

## **Enclosure 2**

### **MFN 12-038, Revision 2**

### **Response for RAI 3.9-273, S01**

#### **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 [[ ]].

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**RAI 3.9-273 S01**

*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 (in the 0-250 Hz range) is larger than +/- 10%, then the finite element model needs to be revised so that the frequency difference becomes less than +/-10%. Otherwise a larger frequency shift should be considered for estimating the most conservative dryer fatigue stresses.*

**GEH Response:**

**1.0 Summary**

If there are significant discrepancies (i.e., [[ ]]) between the steam dryer hammer/shaker frequency response test results and the Finite Element (FE) model predictions, the FE model will be reviewed to determine if there are any latent errors in the modeling. In general, [[ ]]

of the closest test frequency. To do so would detune the response for other modes and at other frequencies. Moreover, revising the FE model based on the hammer test results is not supported given the inherent limitations in the hammer test (e.g. the inability to ensure exact replication of frequency response of the working dryer given that the hammer test is performed while the dryer sits on a support stand, and the limited number of measurement points). [[ ]]

[[ ]] Broadening the frequency shift load cases [[ ]] The pressure load definitions that are used for the dynamic stress analysis have enough frequency content that, when combined with the [[ ]]

effectively exercise the FE model throughout the spectrum. The frequency response test [[ ]] are sufficient to address discrepancies between the hammer/shaker frequency response test results and the FE model predictions.

## **2.0 Discussion**

The objective of the steam dryer frequency response test is to identify the as-built frequencies and mode shapes of several key components of the steam dryer at ambient conditions. Different components of the steam dryer have different frequencies and mode shapes associated with them. The as-built component frequencies and mode shapes may differ from the idealized representation in the finite element (FE) model of the steam dryer. The accessible regions of the assembled dryer are instrumented and tested. The regions typically tested [[  
]]. The test results are then used to validate the model of the steam dryer.

Based on a review of hammer tests performed on several replacement steam dryers, it was determined that the FE models provided a reasonable representation of the actual dryers and no modifications to the FE models were necessary. [[

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There are limitations to the frequency response test evaluation. In the FE model, the modal density is very high and the global modes are mixed or lost among many local modes. In the test, the limited number of measurements in a region makes it impossible to capture those local modes in the experimental modal analysis. [[

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test results reflect the bias in plate thickness introduced by the manufacturing tolerance. The thickness tolerance [[

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]] The other FE mode is reasonably close to the test mode frequency. Also the deviation may be to the low side at one test frequency and to the high side for another test frequency [[

]] Moreover, revising the FE model based on the hammer test results is not supported given the inherent limitations in the hammer test (e.g. the inability to ensure exact replication of frequency response of the working dryer given that the hammer test is performed while the dryer sits on a support stand, and the limited number of measurement points). Instead of attempting to revise the FE model to selectively tune the response, the differences between the test response and the FE model response will be addressed by [[

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If there are outliers in the frequency test results, broadening the frequency shift load cases [[

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### **3.0 Reference**

1. MFN 12-038, Revision 1, Letter from Jerald G. Head, GEH, to USNRC, Subject: 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 – RAI 3.9-273, dated June 1, 2012.

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#### **4.0 ESBWR Licensing Basis Impact**

No changes will be made to the DCD or referenced LTRs.