RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

08/01/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 1045-7141 REVISION 3**
SRP SECTION:	**03.08.05 – Foundations**
APPLICATION SECTION:	**3.8.5**
DATE OF RAI ISSUE:	**07/01/2013**

QUESTION NO. 03.08.05-52:

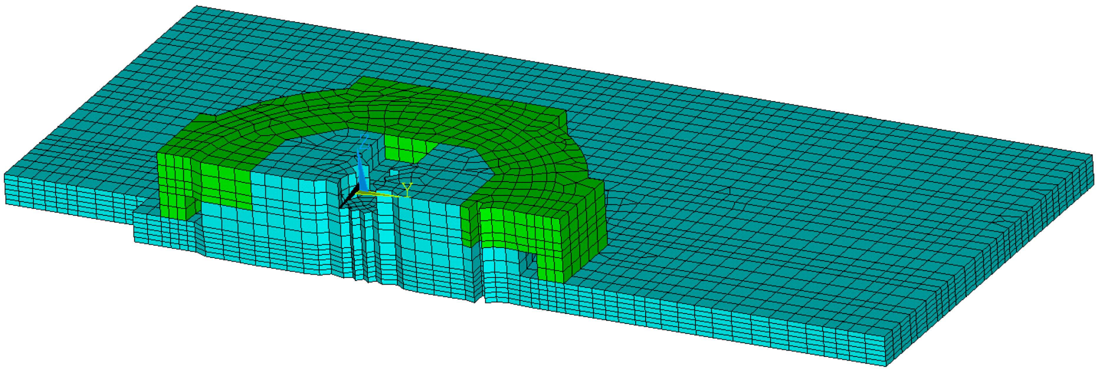
On April 3, 2013, the applicant submitted a markup of DCD Tier 2 Section 3.8 to provide updated information related to a seismic design change.

In Subsection 3.8.5.4.2.1, "Global Three-Dimensional FE [finite element] Modeling of Basemat," the third paragraph (Page 3.8-99) states that "The upper portion of tendon gallery is conservatively modeled using a concrete strength of 5,000 psi to simplify design while providing for the potential in variation of construction joints."

It is not clear to the staff how using a concrete strength of 5,000 psi, which is less than the actual design strength of 7,000 psi, for the mathematical modeling, is conservative; and also provides for the potential in variation of construction joints. The applicant is requested to use 7000 psi of concrete strength for the upper portion of the tendon gallery; or explain the purpose of using the 5000 psi concrete more clearly.

ANSWER:

The analysis of the basemat foundation explicitly models concrete compressive strengths of 5,000 psi, in addition to 7,000 psi at tendon anchorage assembly locations (within the central thickened portion of the basemat) as it will be built by the combined license (COL) applicant for both the general basemat and tendon gallery areas. Both 5,000 and 7,000 psi concrete were modeled to account for potential stress concentrations due to varying material properties. Refer to Figure 1 (provided on the following page of this response) for a diagram of a section cut through the reactor building (R/B) complex basemat taken from the three-dimensional finite element model. Conservatively, computations for reinforced concrete design consider a lower bound concrete compressive strength of 5,000 psi only.



Where:

(cyan)	5000 psi concrete
(green)	7000 psi concrete

Figure 1: Section Cut of R/B Complex Basemat

Impact on DCD

The third paragraph of subsection 3.8.5.4.2.1 of the Design Control Document (DCD) will be revised as shown in Attachment 1 of this RAI.

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.

3.8.5.4.2.1 Global Three-Dimensional FE Modeling of Basemat

The stress conditions of the basemat for the R/B complex are generated by numerous types of loads from the superstructure. The modeling of the basemat therefore involves evaluating the interaction between the basemat and the superstructures to determine the stress conditions at the interface. The global FE model is analyzed utilizing the FE computer program ANSYS (Reference 3.8-14).

~~Regarding the R/B, the element divisions in a horizontal direction inside the secondary shield walls of the containment internal structure are made in a rectangular grid pattern and those divisions outside the secondary shield wall are made in a polar pattern. Peripheral areas of the basemat, outside the thickened mat that supports the PCCV and containment internal structure are divided into a rectangular grid.~~ MIC-03-03-00057

The R/B complex basemat is modeled with a concrete strength of 5,000 psi except for the upper portion of the tendon gallery which is modeled with a concrete strength of 7,000 psi. This modeling of the basemat and tendon gallery matches the concrete strength construction requirements for these areas.~~The upper portion of tendon gallery is considered with concentrated stresses created by the connection with the PCCV. This region is divided into multiple layers of elements in the radial direction to accommodate the differing concrete strengths in this area as shown schematically in Figure 3.8.5-4.is conservatively modeled using a concrete strength of 5,000 psi to simplify design while providing for the potential in variation of construction joints.~~ DCD_03.08.05-52

The ~~basemat below the PCCV and the lower portion of containment internal structure are~~R/B complex basemat is simulated with solid elements (ANSYS SOLID45 elements) that are defined by eight nodes having three degrees of freedom at each node; translations in the nodal x, y, and z directions. ~~The elements below the PCCV are divided into ten layers, and elements in peripheral areas are divided into four layers.~~The R/B complex basemat is divided into six layers in the vertical dimension for areas away from the PCCV. The area below the PCCV is divided into 12 layers in the vertical direction. The portion modeled to simulate the reactor cavity is divided into ten layers in the vertical direction. MIC-03-03-00057

The R/B complex basemat is modeled with element divisions in the horizontal direction in a rectangular grid pattern, in areas away from the PCCV. The element divisions in the horizontal direction within the PCCV boundaries, mainly between the primary shield wall and the secondary shield wall, are mostly in a rectangular grid pattern. The element divisions between the secondary shield wall and the PCCV exterior wall are generally in a polar grid pattern as shown in Figure 3.8.5-5.

~~The FE modeling of the PS/Bs is addressed in Subsection 3.8.4.4.~~

3.8.5.4.3 Boundary Conditions of Basemat

The basemat subgrade is included in the ~~detailed static~~ FE models used for structural design by meshing a sufficiently large volume of soil/rock below and around the basemat. MIC-03-03-00057
~~The stiffness of the backfill around the below-grade walls is not considered in the model.~~For seismic load cases, the stiffness of the backfill soil is only activated along the face of the R/B complex basemat in the opposite direction of the applied earthquake load. MIC-03-03-00057