

---

---

**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

---

---

03/29/2013

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** NO. 858-6126 REVISION 3

**SRP SECTION:** 03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments

**APPLICATION SECTION:** 3.8.3

**DATE OF RAI ISSUE:** 10/25/2011

---

**QUESTION NO. 03.08.03-46:**

Sections 1.8 and 4.1 of MHI technical report MUAP-11013-P (R1) state that one of the tasks will consist of "Design of all components for the force and moment demands using ACI 349 design strength equations supplemented with conservative engineering approaches that are correlated to available test data, research literature, and industry recognized design methods." If no standards or codes exist in the US for SC structures, explain what is meant by industry recognized design methods.

Section 1.8 and the various subsections of Sections 5.0 and 6.0, refer to the use of a nonlinear inelastic finite element (NIFE) modeling approach to correlate the measured and observed behavior from the SC testing performed (Task 3) and then to perform pushover analysis of an NIFE model of the actual US-APWR CIS (Task 4). It appears that these NIFE models will be used to evaluate the 1/10<sup>th</sup> scale, 1/6<sup>th</sup> scale, and SC wall component tests. Provide a summary of the different cases that will be analyzed; computer codes used; finite elements selected; modeling approach for the steel plates, concrete, studs, ties, and connections to other SC type members, as well as to the reinforced concrete structures; material properties including stress-strain curves, and the method of load applications. Provide a description of the verification used to demonstrate the adequacy of the concrete finite element and concrete parameters selected for this element, which represent the nonlinear behavior of concrete in the SC model. The above information should be provided for the NIFE benchmarking evaluation under Task 3 against test data and the overall structure performance confirmation for the US-APWR CIS structure under Task 4. Also, explain the differences between the models used in Task 3 and in Task 4.

Also clarify the phrase of "benchmarked NIFE modeling approach." Explain whether the results show already that the NIFE modeling approach is acceptable by comparison to the test data, or adjustments in the NIFE modeling approach are needed in order to match the test results. If adjustments are needed explain why the modeling approach was inadequate and how the adjustments can be implemented with sufficient confidence that it would be valid for the actual US-APWR CIS model.

---

**ANSWER:**

This answer revises and replaces the previous MHI answer that was transmitted by letter UAP-HF-12051 (ML12075A108).

The industry recognized design methods referenced are the methods used for the design of reinforced concrete structures according to American Concrete Institute (ACI) 349-06. For example, the design methods in Section 8.0 of Technical Report MUAP-11019, Rev. 1, for combined forces and moments are based on industry recognized design methods (stress block diagrams, etc.) for reinforced concrete design.

The benchmarked non-linear inelastic finite element (FE) modeling approach is given in the summary of Task 3 results provided in MUAP-11013, Rev. 2, Appendix A. A description of the design models and analysis techniques used for each different case is provided. The non-linear inelastic FE modeling approach is acceptable by comparison with the test results and adjustments are not needed. The Task 4 results are provided in the US-APWR containment internal structure (CIS) seismic capacity calculations which are available for audit.

**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.