REQUEST FOR ADDITIONAL INFORMATION 614-4853 REVISION 0

8/13/2010

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

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

03.09.02-85

In MHI's response to US-APWR DCD RAI 205-1584, question number 3.9.2-14, the applicant stated that the in-structure response spectra (ISRS), considering local vibration modes, (i.e., wall and floor flexibility) and the description of the analysis method will be provided in Revision 2 of the DCD. The applicant further stated that it would provide a description of the ISRS local vibration modes and the analysis method in DCD Tier 2, Section 3.7, Revision 2. The staff reviewed DCD Section 3.7, Revision 2, but did not find where the applicant had included a detailed description of the analysis method used to account for the wall and floor flexibility in deriving the ISRS. In DCD Revision 2, Section 3.7.2.5, second paragraph, the applicant stated, "The local analyses of floor slab systems with respect to out-of-plane flexibility and effects on the ISRS are addressed as part of a later technical report." The applicant also provided a brief description on the methodology in generation of the ISRS by modeling the local flexibility as a single degree of freedom system. However, the staff noted that the adequacy of the generated ISRS with local flexibility has to be evaluated to ensure the accuracy of the seismic analysis of subsystems supported at these locations.

The applicant is requested to provide the ISRS generated for various locations with local flexibility. Alternatively, provide a reference document where this information is available.

Reference: MHI's Response to US-APWR DCD RAI No. 205-1584; MHI Ref: UAP-HF-09184; dated April 30, 2009; ML091240113.

03.09.02-86

In MHI's response to US-APWR DCD RAI 498-3782, question 03.09.02-62, the applicant stated that Topical Report MUAP-10001 (Rev. 0) "Seismic Design Bases of the US-APWR Standard Plant," "... issued in February 2010 will provide the detailed descriptions regarding these modeling and analysis enhancements, which will be used as a basis for the re-runs of the R/B complex and PS/B dynamic analyses,..." based on SASSI analyses. In its review the staff noted that the report describes in detail the modeling of SDOF models to enhance R/B stick model for capturing the out-of-plane response of flexible slabs and walls. The location, spring-constant, and effective mass of each SDOF model are tabulated. The staff, however, noted that only those slabs and walls that have a fundamental frequency less than 40 Hz are modeled by SDOF, whereas, the ground design response spectra of US-APWR are anchored at 50 Hz. The staff also

noted that the SDOF of each slab or wall is located at center of mass (CM) of the slab or wall, however, the support of equipment or system could be located at a distance away from the mass center.

The applicant is requested to (a) provide justification that only floors and slabs with fundamental frequency less that 40 Hz are modeled with SDOF, and do not include floors and slabs with fundamental frequency up to 50 Hz, and (b) clarify whether the calculated floor response spectra at the location of SDOF (i.e. center of mass) is applicable to the equipment or system located at a distance away from the CM. If they are not applicable, explain how to determine the floor spectra for equipment or system located at a distance away from the CM.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10031; dated February 3, 2010; ML100470583.

03.09.02-87

The staff noted that in US-APWR DCD Tier 2, Rev. 2, Tables 3.7.3-1(a) and 3.7.3-1(b) have been revised, and the SSE damping and OBE damping values listed in the tables are consistent with the acceptable values specified in RG 1.61, Revision 1, for SSE and OBE analyses. The staff further noted that although the damping values specified for CRDM have been deleted in Tables 3.7.3-1(a) and -1(b) of DCD Rev. 2. In its response to RAI 498-3782, question 03.09.02-83, the applicant stated that the damping values specified for welded and friction-bolted steel structures and equipment are also used for CRDM. However, the staff also noted that DCD Rev. 2, Tables 3.7.3-1(a) and -1(b) also list the damping values for steel-concrete modules. It is not clear to the staff which SSCs are included in this category or how were the damping values selected.

The applicant is requested to (a) clarify which SSCs are considered “steel-concrete modules, and (b) describe the basis for selecting the SSE damping and OBE damping values of 5 percent and 4 percent, respectively, for these modules.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10008; dated January 15, 2010; ML100200161.

03.09.02-88

In the response to the US-APWR DCD RAI 498-3782, quesiton 03.09.02-65, MHI provided tables and figures explaining the differences between the J-APWR, which is in operation in Japan, and the US-APWR. The effects of these differences on the FIV of the reactor internals were also clarified. The only remaining concern related to this RAI is the effect of increasing the weight of the fuel assembly and the neutron reflector on the stresses at the junction between the core barrel and the lower core support plate and also on the vibration of the fuel assemblies.

Therefore, the applicant is requested to confirm that the effect of this increase in weight is considered in the analysis of the fuel assembly and the core barrel.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10031; dated February 3, 2010; ML100470583.

03.09.02-89

In the response to the US-APWR DCD RAI 498-3782, question 03.09.02-71, the applicant confirmed how the dynamic analysis of the reactor internals was benchmarked by means of the scale model test, and whether the dynamic analysis was performed on the size and flow conditions of the small scale model or the full-scale J-APWR. The applicant's response explains the source of confusion described in the question, that is, although the analysis model and the measurements were performed on the 1/5 scale model, the comparison of the results are made after the results were scaled to the full size reactor.

In order to eliminate this source of confusion, the applicant is requested to modify the Technical Report MUAP-07023-P(R1) to include the information provided in the response to RAI 03.09.02-71.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10031; dated February 3, 2010; ML100470583.

03.09.02-90

In the response to the US-APWR DCD RAI 498-3782, Question 03.09.02-75, the applicant explained in detail why, despite the existing high degree of uncertainty, a margin of safety of 30 percent is considered conservative for the high cycle fatigue analysis as indicated in Table 3.3.3-4 of the revised vibration assessment report MUAP-07027-P-R1. The staff reviewed the applicant's response and found it acceptable because the margin of safety already covers conservatively estimated bias errors and uncertainties associated with determining the loading functions due to cross flow and RCP pulsation. However, this information should be included in MHI report MUAP-07027-P-R1.

Therefore, the applicant is requested to indicate clearly in the Technical Report MUAP-07027-P(R1) that the safety margin of 0.3 covers all the uncertainties and bias errors which are associated with determining the loading functions.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10031; dated February 3, 2010; ML100470583.

03.09.02-91

In RAI 498-3782, question 03.09.02-78, the applicant was requested to discuss the analysis performed to assess adverse flow effects on the reactor piping system due to the increased flow velocity at the vessel outlet nozzle above that of the current 4-loop reactors. In its response, MHI does not give, or reference, any details of the analysis and just mentions that based on the analysis of the 4-loop reactor, there is sufficient

margin of safety against flow-induced vibration. Since this response does not provide the requested information, the staff's concerns remain unresolved.

The applicant is therefore requested to discuss the analysis performed to assess adverse flow effects on the reactor piping system due to the increased flow velocity at the vessel outlet nozzle as identified in Table 2.1-1 of MUAP-07027-P (R1). The applicant may refer to other sections of the DCD or to technical reports which address the concerns expressed in this RAI.

Reference: MHI's Response to US-APWR DCD RAI No. 498-3782; MHI Ref: UAP-HF-10008; dated January 15, 2010; ML100200161.