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MFN 09-621, Supplement 1

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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Supplemental Response to NRC Report of the August 25, 2009, and September 9, 2009, Regulatory Audit of Reactor Pressure Vessel Internals of the Economic Simplified Boiling Water Reactor**

Reference 1 transmitted GEH's original response to follow-up actions in *NRC Report of the August 25, 2009, and September 9, 2009, Regulatory Audit of Reactor Pressure Vessel Internals of the Economic Simplified Boiling Water Reactor.* This letter transmits supplemental information to Reference 1 to address agreed to changes to LTR NEDE-33313P and DCD Tier 2 Section 3L.5.5.1.3. This letter supplements our response in Reference 1. Please note that all Enclosures and Attachments transmitted in Reference 1 still remain valid.

Enclosure 1 contains marked up pages to NEDE-33313P and DCD Tier 2 Section 3L.5.5.1.3. Revision bars in the right hand column and text strike throughs identify the changes made to these pages. Verified DCD changes associated with these RAI responses are identified in the enclosed DCD markups by enclosing the text within a black box.

The marked up page to NEDE-33313P is non-proprietary even though the page heading indicates GEH proprietary information. This GEH proprietary information header refers to the entire LTR NEDE-33313P.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 09-621 from R. E. Kingston, GEH to the U.S. Nuclear Regulatory Commission (NRC) *Response to NRC Report of the August 25, 2009, and September 9, 2009, Regulatory Audit of Reactor Pressure Vessel Internals of the Economic Simplified Boiling Water Reactor* dated October 8, 2009

Enclosure:

1. Supplemental Response to NRC Request for Document Improvements and Specific Changes to DCD Related to ESBWR Design Certification Application – DCD Tier 2 Section 3.9 – Mechanical Systems and Components – NRC Staff Audit, August 25, 2009

cc:

AE Cubbage	USNRC (with enclosures)
JG Head	GEH/Wilmington (with enclosures)
DH Hinds	GEH/Wilmington (with enclosures)
HA Upton	GEH/San Jose (with enclosures)
eDRF Section	0000-0112-2045

Enclosure 1

MFN 09-621 Supplement 1

Supplemental Response to NRC Request for Document Improvements and Specific Changes to DCD Related to ESBWR Design Certification Application

DCD Tier 2 Section 3.9 – Mechanical Systems and Components

NRC Staff Audit, August 25, 2009

1.0 INTRODUCTION

This topical report will document the finite element stress analyses of the ESBWR steam dryer. At this point the load definition and detailed steam dryer design are not finalized, as they depend heavily on ongoing industry and regulatory interaction. Because the stress analysis depends directly on these inputs, Revision 1~~0~~ of this report only includes a description of the analysis approach and design criteria. A detailed finite element model (FEM) ~~will be~~is used to perform the structural dynamic analyses in order to predict the steam dryer's susceptibility to fatigue under flow induced vibration (FIV) during normal operation. The same FEM will be used to predict the stresses resulting from specified ASME load combinations.

The load definition for the ESBWR steam dryer ~~will be contained~~is described in NEDE 33312P, Reference 1. When ~~these loads are defined,~~ the fatigue analysis and ASME load combination analysis described ~~within will be completed. At that point~~ is performed, the necessary design iterations will be made to include the resultant stresses and fatigue margins demonstrating the ESBWR steam dryer is structurally acceptable for end use.

- radial displacement;
- tangential displacement;
- vertical displacement; and
- meridian rotation.

The following assumptions are made in generating the axisymmetric shell model:

(1) Discrete components move in unison for steam separators, standpipes, and CRDHs and guide tubes.

(2) Masses are lumped at the nodal points. Rotational inertias of the masses are neglected.

(3) Stiffnesses of control rods, control rod drives, steam dryers, and in-core housings are neglected.

(4) Top guide and core plate masses are lumped to the shroud.

(5) Masses of CRDHs below the vessel are lumped to the bottom head.

Equivalent shells are used to model the mass and stiffness characteristics of the guide tubes, steam separators, and standpipes such that they match the frequencies obtained from a horizontal beam model.

Diagonal hydrodynamic mass terms are selected such that the beam mode frequencies of the shell model agree with those from the beam model.

The RPV, chimney and shroud are modeled as thin shell elements. The shell element data are defined in terms of thickness, mass density, modulus of elasticity, and Poisson's ratio for the appropriate material and temperature.

The natural frequencies and mode shapes of the shroud shell model are given in terms of two parameters, termed "n" and "m". The "n" parameter refers to the number of circumferential waves, while the "m" parameter refers to the number of axial half-waves. Thus, for beam types of vibration, n=1.

3L.5.5.1.3 Steam Dryer

The design of the steam dryer assembly for the ESBWR plant is similar to ABWR.

However, the total steam flow rate of the ESBWR plant is different from past designs. These differences warrant a detailed vibration analysis and test monitoring to assure the adequacy of the new design to withstand the FIV.

In the ~~ESBWR~~ABWR initial plant FIV test program of the steam dryer assembly, accelerometers were located on the cover plate and several locations on the skirt, and strain gages were located directly on the skirt, drain channels and hoods (Reference 3L-5). In addition, pressure sensors were used to measure the pressure differentials between the inside and outside of the upper skirt adjacent to the front hood and the lower skirt. The differential pressure fluctuation across the hoods and skirt is the primary forcing function causing vibration of the ~~upper part of the~~ steam dryer structure. ~~The differential pressure fluctuation across the skirt is the primary forcing function causing the vibration of the lower part of the steam dryer structure~~