

# REQUEST FOR ADDITIONAL INFORMATION 643-4967 REVISION 1

10/4/2010

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)

03.07.01-6

## **RAI 3.7.1-12**

In Section 3.7.1.3, "Supporting Media for Seismic Category I Structures," of Revision 1 of the DCD, a value of 15 ksf is specified as the required allowable static bearing capacity for seismic Category I building structure basemats. In RAI 1946 Question 3.7.1-7, the applicant was asked to provide the justification and technical basis for the value of 15 ksf as well as the justification of the minimum factor of safety of 2 that was proposed for the ultimate bearing capacity versus the allowable dynamic bearing capacity. The applicant responded to the RAI in a letter, MHI ref: UAP-HF-09187, dated April 23, 2009. The staff reviewed the applicant response and concluded that the response did not adequately address the issue and as a result, a follow-up RAI (RAI 3978, Question 3.7.1-9) was issued requesting that the applicant describe how the proposed value of 15 ksf is significant to the plant design and how the static and dynamic bearing pressures and corresponding soil capacities will be used in the plant design.

The applicant responded to the follow-up RAI in a letter, MHI Ref: UAP-HF-10022, dated January 29, 2010. The staff evaluated the applicant response and considered the response to be inadequate because, the responses did not answer such questions as the difference between demand and capacity, the difference between static and dynamic values for bearing pressure, the technical basis for safety factors, and whether the 15 ksf value is intended to apply to the soil or to the building foundation.

In order to evaluate the Supporting Media for Seismic Category I Structures, per SRP Acceptance Criteria 3.7.1.II.3, the staff request MHI to provide response to the following specific questions:

1. Provide an analysis of the effect of the maximum groundwater level that is 1 ft below plant grade is considered on the analysis of static and dynamic bearing capacities of saturated soil and associated design safety factor.
2. Discuss what is the static bearing pressure demand value for the soil; the design value used for the static bearing pressure; the safety factor applied to the static bearing pressure; the justification for the minimum bearing pressure capacity; what is the dynamic bearing pressure demand value for the soil?
3. Provide a technical basis and justification for justification to support the minimum required dynamic bearing pressure capacity and state how it is governed, whether by the soil or the building foundation?

Reference: RAI Response 494-3978, UAP-HF-10022; dated January 29, 2010 ;

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03.07.01-7

### **RAI 3.7.1-13**

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100; as well as the guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants," Chapter 3.7.1, "Seismic Design Parameters."

Section 4.2.1, "Selection of Profiles," of MHI's Topical Report, MUAP-10001, Revision 1, "Seismic Design Bases of the US-APWR Standard Plant," states that the profiles adopted for the development of CSDRS consistent strain compatible properties include 270 m/s, 560 m/s, 900 m/s, and 2,032 m/s and that three depths of soil/rock profiles above the hard or soft rock foundations are considered: 100 ft, 200 ft, and 500 ft. The report also stated that due to the stiffness of the 2,032 m/s firm rock profile, only a 100 ft deep profile reflects realistic site conditions and represents a residual soil over weathered rock and underlain by hard rock.

However, in Tables 5.2-1, "Final Profile Categories," and 5.2-2, "Magnitudes, Distances, and Median Peak Accelerations," of the report, the applicant did not present all the profile cases considered. Thus, the staff requests that the applicant provide a technical basis for not analyzing all cases.

Reference: USAPWR Seismic Design Report MUAP-10001, rev 1; dated May 13,2010; ML101400073

03.07.01-8

### **RAI 3.7.1-14**

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100; as well as the guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants," Chapter 3.7.1, "Seismic Design Parameters."

In Section 4.2.1, "Selection of Profiles," of MHI's Topical Report, MUAP-10001, Revision 1, "Seismic Design Bases of the US-APWR Standard Plant," states that for compressional-waves, a water table depth at the surface (foundation level) of each profile was assumed and that the US-APWR DCD specifies a water table depth of 1 foot below the foundation which, for the development of vertical motions, is equivalent to the surface.

In review of the US-APWR DCD, Revision 2, Tier 1, Table 2.1-1, "Key Site Parameters," and Tier 2, Table, 5.2-2, "Key Site Parameters," both listed the maximum groundwater level as being 1 foot below plant grade and not below the foundation as stated in the report. The staff considers the difference between the 'foundation level' and the '1 ft below plant grade' to be significant and most importantly, that the ground water level can greatly affect the analysis results.

Thus, the staff requests that the applicant provide a technical basis for assuming a water table depth at the 'foundation level' of each profile compared with '1 foot below plant grade' as prescribed in Revision 2 of the US-APWR DCD.

Reference: USAPWR Seismic Design Report MUAP-10001, rev 1; dated May 13,2010; ML101400073

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03.07.01-9

### **RAI 3.7.1-15**

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100; as well as the guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants," Chapter 3.7.1, "Seismic Design Parameters."

In Section 1.0, "Introduction," of MHI's Topical Report, MUAP-10001, Revision 1, "Seismic Design Bases of the US-APWR Standard Plant," it states that the seismic design of the standard plant structures is based on a set of SSI analyses performed using the computer program ACS SASSI, which provides a representation of the dynamic properties of the building, and captures the SSI effects related to the flexibility of the basemat foundation.

In the review of the SSI model referenced in the report, the staff identified that Version 2.2 of the ACS SASSI is used in the SSI analyses for the US-APWR standard plant. Since irregularities were observed in other SSI analyses using Version 2.2 of the ACS SASSI computer code in an Event Notification Report, Number 45343, dated September 14, 2009, the staff requests the applicant to provide technical bases for using Version 2.2 of the ACS SASSI program to perform the SSI analyses for the US-APWR standard plant and to validate the analysis results.

Reference: USAPWR Seismic Design Report MUAP-10001, rev 1; dated May 13, 2010; ML101400073

03.07.01-10

### **RAI 3.7.1-16**

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100; as well as the guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants," Chapter 3.7.1, "Seismic Design Parameters."

Based on the review of Section 4.2, "Development of Soil Profiles and strain Compatible Properties," of MHI's Topical Report, MUAP-10001, Revision 1, "Seismic Design Bases of the US-APWR Standard Plant," staff understands that the selected soil profiles also represent hard rock site conditions that are expected in Central and Eastern United States (CEUS). Hard rock implies rather large spectral content in the high frequency range of the ground motion. Recent industry studies have shown that hardrock high-frequency (HRHF) ground motions frequently result in large in-structure response spectra or structural responses.

However, the information presented in Chapter 5 of the report does not show the high frequency response typically expected at the hard rock sites in the central and eastern United States (CEUS) regions. This is indicative of the deficiencies in SSI and structural models that are not sufficiently refined to capture the high frequency input (the range of high frequency to be transmitted should cover a model refinement frequency of at least equal to 50 Hz.), or low spectral content in the high frequency range of the ground motion, or both.

The staff requests that the applicant provide a technical bases and justification that shows that the SSCs for the standard design certification are adequately designed for hard rock site conditions that are expected in Central and Eastern United States

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(CEUS). Otherwise, state in the US-APWR DCD that the exception is taken to hard rock site conditions expected in Central and Eastern United States (CEUS).

Reference: USAPWR Seismic Design Report MUAP-10001, rev 1; dated May 13,2010;  
ML101400073