
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 03.07.02-120:

In Subsection 4.5.3 of MUAP-10001(R3), "Approach to Address Concrete Cracking in Site-Independent SSI Analyses," on page 4-45, it is stated that "Responses obtained from the models with two different levels of stiffness and damping are enveloped in order to develop ISRS for design of the seismic category I and II equipment and components. The SSE loads used for the PCCV and the CIS design are also developed based on the responses obtained from the analyses of models with two different level of stiffness in order to ensure that the design uses seismic loads enveloping both normal operating and accident loading conditions. Responses obtained from models with reduced (cracked concrete) stiffness and SSE damping are used to develop SSE loads for the design of shear walls or reinforced concrete structures since this condition corresponds to the ultimate stress conditions. This approach is consistent with Section 1.2 of RG 1.61."

The Applicant is requested to:

- (i) Explain this apparent inconsistency in approach. Clarify where the envelope is used and where only the cracked conditions and SSE damping are used. Provide the technical basis for this dual approach.
 - (ii) Show that the responses of models with uncracked stiffness and OBE damping do not control the design of the concrete structural members.
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ANSWER:

Technical Report MUAP-10001, Rev. 3 has been superseded and its relevant information has been incorporated into Technical Report MUAP-10006, Rev. 3. Consideration of concrete cracking previously discussed in Section 4.5.3 of Technical Report MUAP-10001, Rev. 3 is now addressed in Sections 02.3.3 and 02.4.2 of Technical Report MUAP-10006, Rev. 3.

- i) As stated in Section 02.3.3 of Technical Report MUAP-10006, Rev. 3, two bounding levels of stiffness and damping properties are developed and assigned to the structural models used for seismic response analyses in order to capture the variations of structural stiffness and damping due to concrete cracking: (1) full (uncracked concrete) stiffness and OBE damping corresponding to low stress levels; and (2) reduced (cracked concrete) stiffness and SSE

damping corresponding to high stress levels. SSE loads, in-structure response spectra (ISRS), and displacements are developed by enveloping both conditions on six different soil profiles. Technical Report MUAP-10006, Rev. 3, Table 02.4.1.1.3-2 refers to Technical Report MUAP-11018, Rev. 1 that contains a discussion of the SC module test data and stress analyses that establishes the bases for the stiffness and damping values used in the seismic analysis.

- ii) There is no need to show that results of models with uncracked stiffness and operating-basis earthquake (OBE) damping do not control the design, because the bounding condition, whether cracked stiffness with SSE damping levels or uncracked stiffness with OBE damping levels, is now used for determination of SSE loads, ISRS, and maximum displacements.

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.