
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/31/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO. 810-5874 REVISION 3
SRP SECTION: 03.07.02 – Seismic System Analysis
APPLICATION SECTION: 3.7.2
DATE OF RAI ISSUE: 08/22/11

QUESTION NO. RAI 03.07.02-103:

In Subsection 3.7.2.4 of DCD (R3), "Soil-Structure Interaction", the second paragraph (page 3.7-29) states in part, "The amplitudes of the interpolated transfer functions are plotted and investigated to ensure the accuracy of the interpolation of the response for the required range of frequencies."

The Applicant is requested to provide a description of how the accuracy of the interpolated transfer functions is checked and should also state if SSI effects are accounted for when checking the accuracy of the transfer functions. If SSI effects are not included when checking the accuracy of the transfer functions, the Applicant should explain how their approach conforms to the guidelines of SRP Acceptance Criteria 4 of SRP 3.7.2.

ANSWER:

This answer revises and replaces the previous MHI answer that was transmitted by letter UAP-HF-11402 (ML11332A148).

Section 03.3.3.2 of Technical Report MUAP-10006, Rev. 3 discusses selection of frequencies to analyze as well as the accuracy of transfer functions. Review of the accuracy of the transfer function is performed on the SSI results of the soil structure system; therefore the SSI effects are accounted for in this review.

Technical Report MUAP-10006, Rev.3, Table 03.3.5-1, shows for the reactor building (R/B) complex, the number of frequencies of analysis and cut-off frequency for uncracked and cracked conditions of each generic soil profile used in the soil-structure interaction (SSI) and structure-soil-structure interaction (SSSI) analyses. The comparative plots presented in the figures in Appendix 3-C of Technical Report MUAP-10006 show that the number of SSI frequencies for each soil profile provides a sufficiently dense grid of frequency points that captures all the significant spectral peaks that define the acceleration transfer function shapes. In the figures, the interpolated acceleration transfer function values are plotted with solid lines and the computed acceleration transfer function values are plotted with dotted markers.

The selection of the frequencies of analyses follows the guidance of ACS SASSI User's Manual (Reference 1), Section 4.1.2, Item 8. The adequacy of the selected number of frequencies of analyses and their distribution is based on the observation of the numerous interpolated transfer function amplitudes. Select transfer functions among those reviewed are presented in Appendix 3-C of MUAP-10006, Rev. 3. Reviews of these transfer function results are performed to observe that the response approaches 1.0 at zero frequency for the response in the direction of input motion and approaches 0.0 for cross-terms. Frequencies were added to the SASSI analyses as needed to produce smooth interpolation of the transfer functions to accurately capture peaks. The review of the transfer functions results presented in Appendix 3-C of MUAP-10006, Rev. 3 show that the interpolations are smooth without significantly distorted interpolation peaks due to approximate interpolation rather than SSI analysis results. The interpolation is determined accurate when added frequencies have an insignificant effect on the results. Spurious narrow peaks that occur in the high-frequency range only amplify responses and have negligible or conservative influence on the calculated in-structure response spectra (ISRA) and the structural seismic demands. Review of Appendix 3-C has confirmed that the reconstruction of acceleration transfer function peaks at all frequencies up to the cutoff frequencies of the analyses is accurate.

As shown in Appendix 3-C of MUAP-10006, the acceleration transfer functions obtained from each of the site-independent seismic SSI analysis cases are used for the checking. Therefore, the SSI effects are fully accounted for when checking the accuracy of the interpolated acceleration transfer function curves.

Reference:

1. "An Advanced Computational Software for 3D Dynamic Including Soil-Structure Interaction," ACS SASSI NQA Version 2.3.0 including "Option A" and NQA "Option FS," User Manuals, Rev. 7.0, Ghiocei Predictive Technologies, Inc., September 26, 2012.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the COLA.

Impact on S-COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

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