US-APWRRAIsPEm Resource

From: Ward, William
Sent: Friday, August 30, 2013 1:30 PM
To: 'us-apwr-rai@mhi.co.jp'; US-APWRRAIsPEm Resource
Cc: Shams, Mohamed; Tegeler, Bret; Galvin, Dennis; Buckberg, Perry; Dixon-Herrity, Jennifer
Subject: US-APWR Design Certification Application RAI 1050-7218 (3.7.2)
Attachments: US-APWR DC RAI 1050 SEB1 7218.pdf

MHI,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, MHI requests and we grant 60 days to respond to the RAI. We will adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Hearing Identifier: Mitsubishi_USAPWR_DCD_eRAI_Public
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Subject: US-APWR Design Certification Application RAI 1050-7218 (3.7.2)
Sent Date: 8/30/2013 1:30:16 PM
Received Date: 8/30/2013 1:30:18 PM
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REQUEST FOR ADDITIONAL INFORMATION 1050-7218

Issue Date: 08/30/2013

Application Title: US-APWR Design Certification - Docket Number 52-021

Operating Company: Mitsubishi Heavy Industries

Docket No. 52-021

Review Section: 03.07.02 - Seismic System Analysis
Application Section: MUAP-10006 R3

QUESTIONS

03.07.02-227
DCD Section 3.7.2.2 states that the member and element forces results obtained from the ACS SASSI analyses are enveloped and used for the development of seismic loads for design of structural members.

Staff review of the applicant's ANSYS dynamic analysis model, described in MUAP 10006 (R3), Part 2, finds that the reactor building basemat is discretized with only two layers of solid elements (ANSYS Solid45) for large areas. A similar approach is used for some parts of the CIS basemat. The staff notes that for the Solid45 element type, ANSYS recommends the use of at least 4 layers of solid elements for adequate moment prediction.

The ACS SASSI structural model is derived directly from the ANSYS dynamic analysis model, using solid elements comparable to ANSYS Solid45 elements. Based on this observation, the staff requests the applicant to confirm whether basemat member forces are derived directly from the ACS SASSI analysis model, and to provide technical justification for using less than 4 layers of solid elements for modeling of the basemat and other parts of the model where bending behavior appears to be important.

03.07.02-228
In accordance with SRP Section 3.7.2, the staff performs a review of all soil-structure interaction (SSI) analyses to ensure that uncertainties in the phenomenon, such as coupling of the soil and structure are considered.

DCD Section 3.7.2 identifies that ACS SASSI is used to analyze the SSI response of the reactor building (R/B) Complex. The staff notes that the SASSI analysis code is based on linear theory, in which full contact between the bottom of the foundation basemat and the supporting soil is assumed. As such, a review of the tendency to uplift during the transient seismic response is important. The tendency to uplift would be indicated by tensile forces between the bottom of the foundation basemat and the supporting soil.

The staff requests the applicant to describe how the potential for uplift of the foundation basemat from the underlying soil/rock was evaluated for the generic cases considered. In addressing this, for each case considered, quantify the minimum area of the basemat that remains under compression at all times during the transient response (considering the simultaneous effect of the three design-basis ground motions and all applicable gravity loads), as a percentage of the total basemat area. In evaluating potential uplift, assess the acceptability of the uplift relative to acceptable engineering practice. An acceptable method for assessing the potential for basemat uplift is described in SRP (Rev 4), Section 3.7.2.

03.07.02-229

Section 03.3.8 of MUAP-10006 (R3) refers to the estimation of maximum displacements relative to the free field motion and basemat. These relative displacements are used in the verification of gaps between the containment internal structure (CIS), prestressed concrete containment vessel (PCCV) and reactor building (R/B), as described in Section 03.4.4, and verification of gaps between the R/B Complex and adjacent non-seismic Category I structures, which is not included in the report.

To assist the staff in its review, the applicant is requested to provide the following additional information:

(1) Provide a detailed discussion of how relative displacements are obtained from ACS SASSI. Is this done in the time domain or frequency domain? Is baseline correction performed? Are total displacements computed first, and then subtracted to obtain relative displacements?

(2) Section 03.4.4 indicates the gap between R/B and PCCV is 4 inches. The largest "coupled displacement" between R/B and PCCV is computed as 3.165 inches (1.728-inch displacement of the R/B plus 1.437-inch displacement of the PCCV). This results in a remaining clearance of only 0.835 inches (4 inches minus 3.165 inches). While this report section discusses the use of conservative seismic analysis assumptions, an independent staff calculation indicates the potential for reduced design margin in the seismic gap. The staff calculation, based on ASCE 43-05, Section 7.3 (Seismic Separation) made use of the applicants computed relative displacements and resulted in a required seismic gap greater than 4 inches.

Based on this observation, staff requests the applicant to describe the acceptance criteria used for the design of the seismic gap(s) between the R/B and PCCV.

03.07.02-230

DCD Subsection 3.7.1.1 states that the COL applicant will perform site-specific analysis of the US-APWR standard plant seismic Category I structures. Further, DCD Section 3.7.5, COL Information Item **3.7(23)** states that the COL Applicant will verify that the results of the site-specific soil structure interaction (SSI) analysis for the broadened in-structure response spectrum (ISRS) are enveloped by the US-APWR standard design.

Staff review of COL item 3.7(23) finds that it is not clear whether the ISRS described in MUAP-10006 (R3), Appendix 3-B, are intended to serve as points of comparison for the COL. Staff notes that SRP Section 3.7.1 (II.) (4), "COL Application Referencing an ESP and CD," specifies that a COL will compare responses at key locations in the structure to the standard design in-structure responses. Staff review finds that the DCD is not clear whether the nodal locations identified in MUAP-10006 (R3), Appendix 3-B are intended to serve as these key locations. Based on the above, the staff requests the applicant to provide the following additional information:

(a) Identify the US-APWR key locations for making site-specific ISRS comparisons to the standard plant design. The basis for the selection of the locations should also be described. The key locations should be clearly described in the DCD.

(b) Include in the DCD plots of ISRS (in three directions) for each key location and include on each plot the results for each soil profile case.