RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/31/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 852-6003 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**10/24/11**

QUESTION NO. RAI 03.07.02-115:

In Subsection 4.3.1.2 of this MUAP 10001 (R3), "Discretization Considerations: Mesh Size," the last paragraph (Page 4-23) states, "The table shows that for the SSI analyses of harder subgrade profiles, the dynamic FE model of R/B Complex is sufficiently refined to transmit waves with frequencies up to 50 Hz through the soil-foundation interface. The SSI analyses of softer soil profiles for which the wave passage frequencies of dynamic FE model are lower than 50 Hz provide responses that are enveloped in the high frequency range by the responses obtained from analyses of harder soil profiles.

Therefore, the SSI analyses of all eight generic soil profiles provide adequate envelope responses up to 50 Hz as required by ISG- 01."

The staff noticed that the applicant's conclusions are not supported by the data presented in the report, as discussed below:

1. The first sentence in the above quoted paragraph states that the FE model of R/B Complex is sufficiently refined to transmit waves with frequencies up to 50Hz through the soil-foundation interface; however, the data shown in Table 4.3.1.2-1 do not support this claim. The values of f_{FE_max} shown in the last column of Table 4.3.1.2-1 are the maximum frequencies for wave passage from the subgrade to the structure. Five out of eight frequencies are less than 50Hz. The applicant is requested to provide technical rationale and data to support the cited statement in this report.

2. The last sentence in the above quoted paragraph states that the SSI analyses of all eight generic soil profiles provide adequate envelope responses up to 50Hz. However, the applicant did not provide the appropriate data to show that the SSI responses of softer soil profiles in the frequency range of f_{FE_max} to 50Hz are enveloped by those of harder soil profiles. The Applicant is requested to provide technical rationale and data to support the cited statement in this report.

The staff also noticed that the applicant has made similar claims for the mesh size used for the dynamic model of the PS/B which is presented in Subsection 4.4.1.2. The applicant is requested to provide the requested data for the PS/B model to confirm that their response to the questions raised above for the R/B complex model also apply to the PS/B model.

ANSWER:

Technical Report MUAP-10001, Rev. 3 has been incorporated into Technical Report MUAP-10006, Rev. 3. Subsection 02.4.1.1.2 corresponds to and supersedes Section 4.3.1.2.

The seismic design basis for the US-APWR has been updated to perform soil-structure interaction (SSI) analyses using dynamic finite element (FE) models of the reactor building (R/B) complex, which consists of the R/B, prestressed concrete containment vessel (PCCV), containment internal structures, east power source building (PS/B), west PS/B, auxiliary building (A/B), and essential service water pipe chase (ESWPC) supported on a combined basemat. Therefore, the PS/Bs are no longer discussed separately as independent structures in Technical Report MUAP-10006, Rev. 3.

The US-APWR seismic response analysis currently uses six generic subgrade conditions, developed to cover the range of site conditions from soft soil to hard rock that may exist across the Central Eastern United States. These six soil profiles provide sufficient diversity to allow the development of a standardized design that can be constructed at most plant sites with limited site specific changes. The justification for the selected soil profiles is provided in Section 01.4.2 of Technical Report MUAP-10006, Rev. 3.

The results of the site-independent SSI analyses serve as basis for development of parameters for design of the structural members and the seismic category I SSCs of the R/B complex. The SSI analyses performed for the set of six (6) generic layered soil profiles consider the effects of frequency dependence of SSI for layered sites.

Table 03.3.4-1 through 03.3.4-3 of Technical Report MUAP-10006, Rev. 3 provide wave passage frequencies of the excavated volume for the six soil profiles. For a selected nominal mesh size at the basemat interface with soil, Table 03.3.5-2 of Technical Report MUAP-10006, Rev. 3, provides the wave passage frequencies for the six generic subgrade conditions below the foundation. Table 03.3.5-1 of Technical Report MUAP-10006, Rev. 3 provides the cut-off frequencies (maximum frequencies analyzed) of the R/B complex. Frequencies for two out of these six soil cases are less than 50Hz, which is acceptable as discussed in Section 03.3.5 of Technical Report MUAP-10006, Rev. 3.

Plots shown in Figure 03.3.6-2 of Technical Report MUAP-10006, Rev. 3 of representative example in-structure response spectra responses for each soil case illustrate that responses of softer soils above the cut-off frequencies are enveloped at high frequencies by the responses of stiffer soil cases. The stiffest profiles control compared to the softer soil cases in the high frequency range. Therefore, it is not necessary for the softer soil cases to have higher cut-off frequencies and transmitting frequencies because the broadened envelope of results is used for evaluation of SSCs. Thus, SSI analyses of all six generic soil profiles provide adequate envelope responses up to 50 Hz and the FE model of R/B complex as quoted is sufficiently refined to transmit waves with frequencies up to 50Hz through the soil-foundation interface.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on the Technical/Topical Report.

This completes MHI's response to the NRC's question.