Enclosure 2

MFN 13-016

GEH Response to RAI 3.9-296

Public Version

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

NRC RAI 3.9-296

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 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?"*

GEH Response

References

1. NEDE-33313P, Engineering Report – ESBWR Steam Dryer Structural Evaluation, Revision 4, September 2013.
2. Regulatory Guide 1.20, Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing, US Nuclear Regulatory Commission, Revision 3, March 2007.
3. NEDE-33312P, Engineering Report – ESBWR Steam Dryer Acoustic Load Definition, Revision 4, September 2013.
4. NEDE-33408P, ESBWR Steam Dryer – Plant Based Load Evaluation – PBLE01 Model Description, Revision 3, September 2013.
5. MFN 12-043, Revision 2, Jerald Head (GEH) to the US Nuclear Regulatory Commission, "NRC Requests for Additional Information Related to the Audit of the Economic Simplified Boiling Water Reactor (ESBWR) Steam Dryer Design Methodology Supporting Chapter 3 of the ESBWR Design Control Document – Response for RAI 3.9-269, Supplement 1, August 9, 2013.

The procedure outlined in Sections 1.0 and 5.0 of NEDE-33313P (Reference 1) describes the high level analysis and measurement tasks that are the GEH implementation of Regulatory Guide 1.20 (Reference 2) requirements for the ESBWR steam dryer. The staff's questions concern Section 5.2 of NEDE-33313P, which is primarily focused on the analysis. Specifically, this section provides a discussion of the dynamic pressure loads associated with Flow Induced Vibration (FIV), as well as a discussion of bias and uncertainty applied to the mechanical fatigue analysis. Responses to each subpart are provided below.

Subpart (a)

Question

GEH states that it will apply [[

]] to future 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.

Response

Table 1 of this response provides clarifying information related to the progression of steam dryer analyses, including the applicable load definition, structural model, and the basis for bias and uncertainty. As can be seen in Table 1, each of the analyses leverages the information available at each stage of the vibration assessment program. The resulting set of evaluations is comprehensive.

The design basis analysis is shown as the first entry in Table 1 (row 1). This analysis uses the loading described in NEDE-33312P (Reference 3) and the end-to-end bias and uncertainty set provided in NEDE-33408P (Reference 4).

The design basis [[

[1] [[

]] This combination of sensors was selected because it minimized frequency dependent fluctuations in load mismatch (projected compared to measured data). The pressure sensor locations are shown in Figure 3.

]]

Power ascension testing then will be performed to support the ESBWR startup program (row 3 in Table 1). Limit curves will be developed based on (full power) design loads. Power ascension tests will be used to confirm that structural margin is available at the intermediate power levels leading to full power, as well as the 100% power condition. Comparisons to on-dryer measurements will be made so that end-to-end bias and uncertainty values for the power ascension test can be calculated to support evaluations (as necessary) during power ascension.

Once power ascension has been completed, a full power benchmark will be performed (row 4 in Table 1). This benchmark will develop end-to-end bias and uncertainty values from the data from on-dryer measurements.

This series of analyses, power ascension tests, and the final benchmark will fulfill the Regulatory Guide 1.20 requirements for comprehensive analysis and measurement.

Subpart (b)

Question

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 [[ ]]?

Response

The clarifications described in the response to subpart (a) explain which set of bias and uncertainty values is applied to which evaluation at each stage of the ESBWR steam dryer vibration assessment program.

In the design basis analysis (row 1 of Table 1), credit for potential [[

]]

Subpart (c)

Question

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.

Response

The language will be modified to reflect a commitment and state "will be."

Subpart (d)

Question

For methods 1-3 – does GEH mean end-to-end, not PBLE bias when referencing Appendix F of Report NEDE-33408P?

Response

The response to subpart (a) clarifies the basis of the bias and uncertainty used for the four analyses.

Subpart (e)

Question

In Section 5.2.4, GEH refers often to "PBLE bias error." Is this actually "end-to-end bias error?"

Response

In Section 5.2.4 of Reference 1, on page 19 in the second paragraph, the term "PBLE bias" appears. This discussion is in terms of end-to-end bias and uncertainty.

The term "PBLE bias" also appears in Section 5.2.2 of Reference 1, on page 13 (under the discussion of Analysis Method 1). This discussion references Appendix F of NEDE-33408P, which is based on the GGNS end-to-end benchmark. The bias and uncertainty values in this discussion are end-to-end.

The discussions in Sections 5.2.2 and 5.2.4 of NEDE-33313P will be revised to improve clarity and reflect the application of end-to-end bias and uncertainty.

ESBWR Licensing Basis Changes

In response to this RAI, several changes are identified applicable to NEDE-33313P:

- The clarification provided in response to subpart (a) is added to Section 5.2.2 (including the table). The response to subpart (b) is also added to clarify that [[

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- The response to subpart (c) is incorporated. The text of paragraph 3 of Section 5.2.2 will be revised to state "will be," consistent with a commitment.
- The responses to subparts (d) and (e) are incorporated. References to bias and uncertainty are clearly identified as end-to-end values, or specifically reference the current version of NEDE-33408P.

Table 2 of this response is incorporated into NEDE-33408P.

Table 1 – ESBWR Steam Dryer Analyses

Analysis	Description	PBLE01 Pressure Loads	Finite Element Structural Analysis	Bias and Uncertainties
[[				
				]]

[2] Refer to NEDE-33313P, Section 5.2.3.

Table 2 – PBLE01 (Load) Bias and Uncertainty for Application to the As-Built Confirmatory Analysis

[[

				]]

* Consistent with Reference 5, positive bias (that would act in the direction of reducing the load) is not credited.

[[

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**Figure 1 – PBLE01 Narrow Band Bias Based On
On-Dryer Pressure Transducer Input – Upper Dryer**

[[

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**Figure 2 – PBLE01 Narrow Band Bias Based On
On-Dryer Pressure Transducer Input – Lower Dryer**

[[

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**Figure 3 – GGNS Dryer Pressure Sensor Locations
(Shown on the Acoustic Model)**