From:	Misenhimer, David
Sent:	Wednesday, March 27, 2013 3:00 PM
To:	'Yandow, Peter (GE Power & Water)'; Head, Jerald G (GE Power & Water)
Cc:	Misenhimer, David
Subject:	ESBWR Supplemental RAIs Letter 415 - Contains Proprietary Information
Attachments:	Final ESBWR Steam Dryer Supplemental RAIs PROPRIETARY 03-26-13.pdf; Final ESBWR Steam Dryer Supplemental RAIs Non-PROPRIETARY 03-26-13.pdf

Dear Mr. Head:

By letter dated August 24, 2005, GE Hitachi Nuclear Energy (GEH) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The U.S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review as a result of the steam dryer audit conducted March 21 through 23, 2012. The staff's request for additional information is contained in the enclosure to this letter.

Pursuant to 10 CFR 2.390, we have determined that the enclosed RAIs contain proprietary information. We have prepared a non-proprietary version of the RAIs (attached) that does not contain proprietary information. The proprietary information is indicated in brackets and redlined in the proprietary version (attached). We will delay placing this document in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any additional information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.390 before the public release date.

If you have any questions or comments concerning this matter, you may contact me at 301-415-6590 or via e-mail at David.Misenhimer@nrc.gov.

Sincerely,

David Misenhimer, P.E.
Project Manager
Office of New Reactors
Division of New Reactor Licensing
Licensing Branch 3 (LB-3)
U.S. Nuclear Regulatory Commission
Two White Flint - 6-C28
Mail Stop: T6-D38
Washington, DC 20555-0001
301.415.6590 (direct)
301.415.6386 (fax)
David.Misenhimer@NRC.com (email)

Request for Additional Information (RAI)
ESBWR Design Control Document (DCD) Revision 9

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RAI 3.9-269 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-269.	GEH did not completely answer RAI 3.9-269 (MFN 12-043, Revision 1, February 7, 2013). GEH should specifically be sure to include the following in a revised response: 1. RAI 3.9-269 contains four subparts. GEH's response does not appear to map to these four subparts. GEH may describe where the requested information is located in its response. As an alternative, GEH may supplement and resubmit the response. 2. GEH has not demonstrated (as the staff requested in the RAI) that the full range of structural strain analyses over [[ ]] and including the reported bias and uncertainty (B/U) has bounded measured data. 3. Report NEDE 33408 Rev. 2 is incomplete, and does not include sufficient description of the end-to-end benchmarking approach, particularly in Section 4.4.4. This description must be provided either in a revision to 33408, or via reference to other reports or design control document (DCD) sections. Also, the staff has follow-up questions based on the information provided in the response. They are: 4. The [[ ]] demonstration is not prototypic of that to be used for the ESBWR dryer, since all pressure sensors [[ ]]. The resulting end-to-end B/U's appear to be very high. However, the response also contains plots of the CLTP pressure data which are based on the prototypic Plant Based Load Evaluation (PBLE) approach [[ ]]. Since the surface pressure comparisons for CLTP are far more representative of those expected for ESBWR design, GEH has the option to provide a CLTP-based [[ ]] as the basis for the ESBWR analysis and design approach. 5. The staff also notes that GEH, in its response to RAI 3.9-292, plans to take credit for

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			[[ ]] in its ESBWR design. The staff does not have the information necessary to determine if taking credit for [[ ]] is acceptable. Reactor pressure vessel, MSL, and dryer geometry changes (which affect resonance frequencies) and differences in flow velocities (which affect the frequency-dependence of fluctuating surface loading on the dryer) between the [[ ]] and the ESBWR designs will shift dominant dryer alternating stress peak frequencies upward and/or downward, such that the [[ ]] may not be applicable for ESBWR. GEH is asked to quantitatively establish that taking credit for [[ ]] will not lead to nonconservative dryer alternating stress calculations in the ESBWR design. Providing [[ ]] at multiple plant power conditions (such as CLTP, discussed in item 4) would help establish the global conservatism of the bias errors. In the absence of further supporting information, GEH is asked not to include credit for conservative [[ ]] in future ESBWR dryer alternating stress calculations, with possible exemptions at and around postulated safety relief valve (Quad Cities Unit 2) and deadleg (Susquehanna) tonal frequencies, which are not expected to occur in the ESBWR plants per GEH design commitments. 6. GEH should address sensor redundancy in its ESBWR instrumented dryer plan to ensure that ESBWR benchmarking is not compromised in the manner that [[ ]] has been.
RAI 3.9-271 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-271.	In its response to RAI 3.9-271 (MFN 12-045, Revision 1, February 8, 2013), GEH stated that the PBLE01 methodology is described in NEDC-33408P, "ESBWR Steam Dryer – Plant Based Load Evaluation Methodology – PBLE01 Model Description), Revision 2, February 2013. GEH provided NEDC-33408 (Revision 2) in its response to RAI 3.9-269 (MFN 12-043, Revision 1, February 7, 2013). Section 2.0 of NEDC-33408P provides a high level description of the PBLE01 methodology. The NRC staff requests that GEH specify the identifying assumptions for the PBLE01 methodology to be applied for the ESBWR steam dryer that can be marked as Tier 2* information.
RAI 3.9-273 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-273.	In the response to RAI 3.9-273 (MFN 12-038, Revision 1, June 1, 2012) regarding hammer test, The NRC staff requests GEH to clarify that if the difference between the measured and predicted frequency [[ ]]. Otherwise a larger frequency shift should be considered for estimating the most conservative dryer fatigue stresses.

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RAI 3.9-277 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-277.	Regarding the response to RAI 2.9-277 (MFN 12-086, Revision 2, February 11, 2013), the staff has the following questions related to the weld quality factors: • Are there any multi-pass welds in the steam dryer fabrication? If so, please confirm that the [[ ]] is qualified to detect any surface breaking flaws. • What is the thickness of each weld pass? • What is the smallest size of the critical flaw in the ESBWR steam dryer welds? The NRC staff requests that GEH address these questions in the applicable ESBWR licensing documents, such as NEDE-33313P.
RAI 3.9-280 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-280.	GEH submitted the response to RAI-280 (MFN 12-051, Revision 2, February 15, 2013). The staff reviewed the response, and also discussed it with GEH during telephone calls on 02/27/2013 and 03/06/2013. This RAI provides the description of and technical basis for the shell overlay element method [[ ]] in the GEH steam dryer global shell model, in order to enforce rotational compatibility. The staff finds that the response adequately addresses all staff comments provided to GEH on 10/15/2012, with one exception (comment 9). Comment 9 requested GEH to address the effect of the shell overlay element method on the local shell stresses at the connection location. GEH identified relevant quantitative information based on a study performed to address staff comment 6. The staff reviewed this information, and concurred that it is relevant to addressing staff comment 9. However, it is based on an assumed shell thickness of [[ ]] than the typical shell thickness in the steam dryer. Therefore, the staff requests GEH to repeat this study using a shell thickness [[ ]] that is representative of the steam dryer design.
RAI 3.9-285 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-285.	GEH submitted the final response to RAI-285 on 02/15/2013. This RAI response provides a comparison of GEH Method 1, GEH Method 2, and a traditional strength of materials approach, for fatigue evaluation of fillet welds. GEH defined 10 typical configurations of double fillet welded T connections for this study. The staff reviewed the RAI-285 response, and discussed it with GEH during telephone calls on 02/27/2013 and 03/06/2013. The staff further discussed it with GEH during the meeting at NRC on 03/19/2013. GEH

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			informed the staff that the demonstration [[ ]] was inappropriately calculated. A corrected calculation indicates that [[ ]]. The staff noted that this new information would be considered in preparing the final follow-up RAI-285 S01. Based on the information provided in the RAI-285 final response, and the three (3) subsequent discussions with GEH, the staff finds that the final response does not adequately address all of the staff comments previously provided to GEH on November 14, 2012. • Regarding staff comment 2 from November 14, 2012: GEH informed the staff on 03/19/2013, that a [[ ]] in the RAI-285 study. Since the typical steam dryer global shell model has element sizes in [[ ]] range, it is not clear to the staff how GEH ensures that Method 2 produces conservative results for fatigue evaluation of fillet-welded T-joints in actual steam dryer applications. a) The staff requests that GEH submit quantitative information that establishes Method 2 solution convergence for the largest shell element size currently used in the global shell model, at the locations of interest (i.e. double fillet-welded T-connections). b) Also describe in detail how the ESBWR global shell model will be evaluated, to ensure convergence of Method 2 at all locations where it will be applied to assess fillet welded T-connections. • Regarding staff comment 3 from November 14, 2012: GEH provided a brief description of the approach used in past convergence studies to meet a specified [[ ]] criterion. The staff needs additional information to better understand how the convergence study described specifically applies to convergence of Method 2 results for assessment of fillet-welded T-connections. Therefore, the staff requests GEH to a) Confirm that the [[ ]] criterion is applied to local FEA shell stresses that are used in Method 2; if not, identify where the [[ ]] criterion is applied, and explain why this is applicable to the local FEA shell stresses used in Method 2. b) Based on previous convergence studies, identify the maximum shell element mesh

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			size, at locations of interest for application of Method 2 to fillet-welded T-connections, that meets the [[ ]] criterion. • Regarding staff comment 5 from November 14, 2012: GEH is requested to address the following: 1) From the results reported in Table 5.5.1b of the RAI-285 response, Method 1 does not converge until the mesh size approaches [[ ]] sizes, the predicted results are consistent with the traditional calculation for fillet welds. The staff notes that the change in the Method 1 prediction, between a [[ ]] mesh, as presented in Table 5.5.2 of the RAI-285 response, is very significant. The [[ ]] mesh results are at least [[ ]] mesh results, and [[ ]] for several cases. Therefore, it would appear that the use of Method 1 for [[ ]]. Therefore, GEH is requested to explain how Method 1 will be applied in a typical steam dryer fatigue evaluation, if the shell mesh [[ ]]. Will GEH refine the mesh locally in areas where Method 1 is to be used? Will a separate local model be used to obtain the converged membrane and bending resultants for use in Method 1? 2) From the results presented in Table 5.5.1b of the RAI-285 response, the Method 2 results for a [[ ]] evaluation results and the converged Method 1 results. However, there is a lack of consistency in the conservatism of the Method 2 results. There is [[ ]]. A review of these configurations indicates that they share a common attribute; namely, that all have a [[ ]] Method 2 results are closer to the traditional results and the converged Method 1 results. During the 02/27/2013 telephone call with GEH, the staff requested GEH to review these Method 2 results for possible errors in the table, or to provide a technical explanation for the validity of these Method 2 results. During the 03/06/2013 telephone call with GEH, GEH indicated that the results are correct, and explained why the level of conservatism changes with the w/t_v ratio. To better understand any possible limitations, the staff requested GEH to analyze a

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			configuration [[ ]]. GEH agreed to do this. The staff subsequently reviewed the data in light of GEH's clarification, and reached the conclusion that for [[ ]], the Method 2 results are nonconservative, when compared to the traditional results and the converged Method 1 results. Therefore, the staff requests GEH to explain how Method 2 will be implemented (e.g., imposing a restriction on the minimum [[ ]], in order to ensure that the Method 2 results are conservative, when compared to the traditional results and the converged Method 1 results. 3) Table 5.5.3b of the RAI-285 response shows that Method 2, with [[ ]] the traditional results and the converged Method 1 results. The 3 configurations analyzed (4s, 5s and 9s) all have [[ ]]. GEH noted the nonconservatism of the results in a Table footnote. The staff discussed this observation with GEH during the 02/27/2013 and 03/06/2013 telephone calls. GEH responded that configurations 4s, 5s, and 9s are not representative of fillet weld details used in the steam dryer, and had identified this in a different part of the RAI-285 response. According to GEH, this analysis was conducted just to satisfy a staff request. The staff noted that it had not requested any specific analysis and left the choice of "representative" configurations to GEH. The staff requests GEH to define the restriction on w/t_v ratio that will be imposed on the ESBWR steam dryer design. Demonstrate the conservatism of Method 2 for the [[ ]], consistent with the GEH response to item (2) directly above.
RAI 3.9-286 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-286.	GEH submitted the response to RAI-286 (MFN 12-077, Revision 2, February 15, 2013). The staff reviewed the response, and also discussed it with GEH during a telephone call on 03/06/2013. This RAI response provides a comparison of GEH Method 3, [[ ]], to the results compiled in the response to RAI-285 for GEH Method 1, GEH Method 2, and a traditional strength of materials approach. GEH selected configurations 8, 9, and 10 from RAI-285 for this comparison. The staff finds that the response does not adequately address all of the staff comments provided to GEH on 11/14/2012. In addition, the response to RAI-286 does not establish a sound technical basis for Method 3 as a conservative procedure [[ ]] On 03/05/2013, in advance of the 03/06/2013 telephone call with GEH, the

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			staff communicated the following to GEH: "Based on its review of the GEH response dated February 15, 2013, to RAI 3.9-286, the NRC staff finds that GEH has not justified the application of GEH Method 3 [[ ]] in the ESBWR steam dryer. This conclusion is based on [[ ]], and the staff's lack of confidence in GEH's implementation of the [[ ]]. For the specific ESBWR steam dryer locations where GEH planned to apply Method 3, GEH must present a different fatigue evaluation method that is acceptable, or must justify the validity of Method 3." During the 03/06/2013 telephone call, the staff discussed with GEH all of the staff's findings leading up to the above conclusion, and also identified GEH actions that would help the staff make a final determination on the acceptability of Method 3. These are identified below. • Regarding staff comment 1 from November 14, 2012, the staff requests that GEH explain how the validity of Method 3 is demonstrated by the information in the final draft response to RAI-286. As necessary, provide additional validation information. • Regarding staff comment 2 from November 14, 2012, see discussion under comment 4 below. • Regarding staff comment 3 from November 14, 2012, the staff does not accept the data presented in Table 7.3 as evidence that a [[ ]]. The staff also noted an apparent error in Table 7.3 that may be indicative of a problem with the [[ ]]. This is not typical, and requires explanation. The staff requests that GEH review their calculations for possible errors in the [[ ]], and either correct the data or provide a quantitative explanation for the result. The staff will re-assess GEH's claim that [[ ]] after receipt and review of the requested additional information. • Regarding staff comment 4 from November 14, 2012, the staff cannot determine if any of the examples of [[ ]]. The staff requests that GEH clarify whether Method 3 has been used in any prior production analyses of steam dryers for [[ ]] evaluation.

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			If Method 3 has been implemented in a production analysis, the staff requests that GEH provide the following information for a representative case: a. sketch of the joint geometry analyzed, with dimensions. b. a picture of the [[ ]], with element dimensions. c. a discussion of how the analyzed mesh size was determined to be adequate. d. a comparison of the Method 2 and Method 3 predictions of alternating peak stress intensity. • Regarding staff comment 5 from November 14, 2012, GEH has concluded that the results presented in the response for the [[ ]] element sizes are not reliable, because the element size is too large to model shell membrane plus bending behavior for configurations 8, 9, and 10. To assist the staff in evaluating the reliability of Method 3 for the smallest element size used in the study, the staff requests that GEH apply Method 3 to configuration 1, [[ ]]. Provide the following information: a. the [[ ]] of both fillet welds, b. the 6 element coordinate stresses (3 normal, 3 shear) in all of the [[ ]], for both fillet welds. c. the [[ ]]. d. the final Method 3 result for [[ ]]. • Regarding staff comment 6 from November 14, 2012, as quantitative confirmation that the interface is modeled correctly, the staff requests that GEH tabulate the element stress component normal to the interface, [[ ]], and from both sides of the interface, for Configuration 9, Horizontal Force only loading, [[ ]]. For this case, there are [[ ]]. Also, explain the statement: “Furthermore, there is [[ ]] in the current steam dryer design.” The staff requests that GEH identify whether [[ ]] has ever been used in production analyses. If so, provide a description of the application. • Regarding staff comment 7 from November 14, 2012, GEH’s explanation of the “dip” is

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			insufficient. The staff requests that GEH provide the necessary numerical data to demonstrate the validity of the dip in the 'MEM + BEND' curve. In addition, the staff notes that the stress intensity at any location, per the Code, is the largest of the absolute value of (σ_1 - σ_3), the absolute value of (σ_3 – σ_2), or the absolute value of (σ_2 – σ_1), [[ ]] was calculated (as indicated in the response), the results presented do NOT represent the stress intensity. The staff requests that GEH address this, by either correcting the statement in the response if it is inaccurate, or correcting the numerical data if the calculation was performed incorrectly. • Regarding staff comment 8 from November 14, 2012, the staff noted that in Table 7.8, the [[ ]] The staff requests that GEH explain this or correct the data in Table 7.8. Also, the staff noted that the Method 1 results reported in Table 7.8 for Configuration 8 are not consistent with the Method 1, Configuration 8, results reported under RAI-285. The staff requests that GEH explain this or correct the data in Table 7.8. • Regarding staff comment 9 from November 14, 2012, the staff notes that the additional results in Figure 7.9, for [[ ]], and raises a question about [[ ]]. There is a very significant difference in the "TOTAL" plot between [[ ]]. The staff sees no apparent reason for the significant difference. To assist the staff in its evaluation of this result, the staff requests that GEH submit plots similar to Figure 5.2C [[ ]] and Figure 7.9 [[ ]], but for Horizontal Force Only loading. Include the [[ ]] that would be used by the [[ ]]. Submit this information for both fillet welds.
RAI 3.9-288 S01	Wong Y.	The staff's question is in regard to	In their response to RAI 3.9.288 (MFN 12-059, Revision 1, February 8, 2013), GEH provides a [[

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		GEH's response to RAI 3.9-288.	]]. The study shows that the hood region is adequately modeled for frequencies up to [[ ]], but the skirt region is accurate [[ ]]. GEH discusses, however, that no strong loads, like [[ ]], will exist in the ESBWR dryer, so that skirt models only need to be accurate [[ ]]. For the staff to confirm this assertion, GEH is asked to provide cumulative measured strain plots (alternating strain summed through frequency) for the Susquehanna and Grand Gulf dryers, and to show that the contribution to overall alternating stress for frequencies above [[ ]] is indeed very low.
RAI 3.9-291 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-289, 290, and 291.	In its combined response to RAIs 3.9-289, 290, and 291 (MFN 12-066, Revision 2, January 30, 2013), GEH provides a summary of the regulatory positions in RG 1.20 in Table 1 of its RAI response. In its summary of Section 2.1 of RG 1.20, GEH does not address the following guidance on page 14 of RG 1.20: After developing a steam dryer load definition, an applicant for the construction and operation of a BWR nuclear power plant (or a licensee using this regulatory guide in planning a power uprate for an operating BWR nuclear power plant) should apply the load definitions to vibration and stress models to determine the vibrations of the valves and stresses within the steam dryer, with justified damping assumptions and applicable weld factors and stress intensities. After including applicable bias errors and random uncertainties, the applicant/licensee should compare valve vibrations against applicable limits, and peak stresses at critical steam dryer locations to the fatigue limits in the ASME Boiler & Pressure Vessel Code. To address Section 2.1 in RG 1.20, GEH states that the ESBWR prototype steam dryer will be analyzed based on the steam dryer design. GEH states that as part of the manufacturing process, there may be adjustments in the design in order to facilitate fabrication of the steam dryer. GEH indicates that following completion of fabrication, there will be an "as-built" predictive analysis that will be used for comparison to the final "as-built" steam dryer measured data during plant startup. GEH states that an ITAAC that will be added to the DCD Tier 1 to ensure that the predictive analysis of the "as-built" steam dryer will be fully documented. Section C.III.4.3, "Combined License Information Items That Cannot Be Resolved Before the Issuance of a License," in RG 1.206 states that for each COL action item that cannot be resolved before license issuance, the COL applicant should provide sufficient information to support the NRC licensing decision, and propose a method for ensuring the final closure of the item following COL issuance. One of the methods for final closure of a COL Information

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			Item specified in RG 1.206 is development of a new ITAAC. In that the "as-built" steam dryer will not be available for the COL applicant to perform a fatigue analysis prior to COL issuance, the COL applicant will need to follow the guidance in RG 1.206 to provide sufficient information to support the NRC licensing decision (such as successful implementation of the PBLE Method 1 on a sample steam dryer), and then rely on the new ITAAC to complete the resolution of the COL Information Item. The NRC staff requests that GEH describe the application of the PBLE Method 1 for the fatigue analysis of the Grand Gulf steam dryer (including any lessons learned from issues identified during the analysis of steam dryer data) in the DCD as an example of the successful implementation of the methodology to allow the COL applicant to incorporate by reference this information in its FSAR to satisfy RG 1.20.
RAI 3.9-291 S02	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-289, 290, and 291.	In its combined response to RAIs 3.9-289, 290, and 291, GEH indicates that COL Information Item 3.9.9-1-A is as follows: The Combined License (COL) Applicant will classify its reactor per the guidance in RG 1.20 and provide a milestone for submitting a description of the inspection and measurement programs to be performed (including measurement locations and analysis predictions) and the results of the vibration analysis, measurement and test program. This COL Information Item only addresses classification of the reactor and activity milestones. The COL Information Item does not address the complete set of guidance in RG 1.20 for preventing potential adverse flow effects on the ESBWR steam dryer. The NRC staff requests that GEH revise the COL Information Item to specify that the COL applicant will implement the recommendations in RG 1.20 for a comprehensive vibration assessment program for the steam dryer. For example, the COL Information Item should specify that the COL applicant (a) describe Comprehensive Vibration Assessment Program for PBLE Method 1 consistent with RG 1.20; (b) submit or reference a steam dryer predicted analysis (for the plant-specific or a sample steam dryer) that concludes that steam dryer will not exceed stress limits with applicable bias and uncertainties and the minimum alternating stress ratio (MASR) of 2.0; (c) describe startup program (with proposed startup license condition) that includes appropriate notification points during power ascension, and submittal of the completed analysis of steam dryer data within 90 days following startup of NRC information; and (d) specify periodic steam dryer inspections during refueling outages. The COL applicant will be able to satisfy this COL Information Item by incorporating by reference

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			the information in the ESBWR DCD with any supplemental information as necessary.
RAI 3.9-291 S03	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-289, 290, and 291.	The GEH response to RAIs 3.9-289, 290, and 291 addresses COL Information Items and ITAAC to be completed by the COL applicant and later the COL licensee. To provide guidance for the COL applicant, the NRC staff requests that GEH propose license conditions to require each licensee referencing the ESBWR design to monitor steam dryer performance during startup and during subsequent refueling outages. For example, the steam dryer license conditions should provide for the licensee to: (a) monitor steam dryer data and main steam line vibration, and take appropriate action as necessary; (b) provide steam dryer data to the NRC staff at prescribed power levels; (c) refrain from exceeding prescribed power levels for specific time periods during initial reactor startup; (d) submit within 90 days following initial startup (1) the results of evaluation of the steam dryer and main steam line components for vibration and stress analysis, and (2) confirmation of PLBE Method 1 and the resulting bias and uncertainties; and (e) perform periodic steam dryer inspections during refueling outages. The license conditions developed to monitor the steam dryer performance for the power ascension at Grand Gulf might provide an appropriate starting point for the ESBWR COL steam dryer license conditions.
RAI 3.9-291 S04	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-289, 290, and 291.	On page 3 of the GEH response to RAIs 3.9-289, 290, and 291, GEH refers to NRC Interim Staff Guidance ISG-024 in support of the ITAAC closure verification process. However, ISG-024 was not issued. The NRC staff requests that GEH revise its RAI response to remove the reference to ISG-024.
RAI 3.9-291 S05	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-289, 290, and 291.	On page 31 of the GEH response to RAIs 3.9-289, 290, and 291, GEH specifies the acceptance criteria of the proposed ITAAC for the as-built steam dryer predicted peak stress as follows: Fatigue analyses of the as-built steam dryer verify that the maximum calculated alternating stress intensity meets or exceeds a Minimum Alternating Stress Ratio of 2.0 to the allowable alternating stress intensity of 93.7 MPa (13,600 psi). In that the NRC staff will confirm completion of this ITAAC through the inspection process, the NRC requests that GEH modify the acceptance criteria for the ITAAC to clarify that the fatigue analyses will demonstrate that the as-built steam dryer stress intensity meets or exceeds the Minimum Alternating Stress Ratio of 2.0.
RAI 3.9-292 S01	Wong Y.	The staff's question is in regard to GEH's response to	In its draft response to RAI 3.9-292 (MFN 13-007, February 19, 2013), GEH described the approach for the ESBWR steam dryer structural evaluation in NEDE-33313P (Revision 3, February 2013), "ESBWR Steam Dryer Structural Evaluation." In Section 1.0, "Introduction,"

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		RAI 3.9-292.	of NEDE-33313P, GEH provides an outline of the approach that does not include a demonstration of the adequacy of the fatigue analysis for the ESBWR steam dryer. The NRC staff requests that GEH revise NEDE-33313P to include a description of the successful application of the steam dryer structural evaluation, such as performed for the steam dryer in the Grand Gulf Nuclear Station.
RAI 3.9-292 S02	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-292.	In its response to RAI 3.9-292, GEH states in Section 5 of NEDE-33313P the following: [[ ]]. The NRC staff notes that the [[ ]] does not represent the true convergence error because the converged results have not been determined. As a result, further mesh refinement may be necessary. For example, the results for the refined meshes could be extrapolated to zero mesh size. The corresponding results would then represent the converged results and may be used to determine the convergence error. The NRC staff requests that GEH confirm that the finite element model for the ESBWR steam dryer will satisfy this convergence criterion for both global shell model and any submodeling.
RAI 3.9-292 S03	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-292.	In its draft response to RAI 3.9-292, GEH describes changes to its ESBWR steam dryer licensing documents in response to the recent RAIs, and provides tables cross referencing those changes to specific RAIs. The NRC staff requests that GEH provide a final version of the proposed revision of the complete sections of the DCD and other licensing documents to incorporate all changes related to the ESBWR steam dryer review resulting from initial and supplemental RAIs. The NRC staff requests that GEH identify the ESBWR steam dryer design and analysis information in the DCD and applicable engineering reports that is considered Tier 2 * information. The NRC staff also requests that GEH verify the accuracy of the tables following the completion of the changes to the various licensing documents.
RAI 3.9-293 S01	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-293.	In its response to RAI 3.9-293 (MFN 12-065, Revision 1, February 8, 2013), GEH indicates in Section 3.9.2.3 of the proposed revision to the ESBWR DCD that subsequent ESBWR plants following the prototype ESBWR plant will apply an acceptance limit for the steam dryer assuring that the stresses remain less than 93.7 MPa (13,600 psi). The proposed revision to the DCD does not address the minimum alternating stress ratio (MASR) [[ ]] for steam dryers in subsequent ESBWR plants. The NRC staff notes that the proposed ITAAC for the fatigue analyses of the as-built steam dryer to verify that the maximum calculated alternating

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			stress intensity meets or exceeds a Minimum Alternating Stress Ratio of 2.0 to the allowable alternating stress intensity of 93.7 MPa (13,600 psi). This ITAAC does not differentiate between prototype and subsequent ESBWR plants. The NRC staff will need to perform a separate review of the design certification application for prototype and subsequent ESBWR plants if the fatigue analysis methodology will be different for the steam dryers in those plants. The NRC staff requests that GEH clarify in the DCD and applicable engineering reports that the steam dryer methodology proposed for the ESBWR design certification is the same for both the prototype and subsequent ESBWR plants.
RAI 3.9-293 S02	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-293.	In its response to RAI 3.9-293, GEH discusses two observations related to the potential adverse flow effects during the power ascension up to extended power uprate (EPU) conditions at the Grand Gulf Nuclear Station (GGNS). Based on its review of the EPU power ascension at GGNS, the NRC staff requests that GEH address or reference the appropriate discussion for the following GGNS items: a. GEH should address the [[ ]] for the ESBWR steam dryer. b. GEH should address the effects of core flow and pressure on acoustic response (such as SRV and vane passing frequency tones) in determining the [[ ]] in the stress predictions for the ESBWR steam dryer. c. GEH should address the determination of the [[ ]] based on the possible range of power levels and steam flow rates for ESBWRs to be constructed. d. GEH should address the effects of the bubble/water level inside the steam dryer skirt in determining the [[ ]] in the stress predictions for the ESBWR steam dryer. e. GEH should address the effect of the [[ ]] in the stress predictions for the ESBWR steam dryer.

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			f. GEH should address the effects of non-acoustic load sources on the prediction of the total stress on the ESBWR steam dryer, and the determination of [[ ]] in the stress predictions for the ESBWR steam dryer to bound these effects. g. GEH should address the prediction of worst-case stress locations in the Grand Gulf steam dryer by the PBLE Method 1, and its effect in [[ ]] in the stress predictions for the ESBWR steam dryer.
RAI 3.9-293 S03	Wong Y.	The staff's question is in regard to GEH's response to RAI 3.9-293.	In its response to RAI 3.9-293, GEH stated on page 6 of Enclosure 1, the following: For low frequency plants such as SSES, GGNS, and ESBWR, Figure 2 indicates that [[ ]]. In that the fatigue curve in the current ASME Code also specifies [[ ]], the NRC staff suggests that a reference to the ASME code (in addition to Reference 10, RG 1.207) also be made.
RAI 3.9-294	Wong Y.	The staff's question is in regard to Engineering Report NEDE-33312P, Rev. 3	Engineering Report NEDE-33312P, "Steam Dryer - Acoustic Load Definition," Revision 3 does not reference PBLE01. The NRC staff requests GEH to include this reference.
RAI 3.9-295	Wong Y.	The staff's question is in regard to Engineering Report NEDE-33313P, Rev. 3	In Engineering Report NEDE-33313P, "ESBWR Steam Dryer Structural Evaluation," Revision 3, the water within and around the bottom skirt region is currently modeled using [[ ]]. However, GEH states that an alternative equivalent approach may be used instead. The NRC staff requests whether GEH will commit to rebenchmarking the end-to-end approach using their GGNS model if they change the water modeling approach.
RAI 3.9-296	Wong Y.	The staff's question is in regard to Engineering Report NEDE-33313P, Rev. 3	In NEDE-33313P, Revision 3, GEH's discussion in Section 5.2 is not concise and not entirely consistent with the procedure outlined in Section 1.0, and the staff is unsure what GEH is committing to. a. GEH states that it will apply [[ ]] to future

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			prototype dryer dynamic testing. The NRC staff requests GEH to clarify what will the FE B/U be combined with. Individual PBLE B/U? If so, where are these defined? NEDE-33408P provides end-to-end B/U, not individual PBLE B/U. b. The first two paragraphs of Section 5.2.2 do not make it clear which [[ ]] prototype dryer. End-to-end? PBLE loading only? Is GEH adding the bias to the uncertainty? Is GEH taking credit for [[ ]]? c. Paragraph 3 of Section 5.2.2 states that after prototype ESBWR dryer data is acquired that [[ ]]. Later, similar language is used to describe Method 4. Does GEH intend to say "will be," instead of "can be?" If this is a commitment (it seems to be based on Section 1.0), it must be defined as such. d. For methods 1-3 – does GEH mean end-to-end, not PBLE bias when referencing Appendix F of Report NEDE-33408P? e. In Section 5.2.4, GEH refers often to "PBLE bias error." Is this actually "end-to-end bias error?"
RAI 3.9-297	Wong Y.	The staff's question is in regard to Engineering Report NEDE-33313P, Rev. 3	In NEDE-33313P, Revision 3, GEH does not address plant operating condition uncertainty in their stress analysis procedure. They discuss, however, in their response to RAI 3.9-293 that the ESBWR will be analyzed at limiting (worst-case) plant conditions. A brief discussion of plant operating condition variability, along with a commitment to analyze the ESBWR dryer at limiting pressure and thermal conditions (as described in GEH's response to RAI 3.9-293), should be included in the report. Also, a commitment to measure dryer strains across the expected range of normal steady state plant operating conditions must be included.
RAI 3.9-298		The staff's question is in regard to Engineering Report NEDE-33313P, Rev. 3	NEDE-33313P, Revision 3 does not define a power ascension test plan (PATP). The NRC staff requests GEH to provide the PATP, or explain where it is provided elsewhere.