Entergy

Entergy Operations, Inc.
P. O. Box 756
Port Gibson, MS 39150

Michael A. Krupa
Director, Extended Power Uprate
Grand Gulf Nuclear Station
Tel. (601) 437-6694

Attachment 1 contains proprietary information.

GNRO-2011/00101

November 14, 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. Entergy letter "Request for Additional Information Regarding Extended Power Uprate", dated October 10, 2011
3. 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 the steam dryer discussed in the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 3). Responses were provided in Reference 2. The NRC has requested further additional information based on those responses. Attachment 1 provides responses to the requests for additional information (RAI) items 1, 3, 4, 7, and 8 requested by the Mechanical and Civil Engineering Branch. Responses to items 2, 5, 6, and 9 will be provided by 11/17/2011.

GE-Hitachi Nuclear Energy Americas, LLC (GEH) considers portions of the information provided in support of the responses to the RAIs 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 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 3) as a result of the additional information provided. There is a new commitment made above and summarized in Attachment 4.

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 November 14, 2011.

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
4. List of Regulatory Commitments

cc: Mr. Elmo E. Collins, Jr.
Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
612 East Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

U. S. Nuclear Regulatory Commission
ATTN: Mr. A. B. Wang, NRR/DORL (w/2)
ATTN: ADDRESSEE ONLY
ATTN: Courier Delivery Only
Mail Stop OWFN/8 B1
11555 Rockville Pike
Rockville, MD 20852-2378

State Health Officer
Mississippi Department of Health
P. O. Box 1700
Jackson, MS 39215-1700

Attachment 2

GNRO-2011/00101

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: [[ ]].

Note

Because the entire contents of Enclosure 1 of Attachment 1 are proprietary, a Non-Proprietary version is not included.

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 conducted an audit of the replacement steam dryer calculations, in which several open items were identified. Entergy provided responses to those items in a letter to the staff dated October 10, 2011. The NRC has requested further additional clarification; the responses are provided below.

RAI 1

The response to the Audit Action Item 1 did not provide updated data for [[ ]] frequency dependent Bias and Uncertainties (B&U) and GGNS dryer loads. The licensee is requested to provide this information.

Response

In the response to NRC Audit Action Item 1, the [[
]] (B&U) were recalculated to [[
]] These revised PBLE [[ ]] values were derived using the same benchmarking procedure and interpolation method as in NEDC-33408P, Supplement 1 [Reference 1]. Because the frequency bands used for the QC2 benchmarks ended at approximately [[
]]
Plots of the B&U values are shown in Figures 1 and 2, and the tabulated values are provided in Table 1 for the [[ ]]

A bias term to characterize the influence of the revised [[ ]] on the GGNS dryer loads was also calculated in the response to Audit Action Item 1. This bias term was based on the load changes for [[

]] The [[ ]] values are shown in Figure 3 and are tabulated in Table 2.

Non-Proprietary

References

1. GE Hitachi Nuclear Energy, "ESBWR Steam Dryer - Plant Based Load Evaluation Methodology Supplement 1," NEDC-33408P-A Supplement 1, Revision 2, October 2010, page 74. This topical report is included in the GGNS EPU LAR as Appendix C to Attachment 11; see page 94 in that document.

2. GE Hitachi Nuclear Energy, "Grand Gulf Replacement Steam Dryer Fatigue Stress Analysis Using PBLE Methodology," NEDC-33601P, Revision 0, September 2010, Appendix A, Section 5.1. This topical report is included in the GGNS EPU LAR as Attachment 11.

Non-Proprietary

[[

]]

Figure 1 - [[ ]]

Non-Proprietary

[[

]]

Figure 2 - [[ ]]

Non-Proprietary

Table 1: [[

]]

[[				

Non-Proprietary

[[				
				]]

Non-Proprietary

[[

]]

Figure 3: [[ ]]

Non-Proprietary

Table 2: [[ ]]

[[		

Non-Proprietary

[[		
		]]

Non-Proprietary

RAI 3

In response to the Audit Action Item 5, the licensee provided a plot (Figure 2) which gives appropriate [[
]] However, the explanation is not clear about how the appropriateness of the [[ ]] is determined. Since the [[
]] greater than that given by Figure 2 would also provide analytically acceptable results for the [[ ]], a criterion needs to be specified for determining the appropriateness of the [[ ]] The licensee is requested to clarify if (for Figure 1) [[

]] The licensee is also requested to confirm if this criterion is utilized in preparing Figure 2.

Response

Figure 2 provided in the response to Audit Action Item 5 presented the [[
]], which is based on a study of [[

]] The purpose of the study was [[

]] This study was performed as an effort to [[
]] applied in the GGNS dryer finite element model.

For a [[ ]] with a concentrated load at one end, the maximum stress (at the fixed end) is a function of the tip displacement:

$$\sigma_{max} = \frac{3dEt}{2l^2}$$

Where, σ_{max} is the maximum bending stress, d is the tip deflection of the beam, E is the modulus of elasticity, t is the beam thickness, and l is the beam length. It is expected that after using the [[

]]

The [[
]] was used to confirm the stress convergence. Figure 1 below shows the [[

Non-Proprietary

]] As demonstrated in this figure, [[

]]

As discussed in the response to Audit Action Item 5, the GGNS replacement steam dryer FE model applied [[ ]] in the [[ ]] to be consistent with the prototype replacement dryer model. The appropriate selection of [[ ]] is especially important for the stress prediction and evaluation of the high stress components which may be affected [[ ]] The stresses are high in the region where the [[

]] Figure 2 in the response to Audit Action Item 5 suggests that for a [[ ]] Because the stresses, including [[ ]] are not significantly different (Figure 1 in this response), it is acceptable to use the [[ ]] Aside from the [[

]] For those plates which are thinner than [[ ]] provide appropriate transfer of [[ ]] The only plate component that is [[

]]

The maximum stress location along [[

]]

as shown in Figure 2 in this response. Because of the constraint provided by the [[ ]], the stress is not [[ ]] and, therefore, the need for [[ ]] In addition, the most limiting stress location for the [[ ]] is not at [[ ]] Therefore, the use of [[

]]

These results confirmed the acceptability of the [[ ]] used in the GGNS flow induced vibration analysis.

Non-Proprietary

[[

]]

Figure 1 - [[

]]

Non-Proprietary

[[

]]

Figure 2 - FE Model of Inlet End Plate - Outer

RAI 4

In response to Audit Action Item 7 pertaining to incorporating the [[
]] into the GGNS dryer analysis, the licensee did not provide the figures 1 through 6 and tables 1 and 2 referenced in their response. The licensee is requested to provide the accompanying figures and tables.

Response

The requested Figures 1 through 6 and Tables 1 and 2 supporting the response to Audit Action Item 7 in the October 10, 2011 GGNS letter are included in Pages 23 through 30 of Attachment 1.

Non-Proprietary

RAI 7

In Appendix F (Section F.2) of the GEH report NEDC-33601P, Revision 0, it is stated that during power ascension from CLTP to EPU, [[

]] However, this comparison does not confirm whether the projected loads are less than or equal to the design loads expected at that specific power level; these design loads may be determined by properly interpolating the EPU acceptance limits for the steam dryer pressures. The licensee is requested to revise or clarify the monitoring plan used during power ascension to confirm that the loads acting on the steam dryer at any given power level do not exceed the corresponding design loads.

Response

The power ascension test plan for the GGNS replacement dryer is provided in Appendix F of GEH report NEDC-33601P, Revision 0, which was provided as Attachment 11 in the GGNS EPU License Amendment Request. Section F.3 provides the process to be performed at each EPU power ascension plateau to confirm that [[

]] Section F.5 provides the process to be performed at each EPU power ascension plateau to assure that there is adequate margin available to the acceptance limits to proceed with the power ascension to the next plateau. This process consists of [[

]] These steps are sufficient to assure that the pressure loads acting on the dryer remain within the EPU design condition loads used for the dryer FIV stress assessment and that the dryer stresses will not exceed the fatigue acceptance criterion for each step during the power ascension. It is Entergy's understanding that the intent of the request is to provide assurance at each power ascension plateau that there will be adequate margin for the power ascension to continue to the full EPU power level. In response to this request, the power ascension monitoring plan will be revised to [[ ]] using the process described in Section F.5. The procedure for acceptance limit comparison and adjustment can be summarized as follows:

Step 1: The [[ ]] for the current plateau are compared to the acceptance limits. If Level 1 limit is exceeded, power will be reduced to a level where the limit criteria are met (Section F.3).

Step 2: At each power ascension plateau, the [[

Non-Proprietary

]]

(Section F.5).

Step 3: At each power ascension plateau, the data trending [[
]] (Section F.5).

Step 4: The [[ ]] are projected to [[

]] (Section F.5).

Step 5: The [[ ]] for the next plateau and EPU condition are compared to the acceptance limits based on EPU design condition loads (Section F.3).

The limit curves are adjusted according to the procedure outlined in Section F.6 if any of the following conditions is triggered:

- [[
-
-

]]

It is noted that the [[

]] As shown in Figure 3-19 of Appendix A of GEH report NEDC-33601P, Revision 0, once the SRV resonance is established, a [[ ]] provides a reasonable extrapolation of the amplitude for the next power step. However, for extrapolations over large power changes, the [[ ]] methodology does not account for the decrease in the amplitude growth rate as the resonance begins to peak. [[

]] Therefore, the [[

]]

Non-Proprietary

The process of projecting the [[ ]] to the EPU condition for comparison to the EPU acceptance limits is equivalent to the suggested comparison of the [[ ]] at a specific power level to the interpolated acceptance limits. This follows because the [[

]]

It is anticipated, however, that projecting the current [[ ]] to the full EPU level will be more straightforward to implement and execute during the power ascension than developing and maintaining a family of limit curves. The [[

]]

RAI 8

(a) In the topical report, BWRVIP-139, in the background section it is stated that for Quad Cities, "*The root cause of the outer hood failure was determined to be high cycle fatigue due to low frequency pressure loading; the same as that for the Unit 2 failure in June 2003*." (i) The licensee is requested to explain the frequency of the low-frequency loading and how long it might have taken to cause the failure. (ii) Since the high-cycle fatigue cracking due to low frequency loading can potentially manifest after a longer period of operation (longer than few operating cycles) at EPU loading, the licensee is requested to describe the long-term inspection requirements for the GGNS replacement steam dryer.

(b) In the topical report, BWRVIP-139, under Results & Findings it is stated that, "*BWRVIP will define re-inspection requirements based on the review of results from the baseline inspection results*." However, it is not clear how the baseline inspection results could help in defining the re-inspection requirements for the dryer because the high-cycle fatigue cracking caused by the low-frequency pressure loading is not likely to be present in the baseline inspection results. The licensee is therefore requested to explain how

Non-Proprietary

the baseline inspection results would help in determining the re-inspection requirements for the GGNS replacement dryer operating at EPU.

Response

(a) (a)(i): The Background section of BWRVIP-139 is paraphrasing the discussions presented in SIL 644 Rev. 1 and refers to the root cause evaluations for the Quad Cities Unit 2 and Unit 1 outer hood failures that occurred in May and November 2003, respectively. No plant-specific measurements of the frequency content of the pressure loadings at Quad Cities were available at the time that root cause assessment of these failures was performed. Based on the on-dryer measurements available from other plants, as well as structural analyses of the dryer response to flat spectrum loading in the 0-200 Hz excitation ranges, it was concluded in the root cause evaluation that low frequency loads in the 0-50 Hz range had the potential to produce cracking at the diagonal brace attachments to the outer hood plates. Both the Unit 1 and Unit 2 hood failures occurred after approximately one year of operation at EPU power, which would represent approximately 10^8 fatigue cycles in the low frequency range (~50 Hz). The dryer failures at Quad Cities were believed to have been caused by the increase in acoustic pressure loads associated with the EPU. This conclusion was based on the similarity of the operating time at EPU for both units at the time of the failure (approximately half an operating cycle) as well as the similarity in the extent of hood damage.

However, as described later in the Background section of the BWRVIP-139, in May 2005, Quad Cities 2 conducted testing with an instrumented dryer. The BWRVIP document corrects itself noting “based on the instrumented steam dryer test at Quad Cities 2, that the damage was caused by high frequency pressure loading. This high frequency pressure loading resulted from a coupling of the vortex shedding frequency at the inlets of safety and relief valves and the ¼-standing wave acoustic frequencies of the valve standpipes.” The report goes on to describe the acoustic load mitigation devices installed and notes that they have effectively eliminated the high amplitude, high frequency pressure loading.

(a)(ii): The primary purpose of the steam dryer inspection plan is to perform a detailed inspection of the dryer in order to identify potential problems that may occur early in the dryer life (e.g., fabrication-related issues). Both BWRVIP-139 and SIL 644 Rev. 2 provide dryer inspection recommendations for the implementation of power uprates as well as long-term inspection programs. The GGNS inspection plan considers the recommendations of the BWRVIP and of the SIL-644. These documents have

Non-Proprietary

considered the operating history and experience of the industry steam dryers, including the Quad Cities 1 and 2 dryer findings in their recommendations.

(b) As noted above in the response to 8.a.1, BWRVIP-139 clarified that, based on subsequent information derived from a testing program on an instrumented Quad Cities 2 dryer, the cause was a high frequency pressure loading. Thus, the premise of the RAI has changed. Entergy plans to follow the inspection recommendations of the BWRVIP-139. Specifically, as GGNS utilizes a curved hood steam dryer, the inspection recommendations of Section 5.3.3 and the re-inspection guidelines of Section 5.3.4 are applicable.

Attachment 3

GNRO-2011/00101

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-049, "Grand Gulf Steam Dryer: Transmittal of Steam Dryer Request for Additional Information 1, 3 and 7," dated November 13, 2011. The GEH proprietary information in Enclosure 1, which is entitled "GEH Responses to Request for Additional Information, Mechanical and Civil Engineering Branch - Steam Dryer, 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 13th day of November 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-2011/00101

Grand Gulf Nuclear Station Extended Power Uprate

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	
Responses to items 2, 5, 6, and 9 will be provided by 11/17/2011.	x		11/17/11