RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/27/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 489-3516, REVISION 0**
SRP SECTION:	**03.04.02 – Analysis Procedures**
APPLICATION SECTION:	**3.4.2**
DATE OF RAI ISSUE:	**11/23/2009**

QUESTION NO. 03.04.02-05:

Supplemental RAI Text:

The staff requests the applicant to provide more information on the base/soil interface shear resistance evaluation and further response on the subject regarding passive earth pressure in the dynamic lateral resistance force evaluation.

Staff Assessment of Response to RAI 3.4.2-03 (No. 219-1908 Revision 0):

According to the Applicant's response to RAI 3.4.2-03 dated 4/29/2009 (see Reference below), the Foundation Sliding for the deeply-embedded mat foundations for the RB/FB and CB mat foundations (or others) was analyzed assuming that the resistance to sliding is provided by shear resistance along the base of the mat, and if necessary, from passive soil resistance in front of the mat in the direction of sliding.

However, no detail guidance was provided in evaluating the shear resistance (along the base) in the DCD. The staff would like the applicant to provide more detailed methodology on shear resistance evaluation at interface, such as what are the criteria used to determine the allowable friction coefficient at the soil and base interface? And provide statement on whether such friction coefficient at base/soil interface is strongly dependent on the interfacial property, such as the moisture or water content at the soil structure interface.

In general, the type of earth pressures to the walls depends solely on the inclination of the wall tilt angle. For example, during the seismic event, the passive (and active) earth pressure is needed to be considered due to the lateral vibration response of the wall structure. Therefore, the staff concurs with the applicant's response of using the passive earth pressure for the initial safety factor evaluation to against slide.

However, in reality, due to seismic cyclic loading (dynamic shear deformation oscillation) induced compaction of the backfill or soil around the walls (in the laterally back and forth excitation displacement of the foundation walls), the subsequence passive earth pressure induced by seismic loading is expected to be significantly reduced within a few cycles. Therefore, from the conservative/safety point, it will be sensible not to include the resistance

contributed by the passive earth pressure to the analysis of safety factor against sliding caused by the earthquake.

Furthermore, in a saturated soil condition (or high water table), the pore pressure will likely carry most of the stress induced by the high strain rate of the seismic dynamic loading.

Reference:

Mitsubishi Heavy Industries, Ltd. "MHI's Response to US-APWR DCD RAI No. 219-1908" MHI Ref: UAP-HF-09151, April 9, 2009, ML091040320.

ANSWER:

As discussed with the Nuclear Regulatory Commission (NRC) staff during the Design Certification Document (DCD) Tier 2, Section 3.7.1, 3.7.2, and 3.7.3 Audit conducted in September 23-27, 2013, this answer revises and replaces the previous MHI answer that was transmitted on March 29, 2013 by letter UAP-HF 13064 (ML13107B428).

A non-linear sliding analysis is used for both the reactor building (R/B) complex and the turbine building (T/B). This analysis is presented in Technical Report MUAP-12002, Rev. 1. The analysis relies only on sliding resistance along the bottom of the basemat, and does not rely on passive pressure in resisting sliding. Design Control Document (DCD) Subsection 3.8.5.5.2 states, “No credit is taken for passive soil pressure in calculating the factor of safety against sliding in standard plant building structures.”

The coefficient of kinetic friction at the soil-structure interface for the standard plant sliding analyses is 0.5. This coefficient of friction of 0.5 is presented in Technical Report MUAP-12002, Rev. 1, Section 4.4 based on the results of a large number of laboratory and in-situ tests reported in the literature that were performed on materials similar to those corresponding to the Standard Plant. The value of 0.5 for the kinetic friction coefficient represents the minimum of all experimental values discussed in the Technical Report. A value of 0.7 for the minimum coefficient of static friction is obtained in a similar manner (Section 4.4 of the Technical Report MUAP-12002, Rev. 1). DCD Subsection 3.8.5.5.2 provides further discussion on the coefficient of friction.

The ground water level is an important parameter for estimating the buoyant forces on the structure, which are a part of the stability analysis. The reduction in contact stress due to hydrostatic pressure is therefore accounted for by considering buoyancy forces. The effect of ground water level on the coefficient of friction at the soil-foundation interface is negligible for the subgrade materials considered for the Standard Plant, as discussed in Technical Report MUAP-12002, Rev. 1, Section 4.4.

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 the Technical Report.

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