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April 24, 2009

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-09194

Subject: MHI's Response to US-APWR DCD RAI No. 223-1996

References:

1) "Request for Additional Information No. 223-1996 Revision 0, SRP Section: 03.08.01 – Concrete Containment, Application Section: DCD, Tier 1 – Section 3.8.1," dated 2/26/2009.
2) "MHI's Response to US-APWR DCD RAI No. 223-1996," UAP-HF-09161, dated 4/14/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 223-1996 Revision 0."

Enclosed is the response to questions 12 and 13 of the RAI (Reference 1). This transmittal, in addition to the previous response (Reference 2), completes the response to this RAI.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Response to Request for Additional Information No. 223-1996, Revision 0

D081
NRO

CC: J. A. Ciocco
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Docket No. 52-021
MHI Ref: UAP-HF-09194

Enclosure 1

UAP-HF-09194
Docket No. 52-021

Response to Request for Additional Information No. 223-1996,
Revision 0

April, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/24/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 223-1996 REVISION 0**
SRP SECTION:	**03.08.01 – Concrete Containment**
APPLICATION SECTION:	**03.08.01**
DATE OF RAI ISSUE:	**2/26/2008**

QUESTION NO.: 3.8.1-12

In DCD Subsection 3.8.1.6 (pg. 3.8-24 and 25) it states "Another site-specific specification shall be produced for the PCCV personnel airlocks and equipment hatch. This specification refers to the ASME Code, Section III, Division 1 (Reference 3.8-2), which is applicable to metallic material not backed by concrete for load carrying purposes (refer to Subarticle CC-2112 for the delineation of jurisdiction). Fracture toughness requirements for materials for locks and hatch and other penetration assemblies subject to Division 1 of the ASME Code, Section III are in accordance with Article NE-2300 (Reference 3.8-2)."

The applicant is requested to provide the following clarification:

(a) In the second sentence of the quoted DCD Subsection 3.8.1.6 material above, Reference 3.8-2 is for Division 2 and not for Division 1. An additional reference is needed in DCD Section 3.8.7 which refers to ASME Section III, Division 1 and then correctly referenced.

(b) In the last sentence of the quoted DCD Subsection 3.8.1.6 material above, Reference 3.8-2 is for Division 2, not Division 1. Reference number 3.8-2 needs to be changed to the correct reference for ASME Section III, Division 1.

ANSWER:

(a) In DCD Revision 2, ASME Section III, Division 1 will be added to Subsection 3.8.7 as a reference.

(b) In DCD Revision 2, the references in Subsection 3.8.1.6 will be modified to refer to the new reference described above in (a) (ASME Section III, Division 1).

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2, Section 3.8, Revision 2 changes to be incorporated.

- Change Reference 3.8-2 to 3.8-48 in the second and third sentences in the fifth paragraph of Subsection 3.8.1.6, Liner Plate, as follows:

  "The COL Applicant is to produce another site-specific specification for the PCCV personnel airlocks and equipment hatch. This specification refers to the ASME Code, Section III, Division 1 (Reference 3.8-48), which is applicable to metallic material not backed by concrete for load carrying purposes (refer to Subarticle CC-2112 for the delineation of jurisdiction). Fracture toughness requirements for materials for locks and hatch and other penetration assemblies subject to Division 1 of the ASME Code, Section III are in accordance with Article NE-2300 (Reference 3.8-48)."

- Add the following reference to Subsection 3.8.7, References:

  "3.8-48 Rules for Construction of Nuclear Facility Components, Division 1, Section III, American Society of Mechanical Engineers, 2001 Edition through the 2003 Addenda."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/24/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 223-1996 REVISION 0**
SRP SECTION:	**03.08.01 – Concrete Containment**
APPLICATION SECTION:	**03.08.01**
DATE OF RAI ISSUE:	**2/26/2008**

QUESTION NO.: 3.8.1-13

It is not clear from the information given in DCD Subsection 3.8.1.7 as to the exact nature and timing of the tests to be conducted upon completion of the PCCV and its major penetration assemblies (equipment hatch and personnel airlocks). The statement that the SIT test meets the requirements for leakage rate testing given in RG 1.206 needs to be more specific and clarified. In addition, Article CC-3000 of the ASME Code cited in DC Subsection 3.8.1.7 for preoperational testing is titled "Design", and does not appear to contain any specific provisions for preoperational testing.

The applicant is requested to provide the following information:

1. A description of the SIT and associated leakage rate testing, including the timing of these tests, that is required for the PCCV and major penetrations (equipment hatch and personnel airlocks).
2. A description of what is included in preoperational testing.
3. The specific Subarticle in CC-3000 of the ASME code that contains requirements for preoperational testing.

ANSWER:

1. Structural Integrity Testing (SIT) is described in Subsection 14.2.12.1.61. In the SIT, the containment is pressurized to the test pressure of 78.2 psig as described in Subsection 3.8.1.3.1, and the deflection measurements, and concrete crack inspections are made to determine that the actual structural response is within the limits predicted by the analyses. The related Containment Local Leak Rate preoperational test is described in Subsection 14.2.12.1.62 and preoperational Containment Integrated Leak Rate Test (ILRT) is described in Subsection 14.2.12.1.63. In the Containment Local Leak Rate preoperational test, the containment penetrations (including equipment hatch and personnel airlocks) and isolation valves are leak tested by performing Type B and Type C tests, in accordance with 10 CFR 50, Appendix J. The ILRT is conducted by performing the Type A test, in accordance with 10 CFR 50, Appendix J (Reference 14.2-18), which describes the primary reactor containment overall integrated leakage testing. These three tests are to be carried

out in the order of SIT, Containment Local Leak Rate Preoperational Test, and ILRT. The SIT is to be carried out after the PCCV is pressurized to P_t (1.15 times the design pressure). Containment Local Leak Rate preoperational test and ILRT are to be carried out by maintaining the PCCV internal pressure above P_a (the containment pressure equals the calculated accidental peak containment internal pressure).

2. The SIT, Containment Local Leak Rate preoperational test, and ILRT are included in preoperational testing. These tests are described in Chapter 14 as preoperational tests.

3. The preoperational structural testing is to be carried out according to CC-6000. CC-3000 described in Subsection 3.8.1.7 will be modified to CC-6000. As an additional correction, the sentence in Subsection 3.8.1.7 which discusses a summary of specific structural testing requirements will be modified to state that the requirements being summarized are for the SIT and not for ILRT.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2, Section 3.8, Revision 2 changes to be incorporated.

- The second paragraph of Subsection 3.8.1.7, Testing and Inservice Inspection Requirements, will be modified as follows: "Preoperational structural testing is performed for the overall PCCV, equipment hatch and personnel airlocks in accordance with Article CC-6000 of the ASME Code, Section III (Reference 3.8-2)."

- Change the fifth paragraph of 3.8.1.7 to state:

  "Specific structural requirements for the SIT of the PCCV are summarized as follows:"

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

This completes MHI's responses to the NRC's questions.

the mix design, cement grout, and production testing requirements. The materials comply with the requirements of Article CC-2200 of the ASME Code, Section III (Reference 3.8-2).

Additionally, it is the responsibility of the COL Applicant to determine the site-specific aggressivity of the ground water/soil and accommodate this parameter into the concrete mix design as well as into the site-specific structural surveillance program. As required by SRP 3.8.1 (Reference 3.8-7), for plants with nonaggressive ground water/soil (i.e., pH is greater than 5.5, chlorides are less than 500 ppm, and sulfates are less than 1,500 ppm), an acceptable program for normally inaccessible, below-grade concrete walls and basemats is to (1) examine the exposed portions of below-grade concrete for signs of degradation, when excavated for any reason; and (2) conduct periodic site monitoring of ground water chemistry, to confirm that the ground water remains nonaggressive. For plants with aggressive ground water/soil (i.e., exceeding any of the limits noted above), an acceptable approach is to implement a periodic surveillance program to monitor the condition of normally inaccessible, below-grade concrete for signs of degradation.

Liner Plate System

Liner Plate

The steel liner plate is designed as SA-516 Grade 60, 1/4 in. minimum thickness.

Where thickened for embedded plates, attachment bracket locations, openings, penetrations, and other such applications, the steel liner plate is SA-516 Grade 70. Grade 60 is used where justified in the design with respect to acceptance criteria previously discussed in Subsection 3.8.1.5.

The ASME Code, Section III (Reference 3.8-2) does not specifically require a corrosion allowance for the liner, and none is provided. The design of the PCCV is sufficient to prevent significant corrosion by protecting the liner against a corrosive environment. A suitable protective coating such as an epoxy coating is applied where necessary for corrosion protection, where suitability implies that the coating is DBA/LOCA-certified, resistant to break-down due to radiation exposure, and easily decontaminated. Further, corrosion allowance is accounted for in the design by demonstrating sufficient margin on the thickness to accommodate a small amount of corrosion that may occur over the 60-year design life.

It is the responsibility of the COL Applicant to produce a site-specific liner plate specification to define the material and welding requirements, testing and quality requirements. This Liner Plate System specification references Article CC-2500 of the ASME Code, Section III (Reference 3.8-2). Fracture toughness requirements for the liner plate material are in accordance with Subarticle CC-2520 (Reference 3.8-2).

The COL Applicant is to produce another site-specific specification for the PCCV personnel airlocks and equipment hatch. This specification refers to the ASME Code, Section III, Division 1 (Reference 3.8-482), which is applicable to metallic material not backed by concrete for load carrying purposes (refer to Subarticle CC-2112 for the delineation of jurisdiction). Fracture toughness requirements for materials for locks and hatch and other penetration assemblies subject to Division 1 of the ASME Code, Section III are in accordance with Article NE-2300 (Reference 3.8-482).

- Materials for all load-bearing components of prestressing systems should be selected so that they can withstand the anticipated low-temperature effects without a loss in their ductility. Methods and procedures similar to those used for materials of liners in Subarticle CC-2520, "Fracture Toughness Requirements for Materials," are acceptable for qualifying the materials. Additionally, suitable tests should be conducted to demonstrate that with the maximum allowable flaw size (cracked button heads, wedges, and anchor nuts); the specific components exhibit the required strength and ductility under the lowest anticipated temperatures.

In addition to the requirements of ASME Code, Section III (Reference 3.8-2), Subarticle CC-2463.1, "Static Tensile Test," the following guidance is used: Any system of prestressing should be subjected to a sufficient number of tests to establish its adequacy. Justification that a sufficient number of tests have been performed, as well as a description of the test program, should be available for NRC review.

Nonload-Carrying and Accessory Materials

Tendon duct, channel, trumpet, and transition cone material meets the requirements of ASME Code, Section III (Reference 3.8-2), Subarticle CC-2440. Corrosion prevention coatings are required for unbonded tendons and are in accordance with Subarticle CC-2442.

Reinforcing Steel Systems

The material is ASTM A615 Grade 60 or A615 Grade 75 (provided that ductility and splicing requirements are met), and meets the requirements of Article CC-2300 of the ASME Code, Section III (Reference 3.8-2).

Splicing material also meets the requirements of Article CC-2300 of the ASME Code, Section III (Reference 3.8-2).

It is the responsibility of the COL Applicant to produce a site-specific specification to define the material and special material testing requirements for the reinforcing steel system including bars and splices. All material conforms to Article CC-2300 of the ASME Code, Section III (Reference 3.8-2).

3.8.1.7 Testing and Inservice Inspection Requirements

Structural integrity testing of the PCCV is performed in accordance with Article CC-6000 of the ASME Code, Section III (Reference 3.8-2), RG 1.35 (Reference 3.8-5), and RG 1.35.1 (Reference 3.8-6). The testing meets the same requirements for ILRT and Containment Leakage Testing as given in RG 1.206 Subsection C.I.6.2.6 (Reference 3.8-1).

Preoperational structural testing is performed for the overall PCCV, equipment hatch and personnel airlocks in accordance with Article CC-6000~~3000~~ of the ASME Code, Section III (Reference 3.8-2).

It is the responsibility of the COL Applicant to establish a site-specific program for testing and ISI of the PCCV, including periodic inservice surveillance and inspection of the

PCCV liner and prestressing tendons in accordance with ASME Code Section XI, Subsection IWL (Reference 3.8-4).

Chapter 6 defines the ILRT requirements for the overall PCCV in addition to ILRT requirements for the penetrations and openings and containment isolation valves. The ILRT program meets the requirements of 10 CFR 50, Appendix J (Reference 3.8-18). Chapter 6 discusses the test and instrument plan, frequency of measurements, structural response predictions, and any other necessary requirements in accordance with Article CC-6000 of the ASME Code, Section III (Reference 3.8-2).

Specific structural requirements for the SIT~~ILRT~~ of the PCCV are ~~based on RG 1.136 (Reference 3.8-3) and are~~ summarized as follows:

Displacement Measurements

Displacement measurements of the PCCV as defined in ASME Code, Section III (Reference 3.8-2) Subarticle CC-6360 meet the following provisions.

- Radial displacements of the cylinder are measured at a minimum of five approximately equally spaced elevations located at 20%, 40%, 60%, 80%, and 100% of the distance between the base and the spring line. These measurements are made at a minimum of four approximately equally spaced azimuths. Measurement of the total displacement may be made between diametrically opposite locations on the PCCV wall. The radial displacement may be assumed to be equal to one-half of the measured change in diameter.
- Radial displacements of the PCCV wall adjacent to the largest opening, are measured at a minimum of 12 points, four equally spaced on each of three concentric circles. The diameter of the inner circle is just large enough to permit measurements to be made on the concrete rather than on the steel sleeve; the middle approximately 1.75 times the diameter of the opening; and the outer approximately 2.5 times the diameter of the opening. For hatch designs with thickened wall sections, the concentric circle at 1.75 times the diameter is relocated at the wall thickness discontinuity and the remaining circle is relocated approximately two wall thicknesses outside the discontinuity. The increase in diameter of the opening is measured in the horizontal and vertical directions. If other openings require structural verification as determined by the designer, displacement measurements are made in the same manner as stipulated for the largest opening.
- Vertical displacement of the top of the cylinder relative to the base is measured at a minimum of four approximately equally spaced azimuths.
- Vertical displacements of the dome of the PCCV are measured at a point near the apex and two other approximately equally spaced intermediate points between the apex and the spring line on at least one azimuth.

Concrete Crack Observations

At a minimum the following areas are observed based on the techniques defined in Subarticles CC-6225 and CC-6350 of the ASME Code, Section III (Reference 3.8-2) at these locations:

3.8-42 Standard Specification for Ready-Mixed Concrete, C94-07, American Standards Testing and Materials (ASTM), 2007.

3.8-43 Standard Specification for Portland Cement, C150-07, Type II, American Society of Testing and Materials.

3.8-44 Standard Specification for Concrete Aggregates, C33-03, ASTM, 2003.

3.8-45 DOD Preferred Methods for Acceptance of Product, MIL-STD-1916, Department of Defense Test Method Standard, April 1, 1996.

3.8-46 Structural Welding Code – Reinforcing Steel, D1.4, American Welding Society, 2005.

3.8-47 Inspection of Water-Control Structures Associated with Nuclear Power Plants, RG 1.127, Rev. 1, U.S. Nuclear Regulatory Commission, March 1978.

3.8-48 Rules for Construction of Nuclear Facility Components, Division 1, Section III, American Society of Mechanical Engineers, 2001 Edition through the 2003 Addenda.