

# REQUEST FOR ADDITIONAL INFORMATION 211-1946 REVISION 1

2/25/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.07.01 - Seismic Design Parameters

Application Section: 3.7.1

QUESTIONS for Structural Engineering Branch 1 (AP1000/EPR Projects) (SEB1)

03.07.01-1

## **RAI 3.7.1-1**

In Section 3.7.1.1 (c) of the DCD, the artificial response spectrum for 5% damping generated from artificial ground motion time histories fall short of the acceptance criteria provided in Section 3.7.1 of the SRP. Section 3.7.1 of the SRP requires that the computed 5% damped response spectrum of the accelerogram not fall more than 10% below the target response spectrum at any one frequency and that it should not fall below the target spectrum for more than 9 adjacent frequency points. The applicant has justified variance (non-exceedances) from the SRP acceptance criteria on the basis of its judgment that the non-exceedances occurred at low frequencies that are not significant for the design of the US-APWR standard plant SSCs. Provide a technical basis of the judgment including a list of SSCs that were considered to conclude that the non-exceedances will not have a significant effect on the seismic analysis of structures, systems, and components in the US-APWR standard plant. Also, describe the steps that will be taken to ensure that the seismic input used to calculate the hydrodynamic loads on liquid-containing tanks contains sufficient energy in the low-frequency region associated with the convective response of the tanks.

## **RAI 3.7.1-2**

Figures 3.7.1-6 through 3.7.1-8 in the DCD provide a comparison of two horizontal and a vertical 5% damped response spectrum obtained from artificial ground motion time histories with the design response spectra. The SRP subsection 3.7.1.B requires that the response spectra obtained from artificial ground motion time histories should envelop the design response spectra for all damping values. Provide a comparison of design spectra with the spectra obtained from artificial ground motion time histories for all design damping values to demonstrate that the response spectra obtained from the artificial time histories of ground motion envelop the design response spectra.

## **RAI 3.7.1-3**

Section 3.7.1.1 of the DCD includes a description of the generation of the artificial ground motion time histories for use as the input motion for the US-APWR standard plant. It is not clear if the artificial ground motion time histories were generated based on seed recorded time histories. The acceptance criteria of the SRP subsection 3.7.1.II.1B states that the artificial ground motion time histories that are not based on seed recorded

## REQUEST FOR ADDITIONAL INFORMATION 211-1946 REVISION 1

time histories should not be used. Confirm that the artificial time histories are generated based on seed recorded time histories. Provide justification if the artificial ground motion time histories are not generated based on seed recorded time histories. Also, describe the seed motions used and how they were modified to generate the artificial time histories.

### **RAI 3.7.1-4**

In Section 3.7.1.1 of the DCD, a methodology to develop site specific horizontal GMRS is described that refers to the industry standard ASCE 4-98 as the basis for defining the shear wave velocity for rock material. The staff has not reviewed and endorsed ASCE 4-98 for the SSI application. Currently this ASCE standard is under revision. Provide the bases and justification including appropriate test data to support the shear wave velocity of 3500 ft/s for rock material. Also, provide justification for the position that non-linearities of the subgrade material need not be addressed if the initial (small strain) shear wave velocity of the material is 3,500 ft/s or greater.

### **RAI 3.7.1-5**

Section 3.7.1.2 of the DCD states that the damping values presented in Tables 3.7.3-1(a) and 3.7.3-1(b) are in accordance with RG 1.61 and ASCE 4-98. The SRP acceptance criteria 3.7.1.II.2 states that the damping values used in the analyses of Category I SSCs are considered acceptable if they are in accordance with RG 1.61. The staff has not reviewed and endorsed ASCE 4-98 for the damping application. Currently this ASCE standard is under revision. Provide justification for all the damping values in Tables 3.7.3-1(a) and 3.7.3-1(b) that are either different from or are not specified in RG 1.61. In particular, justify the damping values shown for welded aluminum structures, and state the percentage of critical damping values to be used for conduit systems with other than maximum cable fill.

Also, the primary shield wall and other walls inside containment are fabricated as steel-concrete (SC) module walls described in Section 3.8.3.1.5 of the DCD. Discuss the methodology for calculating the stiffness and damping values used in modeling the module walls for seismic analysis of the containment structures. Provide justification including test data to demonstrate the appropriateness of the stiffness and damping values used in the seismic analysis and design.

### **RAI 3.7.1-6**

In Section 3.7.1.1 (a) of the DCD, it is stated that the Nyquist frequency of 100 Hz is considered to assure that seismic analysis will capture the responses of SSCs in the high frequency range. Define what is considered the high frequency range and discuss the criteria used to assure that an adequate number of discrete mass degrees of freedom is considered in dynamic modeling of SSCs to capture the seismic response in the high frequency range.

### **RAI 3.7.1-7**

In Section 3.7.1.3 of the DCD, a value of 15 ksf is specified for the required allowable static bearing capacity for seismic Category I structures basemats. Provide the bases and justification for the 15 ksf value. Also, a minimum factor of safety of 2 is proposed for

## REQUEST FOR ADDITIONAL INFORMATION 211-1946 REVISION 1

the ultimate bearing capacity versus the allowable dynamic bearing capacity. Provide the bases and justification for the proposed minimum factor of safety of 2.