
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

03/29/2013

**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-09363 (ML091900557).

The method for calculating maximum expected settlements of the Standard Plant structures is described in the following:

Maximum values have been calculated for settlement, differential settlements and tilt of the Standard Plant structures. The settlements were calculated by three-dimensional finite element (FE) analysis using ANSYS. Both the reactor building (R/B) complex and the turbine building (T/B) were modeled by their dynamic FE models used for the seismic soil-structure interaction calculations. The two FE models were placed on adjacent layered subgrade modeled by solid elements. The weight of the access building (AC/B) was also included in the analysis. In this manner, all Standard Plant structures were included in the analysis and the effects of nearby structures were accounted for. The tank house was not included, as it weighs less than 2 percent of the R/B complex weight.

The volume of subgrade included in the analysis (3000 ft by 2400 ft in a horizontal plane, and 960 ft in depth) was sufficiently extended to avoid the effects of boundary conditions on

the resulting settlements. Two sets of three-dimensional settlement analyses were performed; one for a predominantly sand site and the second for a predominantly clay site. The deformability properties of the subgrade layers were established to simulate immediate and time dependent deformability of natural soil materials. For this purpose, soil investigation data, laboratory soil test results and design soil deformation properties have been collected from two existing nuclear power plant sites (References 1 and 2, for sand site and clay site, respectively) with shear wave velocity profiles in the upper 500 ft similar to profile 270-500, which is the most deformable subgrade profile considered for the Standard Plant. The subgrade layers placed 500 ft or deeper below the plant grade were assigned rock properties equivalent to the corresponding layers described in profile 270-500.

The settlement analysis results were obtained as total settlements, differential settlements within the same structure, differential settlements between adjacent structures and tilt. These quantities were calculated at the end of construction, at the end of plant life, and during the operation period. The operational life of the plant was considered to include a standard plant commission of 40 years plus a possible extension of 20 years. The key parameters related to settlement listed in the DCD, Tier 2, Table 2.0-1 and Tier 1, Table 2.1-1 have been updated based on the maximum values obtained from the settlement analysis assuming a predominantly clay site, as follows:

- A. Settlements during construction and operational life:
 - 1. Total settlement of the R/B complex foundation: 9 in.
 - 2. Differential settlement across the R/B complex foundation: 5.5 in. (this corresponds to a general slope of the R/B complex foundation smaller than 1/1000)
- B. Settlements during operational life only
 - 1. Maximum differential settlements between adjacent buildings: 0.5 in.
 - 2. Maximum tilt of the R/B complex foundation: 1/2000 (rise over run)

More details regarding the loads included in the settlement analysis, the method to account for time dependent deformations of soil materials, and considerations regarding the construction and the operational life of the plant are presented in the answer to RAI 340-2004 Question 03.08.05-14.

References

- 1. Vogtle Early Site Permit Application, Part 2 – Site Safety Analysis Report, Rev. 5. Southern Nuclear Operating Company, December 2008.
- 2. South Texas Project Nuclear Generating Station, FSAR, Units 1 & 2, Rev. 7.

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 the Technical/Topical Report.

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