RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/31/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 850-6002 REVISION 3**
SRP SECTION:	**03.07.01 – Seismic Design Parameters**
APPLICATION SECTION:	**3.7.1**
DATE OF RAI ISSUE:	**10/21/11**

QUESTION NO. RAI 03.07.01-24:

In Figure 4.2-2 of MUAP-10001 (R3), rock appears to have higher damping ratio than sand for comparable strain levels. To help the staff better understand the comparable damping ratios, the applicant is requested to provide the technical basis and identify the corresponding references leading to this result. Additionally, is this relationship considered appropriate for hard rock as well as firm or soft rock?; and discuss whether the high rock damping is conservative or unconservative from an SSI perspective and provide the appropriate technical justification.

ANSWER:

This answer revises and replaces the previous MHI response that was transmitted by letter UAP-HF-11417 (ML11339A013).

Figure 4.2-2 of Technical Report MUAP-10001, Rev. 3 has been replaced by Figure 01.4.2-2 of Technical Report MUAP-10006, Rev. 3. The unpublished modulus reduction and damping curves for rock are no longer used for development of generic strain compatible rock properties. Instead, the strain compatible rock properties presented in Section 01.5.2.2 of MUAP-10006 are obtained using the EPRI TR-102293 soil degradation curves. As described in Section 01.4.2 of MUAP-10006, these curves that were developed for use as generic soils, are comprised of gravels, sands, and low Plasticity Index (PI) clays also provide realistic strain compatible properties for the generic rock materials when subjected to low intensity strains as those generated by seismic ground motions where their spectra, as full column response spectra, at foundation bottom are enveloped by the CSDRS. These curves represent strain dependent properties of generic soils with more linear (less strain dependent) behavior than the previously used rock degradation curves.

The site response analyses considered the rock base materials located below the top soil at nominal depths set at 100 ft, 200 ft and 500 ft to be stain-independent. Therefore, soil degradation curves are not applied to rock base materials of the standard plant generic profiles. The sensitivity of the results of site response analyses to the selection of modulus reduction and damping curves for rock-like material is limited by the fact that the deeper rock base strata have higher stiffnesses and thus develop lower shear strains than the top soil materials for the same level of loading. At much greater depths, where weathering is absent and fractures are likely to

remain closed, even under strong shaking, the behavior of rock-like materials can realistically be assumed to remain largely elastic so that modulus reduction and damping curves are no longer considered to be applicable.

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.