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## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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1/31/2013

### US-APWR Design Certification

### Mitsubishi Heavy Industries

Docket No. 52-021

**RAI NO.:** NO. 854-6088 REVISION 3  
**SRP SECTION:** 03.07.02 – Seismic System Analysis  
**APPLICATION SECTION:** 3.7.2  
**DATE OF RAI ISSUE:** 10/24/11

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#### QUESTION NO. RAI 03.07.02-161:

Section 4.2.2 in MUAP 11007 (R0) indicates that Poisson's ratio values close to 0.5 will be used without stating what limiting value will be used. Of more importance is the fact that the effective values of Poisson's ratio used in the site response calculations (especially for soft sites) of MUAP-10001(R3) are not related to values from data for real soil, since the P-wave velocities are obtained from low strain shear moduli, while S-wave velocities are obtained from high or iterated strain values. The approach in MUAP-10001(R3) appears to be incompatible with the discussion in this section of MUAP-11007(R0). Section 4.2.2.1 indicates that P-wave velocities for the unsaturated cases will be selected at 20% to 30% of the saturated velocities. The applicant is requested to provide the basis for these assumptions, which should be correlated with the results in MUAP-10001(R3).

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#### ANSWER:

The content of the latest Technical Report MUAP-10001, Rev. 4 is now incorporated into Technical Report MUAP-10006, Rev. 3. Technical Report MUAP-11007, Rev. 2 provides the groundwater level parametric study.

Section 2.3 of MUAP-11007, Rev. 2 describes the approach used in MUAP-10006 Rev 3, Section 01.4.2.1 to account for the groundwater in the generic soil profiles.

Section 2.4 of MUAP-11007, Rev. 2 describes the methodology used for the development of the three generic unsaturated site profiles (270-200Dry, 270-500Dry and 560-500Dry) representing the dynamic strain compatible properties of the soils at generic sites 270-200, 270-500 and 560-500 when the groundwater levels are low. Both the saturated and unsaturated  $V_p$  soil profiles are developed considering the constrained soil modulus to be strain independent. The strain compatible shear wave velocities and soil damping of both the saturated and unsaturated soil profiles are developed based on the site response analyses using the methodology described in MUAP-10006, Section 01.4.2.2. The initial small strain  $V_s$  and damping profiles used as input for these site response analyses are the same for unsaturated and saturated soil profiles. The only other difference in the inputs used for the response analyses of saturated and unsaturated soil profiles is in the unit weights of unsaturated soils located above the groundwater level.

Figure 3 2, Figure 3 3 and Figure 3-4 of MUAP-11007, Rev. 2 compare respectively the  $V_s$ ,  $V_p$ , and material damping of saturated soil and unsaturated soil profiles. Figure 3-5 provides comparison of Poisson ratio profiles for the strain compatible properties of saturated versus. unsaturated soil. The plots show that the three generic soil profiles provide smooth Poisson's ratio profiles for both saturated and unsaturated conditions without an abrupt increase of Poisson's ratio. The Poisson's ratio for all profiles maintains values that are below 0.48 which ensures the numerical stability of the SASSI results.

**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.

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