REQUEST FOR ADDITIONAL INFORMATION 214-1920 REVISION 0

2/25/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.09.02 - Dynamic Testing and Analysis of Systems Structures and Components
Application Section: 3.9.2.2

QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

03.09.02-34

In DCD Tier 2, Section 3.9.2.2.2, MHI states that the stiffness of the seismic subsystem anchorage must be determined and the assumptions made in the seismic analysis must be verified as accurately reflecting the mounting condition. The staff requests the applicant to address the following:

(1) Discuss how the dynamic characteristics of the support anchorages, including base plate and anchor bolts or through bolts, connecting to the building structure is determined. Discuss how the equipment seismic analysis account for the dynamic characteristics of the support anchorage, especially for heavy equipment.

(2) Anchor bolt torque relaxation may occur after years of operation and cause reduction in the natural frequency of the equipment and support assembly, and increase in its seismic response. Provide the plant-specific compensatory measures or quality control/assurance programs used to alleviate the effects of anchor bolt torque relaxation.

(3) Clarify whether, and explain why, expansion anchor bolts will or will not be used for safety-related systems and components.

03.09.02-35

In DCD Tier 2, Section 3.9.2.2.2, MHI states that two models are used for the RCL seismic analysis. One for RCL seismic analysis, which consists of stick mass spring model of steam generator (SG), reactor coolant pump (RCP), reactor pressure vessel (RPV), loop piping, and building. The other is for seismic analysis of internal components of SG itself. The staff requests the applicant to address the following:

(1) For the SG and its internals, discuss their isolated structural model in detail. This should include SG pressure boundary and its upper internals, such as feedwater headers, platforms, separators, dryers; as well as lower internals, such as tubesheet, tubes, tube support plates, anti-vibration bars, bundle wrappers, and seismic stops.

(2) Discuss how the hydrodynamic coupling of the SG shell to the tubes and other SG internals is simulated in the SG isolated structural model.

(3) Discuss how local flexibility of the SG shell at the primary nozzle connections is accounted for in the model.

(4) Discuss how SG component supports are modeled.

(5) Provide the natural frequencies and mode shapes (including their graphical representation) obtained for the SG and its internals, and, based on that, discuss the adequacy of their respective modeling.

03.09.02-36

In reference to DCD Tier 2, Section 3.9.2.2.2, regarding RCL seismic analysis, the staff requests MHI to address the following, in regard to a seismic analysis of the RPV and its internals:

(1) Clarify whether a separate seismic analysis for the RPV and its internals is performed. If not, explain why it is not needed. If yes, provide additional information for items (2) through (6).

(2) For the RPV and its internals, discuss their isolated structural model in detail. This should include RPV pressure boundary, CRDMs, CRDM nozzles, closure head equipment (CHE), lower internals, upper internals, and fuel assemblies.

(3) Discuss how the hydrodynamic coupling of the RPV shell to the core barrel (CB) shell and of the CB to the heavy reflector (HR) is simulated in the RPV isolated structural model.

(4) Discuss how local flexibility of the RPV shell at the primary nozzle connections is accounted for in the model.

(5) Discuss how RPV component supports are modeled.

(6) Provide the natural frequencies and mode shapes (including their graphical representation) obtained for the RPV and its internals, and, based on that, discuss the adequacy of their respective modeling.

03.09.02-37

In DCD Tier 2, Section 3.9.2.2.6, MHI states that modal responses are combined by the methods described in DCD Section 3.7.3.5, when the response spectrum method of analysis is used. The staff requests the applicant to confirm that for mechanical components, modal responses are combined by one of the RG 1.92, Rev. 2, methods. Demonstrate also that the 10% grouping method (using SRSS) for combining closely-spaced modes, in the seismic and dynamic analysis of APWR mechanical components, complies to the guidelines provided in RG 1.92, Rev. 2, Section C.1.1.1.

03.09.02-38

In DCD Tier 2, Section 3.9.2.2.8, MHI states that generally the equipment supported at two or more locations with distinct seismic input uses upper bound of envelop of all the individual response spectra for those locations. The staff requests the applicant to clarify if the uniform support motion (USM) method of analysis used for USAPWR equipment and components is in accordance with the requirements of SRP 3.9.2.II.2.G.

03.09.02-39

In DCD Tier 2, Section 3.9.2.2.13, MHI states that the damping values used for seismic analysis are consistent with RG 1.61, Rev. 1. The staff requests the applicant to provide a list of damping values used for each of the major mechanical components analyzed, and justify that the damping values used are consistent with the recommendation of RG 1.61, Rev. 1. Provide the basis of assigning a 5% damping value for control rod drive mechanisms, as shown in DCD Tier 2, Table 3.7.3-1(a).

03.09.02-40

In DCD Tier 2, Section 3F.1.2, for seismic Category II conduit systems, MHI states that these conduit systems, including support anchorages, are analyzed and designed by the COL applicant for the site SSE using the same methods and stress limits specified for seismic Category I structures and subsystems, except structural steel in-plane stress limits are permitted to reach 1.0 $F_{y.}$ Clarify where in DCD this COL information item is described.

03.09.02-41

In DCD Tier 2, Section 3F.4.2 and Section 3G.4.2, respectively, for response spectrum modal analysis of conduit systems and cable tray systems, MHI states that the conduit systems and cable tray systems can be analyzed using the envelope broadened response spectra methods, considering uniform support motion, or the independent support motion method. The staff requests MHI to address the following:

(1) Clarify whether the proposed USM and ISM methods of analysis conform to the guidance provided in SRP 3.9.3.II.2.G and NUREG-1061, Vol.4, respectively.

(2) For the design analysis of conduit and cable tray systems, using the damping values as proposed in DCD Tier 2, Table 3.7.3-1(a), demonstrate that the modal combination methods used, including that for closely-spaced modes, are in accordance with the guidance of RG 1.92, Rev. 2.