
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

12/27/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 340-2004 REVISION 0
SRP SECTION: 03.08.05 - Foundations
APPLICATION SECTION: 3.8.5
DATE OF RAI ISSUE: 04/21/2009

QUESTION NO. 03.08.05-13:

In DCD Subsection 3.8.5.4.4, the third paragraph (Page 3.8-74) states, "The basemat FE model is analyzed for various phases of construction, including the determination of displacement."

The applicant is requested to provide the following information:

- (a) Were both the immediate settlement and the settlement due to consolidation included in the displacement calculations?
 - (b) Describe how these settlements were calculated.
 - (c) Was the effect of nearby structures' weights included in the settlement calculation?
-

ANSWER:

This answer revises and replaces the previous MHI answer that was transmitted by letter UAP-HF-13064 (ML13107B428) on March 29, 2013.

(a) Were both the immediate settlement and the settlement due to consolidation included in the displacement calculations?

Answer: Yes. The settlement calculations have been performed using secant (equivalent elastic) soil deformation moduli, as illustrated in Figure 2 of the Answer to RAI 340-2004, Question 03.08.05-14. These moduli were determined for each soil layer (including sand layers and clay layers) and used in linear Finite Element (FE) analyses.

For clay layers, the secant moduli were determined in an iterative process from the condition that the average settlements of each structure obtained from the linear analyses are approximately equal with the corresponding settlements that account for time dependent deformability. As explained in the Answer to RAI 1045-7141, Question 03.08.05-59, and illustrated in Figure 5 of that Answer, both immediate settlements and settlements due to consolidation are calculated when estimating the secant deformation moduli.

For sand layers, the secant deformation moduli have been calculated using equations (3) and (4) in the Answer to RAI 1045-7141, Question 03.08.05-59. As explained in that Answer, these equations have been derived from equation (1), an empirical relation that links the total settlements in sand under loading to the period of time the loads have been acting. These total

settlements, obtained from experimental measurements, include both immediate settlements and creep (settlements occurring in time under constant load).

Thus, the secant deformation moduli used in the FE analysis for settlement calculations account for the effect of both immediate settlement and settlements occurring in time (consolidation or creep), and therefore the resulting displacements include both immediate settlements and settlements occurring in time.

(b) Describe how these settlements were calculated.

Answer: The method for calculating maximum expected settlements of the Standard Plant structures is described in the Answer to RAI 340-2004, Question 03.08.05-14. Detailed technical information about modeling time dependent settlements is presented in the Answer to RAI 1045-7141, Question 03.08.05-59.

(c) Was the effect of nearby structures' weights included in the settlement calculation?

Answer: Yes. The settlements were calculated by three-dimensional finite element (FE) analysis using ANSYS. The FE model included the Reactor Building (R/B) complex and the Turbine Building (T/B), placed on adjacent layered subgrade modeled by solid elements. The weight of the access building (AC/B) was also included in the FE model as an equivalent mat. The tank house was not included in the FE model, as it weighs less than 1.5% of the R/B complex weight. By including the Standard Plant structures in the same analysis, the effects of nearby structures were accounted for.

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/Topical Report.

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