

---

---

**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

---

---

1/31/2013

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** NO. 625-4924 REVISION 0  
**SRP SECTION:** 03.07.02 – Seismic System Analysis  
**APPLICATION SECTION:** 3.7.2  
**DATE OF RAI ISSUE:** 08/30/10

---

**QUESTION NO. RAI 03.07.02-20:**

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 3.7.2, 'Seismic Design Parameters.

The staff, based on its review of MUAP-10001, Rev. 1 finds that the applicant has used inconsistent approaches, qualitatively and quantitatively to account for concrete cracking in the seismic models, as noted below.

1. On p. 3-3, is the third sentence in the second paragraph intended to mean that concrete cracking is accounted for by broadened ISRS.
2. On p. 3-3, it is stated that the stiffness of the CIS lumped mass stick model is reduced by 25% to account for concrete cracking resulting from thermal loads,
3. On p. 4-14, it is stated that the elastic modulus of selected slabs in the R/B reduced by 50% to simulate a cracked condition.
4. On p. 4-15, it is stated that the FH/A shear wall areas reduced by 50% for concrete cracking.
5. On p. 4-22, a factor of 0.5 is used for the reduction of flexural stiffness of shell elements in the PS/B lumped mass model.
6. On p. 4-23, it is stated that the stiffness of the lumped mass stick model of the CIS is reduced by 25% to address potential effects due to cracking of the SC modules.

Explain the overall methodology for addressing concrete cracking and explain how the qualitatively and quantitatively different methods of accounting for cracking that are given above result in a consistent approach for accounting for cracking.

Also, when the structural models are analyzed with assumed cracked section properties, the potential for load redistribution relative to the results from the models with uncracked section

properties exists due to changes in modal frequencies and corresponding changes in input spectral acceleration. This redistribution has the potential for some sections that had acceptable demand-to-capacity ratios in the uncracked model to have unacceptable demand-to-capacity ratios in the cracked model. Describe how the models will be checked or modified to ensure that the final configuration of the model results in acceptable demand-to-capacity ratios at all sections.

The assumption of cracked or uncracked concrete member used in the final configuration of the cracked concrete seismic models should be validated by the final combined stresses in concrete members.

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

---

## **ANSWER:**

This answer revises and replaces the previous MHI answer that was transmitted by letter UAP-HF-10300 (ML103120403).

Technical Report MUAP-10001 has been superseded and the relevant information incorporated into Technical Report MUAP-10006, Rev. 3. The reactor building (R/B), prestressed concrete containment vessel (PCCV), containment internal structure (CIS), east and west power source buildings (PS/B), auxiliary building (A/B), and essential service water pipe chase (ESWPC) are now structurally integrated and supported on a common basemat to form the R/B complex.

The overall methodology for addressing concrete cracking in the seismic soil-structure interaction (SSI) analyses has been revised and is described in detail in Technical Report MUAP-10006, Rev. 3, Sections 02.3.2, 02.3.3, 02.4.2, and Appendix 2-A. As stated in this report, a dynamic finite element model of the R/B complex was analyzed using two different levels of stiffness and damping properties that correspond to full stiffness (uncracked concrete) with operating-basis earthquake damping and reduced stiffness (cracked concrete) with safe-shutdown earthquake damping.

### **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 a Technical/Topical Report.

---

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