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September 13, 2013

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Perry Buckberg

Docket No. 52-021
MHI Ref: UAP-HF-13234

**Subject: MHI's Response to US-APWR DCD RAI No. 1047-7217, Questions
03.07.01-44 and 03.07.01-45**

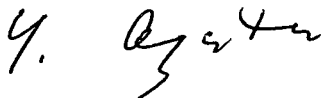
Reference: 1) "Request for Additional Information 1047-7217, Review Section: 03.07.01 –
Seismic Design Parameters, Application Section: 3.7.1 [MUAP-10006(R3)],"
Issued August 14, 2013, ML13226A488.

With this letter, Mitsubishi Heavy Industries, Ltd. (MHI) transmits to the U.S. Nuclear
Regulatory Commission (NRC) a document entitled "MHI's Response to US-APWR DCD RAI
No. 1047-7217, Questions 03.07.01-44 and 03.07.01-45".

Enclosed is the response to two (2) RAI Questions, Questions 03.07.01-44 and 03.07.01-45,
contained within Reference 1. This transmittal completes the response to these RAI
questions.

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi
Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this letter.
His contact information is below.


Sincerely,



Yoshiki Ogata
Director - APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. MHI's Response to US-APWR DCD RAI No. 1047-7217, Questions 03.07.01-44 and
03.07.01-45



CC: P. Buckberg
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Docket No. 52-021
MHI Ref: UAP-HF-13234

Enclosure 1

UAP-HF-13234
Docket Number 52-021

MHI's Response to US-APWR DCD RAI No. 1047-7217
Questions 03.07.01-44 and 03.07.01-45

September 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

09/13/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 1047-7217 REVISION 3
SRP SECTION: 03.07.01 – Seismic Design Parameters
APPLICATION SECTION: 3.7.1
DATE OF RAI ISSUE: 08/14/2013

QUESTION NO. 03.07.01-44:

The staff performed a review of DCD Section 3.7.1 pertaining to supporting media for Seismic Category I Structures, in accordance with the guidance provided in SRP Section 3.7.1. In DCD Section 3.7.1.3, the applicant provides a description of the site response analysis performed to develop the six (6) strain-compatible generic soil profiles used for seismic design/analysis of the US-APWR standard plant, subject to the certified seismic design response spectra (CSDRS). However, it is not clear to the staff whether a COL applicant is expected to implement the approach described in the DCD, or would implement existing regulatory guidance in RG. 1.208 and ISG-17, in performing the site response analysis for the site-specific soil-structure interaction (SSI).

Based on the above, the staff requests the applicant to clarify in DCD Section 3.7.1 the method the COL applicant will implement for developing the site-specific strain-compatible soil profiles, for use in the site-specific SSI analysis. If the proposed method in the DCD for use by COL applicant departs from applicable regulatory guidance, the departures should be clearly identified in the DCD and the departures should be technically justified.

ANSWER:

The last paragraphs of Subsection 3.7.1.3 provide a description only of the site response analyses used for development of generic profiles of strain compatible subgrade properties. The intent is not to provide specifications or guidelines on the approach and methodology which the Combined License (COL) Applicant shall use for development of soil properties for site-specific soil-structure interaction (SSI) analyses. Unlike the generic seismic design parameters used for standard design, which result in a range of responses covering SSI responses at a wide variety of candidate sites, the design parameters used for site-specific SSI analyses as stated in Subsection 3.7.1.3 are specific for the particular site. Therefore, the approach used for development of generic profiles is not applicable for the profiles used for site-specific SSI analyses.

The COL Applicant will develop the site specific strain-compatible soil profiles. Subsection 3.7.2.4.5 provides guidelines and requirements for the development of input for the site-specific SSI analyses. The site-specific SSI analyses use soil properties that are compatible

to the strains generated by the site-specific design ground motion. These strain compatible soil properties are obtained from the results of site response analyses performed for calculation of site-amplification factors used for development of ground motion response spectra (GMRS) and site-specific foundation input response spectra (FIRS) as specified in Regulatory Position 4.2 of Regulatory Guide (RG) 1.208. The development of strain compatible soil properties and the input control motion for site-specific SSI analyses shall follow the requirements of DC/COL-ISG-17 in order to ensure hazard consistent input for site response and site specific SSI analysis. As stated in Subsection 3.7.2.4.5, the site-specific SSI analyses account for the uncertainties and variations of the subgrade properties by using a set of profiles of soil dynamic properties that conform with the guidelines of Section II.4 of SRP 3.7.2

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

09/13/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 1047-7217 REVISION 3
SRP SECTION: 03.07.01 – Seismic Design Parameters
APPLICATION SECTION: 3.7.1
DATE OF RAI ISSUE: 08/14/2013

QUESTION NO. 03.07.01-45:

In support of the evaluation of DCD Section 3.7.1, the staff reviewed relevant sections of MUAP-10006 (R3), Part 1. The staff noted that MUAP-10006, Section 01.4.2, p. 01.4-6, and Section 01.4.2.1, pg. 01.4-8, state that for the development of the strain-compatible profiles, for cases 270-200 and 270-500, the top 68 ft of soils are removed and replaced, so that the parameter V_{s30} is at least 425 m/s. The stated intent is to ensure that the lower-bound (minus one sigma) strain-compatible shear wave velocity near plant grade is at least 800 ft/s.

Staff experience in construction and placement of fill materials finds that soil replacement consistent with the above assumptions may be difficult to achieve in practice. Typical engineered granular backfills with strain levels consistent with the certified seismic design response spectra (CSDRS) motions would likely have near-surface strain-compatible shear wave velocities that are significantly lower than the assumed median values of 1296 ft/s (case 270-200, Table 01.5.2.2-1), 1178 ft/s (case 270-500, Table 01.5.2.2-2), and 1066 ft/s (case 560-500, Table 01.5.2.2-3) (e.g., Menq 2003).

Therefore, the staff requests the applicant to address the following:

- (a) Provide the technical basis for the above backfill assumptions, taking into consideration field measurements of near-surface shear wave velocities for typical engineered granular backfills.
- (b) Clarify whether there is a COL Item to ensure this requirement (i.e., lower-bound strain-compatible shear wave velocity near plant grade of at least 800 ft/s) is met at a particular site. Explain how a COL applicant will demonstrate the applicability of the certified standard plant design if this requirement cannot be met.

Reference

Menq, F. Y. (2003), "Dynamic Properties of Sandy and Gravelly Soils." Ph.D. Dissertation. School of Civil Engineering, University of Texas at Austin.

ANSWER:

- (a) The generic soil profiles presented in Technical Report MUAP-10006, Rev. 3 are representative of strain compatible properties of in-situ materials, rather than the engineered fill material that is backfilled around the US-APWR foundations during the construction of the plant. The assumption of horizontally infinite layering pertaining to the methodology implemented both in soil-structure interaction (SSI) analysis and site response analysis cannot always be justified because the horizontal extent of the backfill is limited. Therefore, the seismic response analyses described in Design Control Document (DCD) Subsection 3.7.2.4 and Technical Report MUAP-10006, Rev. 3 consider the engineered backfill material that is placed around the perimeter of the building as part of the structural model. As shown in Figures 03.3.4.1-4 and 5 of Technical Report MUAP-10006, Rev. 3, two rows of solid elements attached to the exterior basement walls of the Reactor Building (R/B) complex model the dynamic properties of the backfill. Tables 03.3.3.1-10 through 03.3.3.1-15 of Technical Report MUAP-10006, Rev. 3 provide the strain compatible dynamic properties that are assigned to these backfill solid elements. Section 03.3.1 of Technical Report MUAP-10006, Rev. 3 describes the development of these strain compatible backfill properties that is based on two sets of generic small-strain dynamic properties of typical granular engineered fill materials presented in Tables 03.3.1-8 and 03.3.1-9 of Technical Report MUAP-10006, Rev. 3.
- (b) The intent of the cited statements in Sections 01.4.2 and 01.4.2.1 of Technical Report MAUP-10006, Rev. 3 is not to set requirements on the dynamic properties of the embedment soil, but only to describe the approach taken to develop the generic soil profiles 270-200 and 270-500. There are no Combined License (COL) Items setting requirements on the shear wave velocity of the embedment, regardless if it is engineered backfill or in-situ soil. Instead, site specific SSI analyses of standard plant Category I structures are performed as required by DCD COL_3.7(20) and COL_3.7(23) to a) address explicitly the effects of site-specific properties of embedment soil on the seismic response and b) demonstrate the applicability of the standard design for a particular site. As described in DCD Subsection 3.7.2.5.4, these SSI analyses use as input site specific seismic design parameters including dynamic properties of the site materials that are compatible to the strains generated by the site specific design ground motion. The applicability of the standard seismic design for the particular site is demonstrated by showing that the responses obtained from the site-specific SSI analyses are enveloped by the standard design.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-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.