 (P3-13) vs. P3 and P13
Measurement data for TC41

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Figure 2 - QC2 (P3-P13) vs. P3 and P13
Measurement data for TC32b

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Figure 3 - QC2 (P20-P14) vs. P20 and P14
Measurement data for TC41

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Figure 4 - QC2 (P20-P14) vs. P20 and P14
Measurement data for TC32b

[[

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Figure 5 - SSES (P5-P6) vs. P5 and P6
Measurement data for TP1H1

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Figure 6 - SSES (P5-P6) vs. P5 and P6
Measurement data for TP1G2

Bias and Uncertainty

To evaluate the impact of delta-P in the benchmark analysis, the pressure differential is substituted for the corresponding external pressure transducer to compare the effects on the bias and uncertainty of the individual sensor and the effect on the group sensors. [[

]].

Table 1 below outlines the data considered to qualify the uncertainty due to the use of differential pressure data. [[

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[[

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Figure 7 - QC2 Pe (P3) vs. dP (P3-P13)
Measurement data for TC41

[[

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Figure 8 - QC2 Pe (P20) vs. dP (P20-P14)
Measurement data for TC41

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Figure 9 - SSES Pe (P5) vs. dP (P5-P6)
Measurement data for TP1G2

Table 1 - Uncertainty due to dP pressure

[[				
				]]

[1] Reference 1

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Table 2 - Combined Uncertainty with dP Error by Region

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References:

1. NEDC-33408P-A Supplement 1, ESBWR Steam Dryer – Plant Based Load Evaluation Methodology, Revision 2, October 2010.

Action Item # 7

Consideration of [[ ]]: The licensee is requested to explain how tones from [[ ]] will be accounted for in GGNS. The explanation could be based on a comparison of SSES and GGNS in-plant measurements

Response

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References:

1. NEDC-33601P, “Engineering Report Grand Gulf Replacement Steam Dryer Fatigue Stress Analysis Using PBLE Methodology,” Revision 0, Class III, September 2010.

2. MFN 09-509 Letter to NRC, “Response to Portion of NRC RAI Letter No. 220 and 399 Related to ESBWR Design Certification Application -- DCD Tier 2 Section 3.9 --Mechanical Systems and Components, RAI Numbers 3.9-213 and 3.9-217 S01,” July 31, 2009.

Action Item # 8

Consideration of the Dryer Cracking Experience from SSES2: The licensee is requested to provide any preventive measures or design changes to GGNS dryer in light of the cracking observed in SSES2 steam dryer.

The staff also requests that ENTERGY submit a report after the evaluation of Susquehanna Unit 2 steam dryer cracking is completed, explaining whether there are any areas of the GGNS replacement dryer that need to be modified or further analyzed based on the final results and conclusions of the Susquehanna evaluations

Response

Entergy provided information regarding the causal factors for the Inter-Granular Stress Corrosion Cracking (IGSCC) of the SSES Units 1 and 2 steam dryers in the response to RAI #5 in our July 6, 2011 letter. The causal factors for that cracking have not changed. The RAI response also summarized preventive measures for IGSCC flaws that have been implemented for the GGNS replacement steam dryer.

The response to RAI #5 also discussed the through-wall crack in the dryer skirt panel at the bottom of the dryer support ring in SSES Unit 2 steam dryer. While the root cause analysis of the skirt crack has not been finalized, the most likely cause is still believed to be related to the weld of the seismic block to the skirt. The seismic block has been redesigned and the weld has been eliminated from the GGNS replacement steam dryer. [[

]].

Entergy will provide a summary report describing the conclusions of the SSES Unit 2 skirt crack evaluation as well as the potential impact of its findings on the GGNS steam dryer once the root cause evaluation effort has been finalized.

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Action Item # 9

GGNS dryer stresses: The licensee is requested to provide confirmation that the range of peak stress intensity is assumed to be [[ ]] over time history (this was cited in ESBWR submission) for the GGNS steam dryer calculations. The licensee is also requested to explain whether the conservatism introduced by this assumption is quantified for the GGNS and/or SSES dryers.

Response

As outlined in the ESBWR Steam Dryer Structural Evaluation LTR (Reference 1), the steam dryer fatigue evaluation consists of calculating the alternating stress intensity from FIV loading at all locations in the steam dryer structure and comparing it with the allowable design fatigue threshold stress intensity. [[

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The GGNS Steam Dryer fatigue evaluation follows the same procedure provided in Reference 1. [[

]]

The ASME Code (Section III, Div 1, NG-3222.4) prescribes the alternating stress intensity for fatigue evaluation of cyclic operations. [[

]]

References:

1. ESBWR Steam Dryer Structural Evaluation LTR NEDC-33313P-A, Rev. 2, October, 2010.

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Action Item # 10

GGNS steam dryer stresses: [[

]] as noted in CAR [Corrective Action Report] 52763. The licensee is requested to determine the impact of this modeling error on dryer stresses.

Response

The impact of the support ring thickness modeling error on the steam dryer stresses has been assessed by determining biases [[

]]

The biases in this assessment are defined as:

[[

]]

The biases for all the dryer components for all load cases are shown in Table 1. Each bias value from the array of biases in Table 1 [[

]]

The biases from Table 1 are provided as inputs [[ ]

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Table 1 - Support Ring Thickness Modeling Error Biases for Steam Dryer Components

[[

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Action Item # 11

GGNS steam dryer stresses: The licensee is requested to provide a summary of the GGNS reanalysis of the replacement steam dryer stresses. This summary should include a list of changes made for the reanalysis and a comparison of the relevant stresses from reanalysis with those calculated in the original analysis submitted to the NRC. The licensee is also requested to explain whether the reanalysis led to any changes in the design of the replacement dryer.

Response

Appendix A, Section 8.2.6 of Reference 1 provides a discussion [[ ]] applied to the original GGNS steam dryer evaluation. In early to mid-2011, the GGNS FIV analysis was rerun with corrections incorporated directly into the [[ ]], so that additional correction factors would be unnecessary. One of the objectives of this evaluation was to confirm that the correction factors applied to the GGNS analysis were adequately conservative.

As discussed in Section 3.3.2.2.1 of Reference 1, there is an [[ ]] because of the [[ ]]. For this reason, the PBLE methodology includes a provision for [[ ]]. Even though the methodology considers these differences, several discrepancies between the as-designed and as-analyzed dryer were identified, which have been explicitly evaluated. This includes a [[ ]] (NRC Action Item #10), as well as differences in [[ ]] used in the benchmarks (NRC Action Item #1). A complete list of items that have been addressed is provided in Table 1. The revised stress table that results from incorporating the Table 1 changes is provided in Table 2.

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Table 1 – Changes Incorporated into the GGNS FIV Reanalysis

Item	Description
New GGNS acoustic model	The GGNS acoustic model was modified to correct the [[ ]], to include the [[ ]] and to increase [[ ]].
Nozzle area error in benchmarks (NRC Action Item #1)	Both the QC2 and SSES acoustic models also contained the [[ ]]. The impact of the QC2 [[ ]] on GGNS dryer loads was evaluated by revising the [[ ]], as well as the [[ ]] using the corrected FRFs. This is discussed in the response to NRC Action Item #1. Because [[ ]] data was not used in the GGNS dryer load definition, the GGNS dryer loads were not impacted by the SSES [[ ]].
Delta pressure data in benchmarks (NRC Action Item #6)	Both the QC2 and SSES replacement dryers were instrumented with a significant number of on-dryer pressure sensors. The measurements from the sensors were used to benchmark the PBLE predictions. Most of the sensors were installed on the exterior of the dryer. [[ ]]. The benchmarking of the [[ ]] in QC2 and SSES was performed in NRC Action Item #6, which results in an [[ ]]. The [[ ]] is combined with other [[ ]].
Vane passing frequency (NRC Action Item #7)	The impact of [[ ]] on GGNS dryer loads was addressed in NRC Action Item #7. The GGNS plant uses [[ ]].

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Item	Description
Support ring (NRC Action Item #10)	The impact of the [[ ]] dimensional difference (as-designed versus as-analyzed) on the predicted dryer stresses is discussed in the response to NRC Action Item #10. [[ ]]
Revised Finite Element Bias and Uncertainty	It was noted that the [[ ]]. The RAI response was clear that the [[ ]] is used in the determination of the [[ ]]. In the GGNS stress analysis, the [[ ]] are reported as the peak stress for fatigue. Then the [[ ]] are used to adjust the peak stress. Therefore, it is consistent and logical to use the [[ ]].

Acoustic to structural FE model [[ ]] were addressed in NRC audit item #3. [[ ]] were calculated for both structural model and acoustic model. The [[

]]. Furthermore, the GGNS stress analysis has incorporated the NRC staff's recommendation for additional margin [2], which addresses the fact that there are limited benchmarks for the PBLE methodology (and the staff's concern for potential additional [[ ]]). Due to the [[

]] presented in Table 2.

Incorporating the modifications presented into Table 1, the GGNS final stresses and margins were recomputed for the fatigue evaluation. It was found that [[

]].

[[
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Table 2 - GGNS Reanalysis Stress Table

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May 2011 Re-analysis Summary

The primary purpose for the May 2011 reanalysis (described above as the early to mid-2011 analysis) was to validate the bias factors applied to the GGNS replacement dryer final stress table for Steam Dryer Analysis Report (SDAR) due to acoustic model errors (Reference 1). In the reanalysis, [[

]].

In addition to the new pressure loads from the revised acoustic model, the structural Finite Element Model (FEM) was modified to include the following notable changes:

- The addition of the four lifting rods and collar sets
- Refined trans-brace bracket elements and the corresponding baseplate attachment location to eliminate a local point of singularity on the baseplate

In addition to these notable changes, another minor FEM [[

]]. By doing this, [[

]].

After a preliminary run of the revised model with the new loads, it was found that the [[

]]. This design change was assessed in the reanalysis, and is the only design change encouraged by the reanalysis.

The reanalysis stress table is provided as Table 3. The table contains a summary of the maximum stress intensity per component at the Current License Thermal Power (CLTP) as well as [[ ]] as discussed in Reference 1. A comparison of the stress intensity for the top ten stress components from both SDAR submittal and re-analysis is provided as Table 4. [[

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Thus, in the GGNS dryer reanalysis, the most limiting [[
]] whereas for the submittal analysis it is [[

]].

References:

1. NEDC-33601P, “Engineering Report Grand Gulf Replacement Steam Dryer Fatigue Stress Analysis Using PBLE Methodology,” Revision 0, Class III, September 2010.

2. MFN 11-230, “Clarification of Intent on Methodologies for Demonstrating Steam Dryer Integrity for Power Uprate – GE-Hitachi Nuclear Energy,” Robert Nelson (NRC) to Jerald Head (GEH), September 14, 2011.

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Action Item # 12

Conservatism in Steam dryer Stresses: The licensee is requested to provide a list of conservatisms and approximate quantification where appropriate in the GGNS and/or SSES steam dryer stress evaluations performed by GEH.

Response

Reference 1 provides a comprehensive description of the fatigue calculations and associated methodology applied to the GGNS replacement steam dryer. Reference 1 describes the detailed development of the dryer analysis methodology and, where applicable, identifies where conservatism is introduced into specific models and correlations. For example, Section 2.4.2 of Reference 1 Appendix C describes how [[

]]. However, in most cases, the impact of these individual models or design choices is quantified through the benchmark comparisons, which represent an integral assessment of predictive capability in terms of key parameters (i.e., stress and strain). Given this thought, rather than evaluating the merits of individual models, the discussion presented here simply considers two aspects of the analysis: (1) a brief discussion of the benchmarking results, which provides an expectation of accuracy when the PBLE and structural FE based method is applied to other plants and (2) conservatisms associated with the analysis technique that are expected, but not quantified through the benchmark analysis.

End-to-End Benchmarking

An evaluation of PBLE and FE analysis bias and uncertainty was provided in Enclosure 2 of Reference 2. The evaluation was based on a comparison of predicted versus measured data from SSES, which is the prototype for the GGNS dryer. [[

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A summary of the FE model bias and uncertainty evaluation is provided in Table 1.

Table 1 – GEH FE Model Bias and Uncertainty (Reference 2)

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		]]

Analysis Approach

The items below represent conservatisms in the GGNS analysis that are expected to be present, but not credited in the final stress analysis results.

- MSL Measurement Filtering – [[

]] The magnitude of this item has not been quantified for GGNS.

- Bias and Uncertainty Treatment – The fatigue stress bias and uncertainty evaluation and the determination of the maximum adjusted stress intensity are performed on a

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component-by-component basis using the four methods described in NEDC-33601P.
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- Fatigue Design Limit – The GEH steam dryer methodology utilizes the endurance limit from ASME Section III, Design Fatigue for Austenitic Steels, Curve C as the acceptance

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criterion for the predicted alternating stress. The limit from Curve C is 13.6 ksi based on 10^{11} cycles assumed over the 40 year design life of the dryer. In determining the acoustic pressures acting on the dryer, [[

]] so that the FIV loads determined by the stress analysis will have considered the peak stress intensities that occur at frequencies as low as 1 cycle per 100 seconds, or less than $2x10^7$ cycles over the life of the dryer. Therefore, the design limit is conservative in that the peak load cycles are assumed to occur at a much higher rate than actual in-service conditions would indicate (i.e., compared to on the on-dryer measurements). Based on plant measurements, the fatigue usage is expected to accumulate at a lower rate over the 40 year design life of the dryer. Therefore, there is margin available to accommodate higher loading and still remain within a fatigue usage factor of 1.0 over the life of the steam dryer.

A rain-flow cycle counting analysis was performed using the strain amplitudes measured on the instrumented SSES and QC2 replacement steam dryers. Figure 1 shows the upper (hood region) and lower (skirt region) dryer instrument histograms (cycles versus strain amplitude) for both dryers. While the upper and lower sensors show consistent curve characteristics, there is marked difference between QC2 (dominated by high frequencies) and SSES (dominated by low frequencies). Figure 2 shows the highest 20% of the strain range from Figure 1.

[[

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Figure 1 – Strain Histogram SSES and QC2 Replacement Dryers

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Figure 2 – Strain Histogram SSES and QC2 Replacement Dryers High Amplitude Strain

For low frequency plants such as SSES and GGNS, [[

]]

- Design margin – A minimum alternating stress ratio of 2.0 for the fatigue stress of the dryer has been implemented to account for [[

]] as outlined in Reference 3.

Non-Proprietary

References:

1. NEDC-33601P, “Engineering Report Grand Gulf Replacement Steam Dryer Fatigue Stress Analysis Using PBLE Methodology,” Revision 0, Class III, September 2010.

2. MFN 09-509, “Response to Portion of NRC RAI Letter No. 220 and 339 Related to ESBWR Design Certification Application – DCD Tier 2 Section 3.9 – Mechanical Systems and Components; RAI Numbers 3.9-213 and 3.9-217 S01,” Richard Kingston to USNRC Document Control Desk, July 31, 2009.

3. MFN 11-230, “Clarification of Intent on Methodologies for Demonstrating Steam Dryer Integrity for Power Uprate – GE-Hitachi Nuclear Energy,” Robert Nelson (NRC) to Jerald Head (GEH), September 14, 2011.

Enclosure 1 to

Attachment 2

GNRO-2011/00088

Grand Gulf Nuclear Station Extended Power Uprate

Response to Request for Additional Information

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

Because Enclosure 1 to Attachment 1 contains only proprietary information, a Non-Proprietary version is not included.

Attachment 3

GNRO-2011/00088

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-046, "Grand Gulf Steam Dryer: Transmittal of Audit Report Action Item Responses," dated October 10, 2011. The GEH proprietary information in Enclosure 1, which is entitled "GEH Responses to NRC Steam Dryer Audit Report Action Items" 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 10th day of October 2011.

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

Attachment 4

GNRO-2011/00088

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
1. Entergy will provide a summary report describing the conclusions of the SSES Unit 2 skirt crack evaluation as well as the potential impact of its findings on the GGNS steam dryer once the root cause evaluation effort has been finalized.	x		