
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/31/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 852-6003 REVISION 3
SRP SECTION: 03.07.02 – Seismic System Analysis
APPLICATION SECTION: 3.7.2
DATE OF RAI ISSUE: 10/24/11

QUESTION NO. RAI 03.07.02-119:

In Section 4.3.3 (p. 4-33) of MUAP 10001 (R3), four guidelines with numerical criteria are laid out to confirm the accuracy of the translation from the ANSYS model to the ACS SASSI model. However, immediately following these guidelines, the applicant stated that the comparison of the results can indicate larger deviation than specified in the guidelines but did not provide the acceptance criteria used to confirm a sufficiently accurate translation. The applicant is requested to provide additional information in items (i) through (iv) below:

(i) It is stated on page 4-34 that “ACS SASSI uses a mixed mass matrix (average lumped and consistent masses to represent the mass of the structure. The mode superposition analyses in ANSYS are performed using either a lumped or consistent mass matrix.” If the mesh is fine enough, the use of lumped, consistent, or mixed mass does not have significant effect on responses. Explain why the mesh cannot be refined to eliminate this as a cause for differences.

(ii) It is stated on page 4-34 that “The ANSYS modal superposition time history analysis uses analysis time integration scheme to solve the decoupled dynamic response equations. ACS SASSI frequency domain solution is based on the convolution of the complex Fourier spectra of the input motion and the complex acceleration transfer functions computed for a limited number of selected frequencies, not at all Fourier points.” Explain why additional frequencies cannot be added in the SASSI solution to eliminate this as a cause for differences.

(iii) It is stated on page 4-34 that “ANSYS uses constant value modal damping ratio to account for the dissipation of energy due to structural damping. ACS SASSI uses the complex damping approach in which the dissipation of energy due to structural damping is accounted for in the complex stiffness matrix of the system that is assembled from the complex stiffness matrices of the finite elements. The ACS SASSI analyses allow different structural damping to be used to account for the dissipation of energy in different structural components.” The staff notes that (1) ANSYS allows modedependent damping; (2) ANSYS also allows material-dependent damping; and (3) complex damping is a mathematical representation and should not contribute to response differences. Explain why the SASSI and ANSYS damping representations cannot be made as equivalent as possible, within the constraints of the two codes, to eliminate this as a cause for differences.

(iv) Based on the ARS comparisons presented in Section 5 of MUAP-10001(R3), discuss the extent to which the guidelines have been satisfied, and also discuss the extent to which the factors that may lead to violations of the guidelines actually affected the results.

ANSWER:

Technical Report MUAP-10001, Rev. 3 is superseded by 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/Bs), auxiliary building (A/B), and essential service water pipe chase (ESWPC) are now structurally integrated and supported on a combined basemat to form the R/B complex. Technical Report MUAP-10006, Rev. 3, presents the information relevant to the A/B as well as the other buildings that make up the R/B complex.

The validation of the model no longer uses the methodology or acceptance criteria that were stated in Technical Report MUAP-10001. The methodology and validation of the model is presented in Part 2 of Technical Report MUAP-10006, Rev. 3.

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. MHI to Verify

Impact on Technical/Topical Report

There is no impact on Technical/Topical Report

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