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TOKYO, JAPAN

July 8, 2011

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-11212

Subject: MHI's Responses to US-APWR DCD RAI No. 742-5703 Revision 3 (SRP 03.12)

Reference: 1) "REQUEST FOR ADDITIONAL INFORMATION 742-5703 REVISION 3, SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports, Application Section: 3.12" dated 4/27/2011.

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. 742-5703, Revision 3."

Enclosed are the responses to one RAI contained within Reference 1. This transmittal 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,

Atsushi Komaki for

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

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NRO

Enclosure:

1. Response to Request for Additional Information No. 742-5703, Revision 3

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-11212
Docket No. 52-021

Response to Request for Additional Information No. 742-5703, Revision 3

July, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

07/08/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 742-5703 REVISION 3**
SRP SECTION:	**03.12 – Piping Design Review**
APPLICATION SECTION:	**3.12**
DATE OF RAI ISSUE:	**4/27/2011**

QUESTION NO. RAI 03.12-25:

Section 3.12.5.10 of US-APWR DCD states that structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing monitoring activities for the first US-APWR plant.

In order to use the first US-APWR initial plant operation to verify that the design transients for the surge line are representative, the applicant has to assure that all US-APWR plants have to use the same heatup and cooldown procedure/method. Currently, most of the US plants heatup/cooldown procedures are not the same as the heatup/cooldown procedures used by many Japanese units. How does Mitsubishi ensure that all US-APWR plants will use the same heatup and cooldown procedure/method?

ANSWER:

The performance of the Reactor Coolant System (RCS), including the pressurizer surge line will be subject to extensive thermal expansion and operational verification testing during Hot Functional Testing (HFT) for the first US-APWR constructed. The testing is conducted in a tightly controlled manner with the RCS being heated (by the Reactor Coolant Pumps) in a slow and methodical manner. Temperature sensors are arrayed on the RCS boundary (metal surface), including the pressurizer surge line, as well as inside the RCS itself. The rate of expansion is measured and monitored to verify the design basis as well as to confirm that thermal expansion clearances are adequate. During heatup and cooldown, the pressurizer spray valve is slightly opened to maintain a small but continuous flow through the pressurizer heated water volume and through the surge line to help maintain quasi-isothermal conditions in this line and to minimize thermal stratification. The HFT will also verify that any temperature stratification or surge line differential temperatures that does occur is within the analyzed values, and that the surge line operating characteristics meet the applicable analyzed ASME Code Section III requirements as shown in the enclosure of the MHI letter "Revised Design Completion Plan for US-APWR Piping Systems and Components" dated May 12, 2011(ML11136A234). The results of the HFT will be used to confirm adequate design margins for the surge line. It is normal practice for the RCS heatup/cooldown rates to be limited in the plant licensing documents (technical specifications). This in turn is subsequentially made part of the generic MHI US-APWR operating procedures as

well as plant specific operating procedures. MHI will prepare generic operating procedures (guidelines) to assist US-APWR owners in formulating plant specific operating procedures. These generic procedures capture the allowable heatup and cooldown rates for the RCS, including the pressurizer surge line and provide guidance to plant owners on allowable rates (ASME based analysis and actual field testing as described above). Licensees will use these generic procedures to assist in the formulation of plant specific procedures.

A statement will be added the activities required to assure the structural integrity of the pressurizer surge line for subsequent plants to DCD section 3.12.5.10. The heatup and cooldown operations are also related to the low temperature over pressure protection design bases, and the outline of the operation are described in the Subsections 5.2.2.2.2.1 and 5.2.2.2.2.2. DCD Subsection 3.12.5.10 will include a statement to clarify that items 2 through 4 of the activities in the first US-APWR plant will not need to be performed in subsequent plants if the fatigue evaluation results comply with the ASME Code.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.12, changes to be incorporated.

- Revise the last paragraph of Subsection 3.12.5.10 to read as follows:

  "Structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing the following activities for the first US-APWR plant constructed.

  1. Fatigue evaluation is to be performed by considering the repeated event of thermal stratification occurring in the pressurizer surge line. It will be confirmed by analysis and hot functional testing that thermal deflections of the piping do not result in adverse conditions.

     If the fatigue evaluation results comply with the ASME Code Section Ⅲ, items 2 through 4 will not be performed in subsequent US-APWR plants.

     If the fatigue evaluation results yield noncompliance with the ASME Code Section Ⅲ, items 2 through 4 below, are to be performed.

  2. Plant heatup and cooldown are the most severe conditions for thermal stratifications of the pressurizer surge line due to developing the largest difference of temperature between the hot leg and the pressurizer, which are to be considered for mitigation of thermal stratification in the US-APWR.

  3. The temperature of the surge line is to be monitored for the effects of thermal stratification at heatup and at cooldown during hot functional testing.

  4. Monitoring results are to be included in stress and fatigue analysis to ensure ASME Code Section Ⅲ compliance.

  The outline of the heatup and cooldown operation are described in the Subsection 5.2.2.2.2.1 and 5.2.2.2.2.2. "

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.

Attachment 1

US-APWR DCD Section 3.12 Mark-up

Response to RAI No.742-5703 Revision3

At the horizontal portion of the pressurizer surge line, thermal stratification is expected to occur if the surge flow velocity is low, and to disappear if the velocity is high. At normal operation, a low flow-rate out-surge flow in the line connecting the pressurizer to the hot leg may occur due to a continuous spray, which could lead to a thermal stratification in the cross section of pressurizer surge line in accordance with the temperature difference between pressurizer and hot leg. When a high-flow rate out-surge flow or in-surge flow occurs during transient events, this thermal stratification disappears. The low flow-rate out-surge flow is recovered as soon as out-surge or in-surge ends, thus, reproducing the thermal stratification.

Structural integrity of the pressurizer surge line of the US-APWR plant is to be assured by performing the following activities for the first US-APWR plant.

1. Fatigue evaluation is to be performed by considering the repeated event of thermal stratification occurring in the pressurizer surge line. It will be confirmed by analysis and hot functional test that thermal deflections of piping do not result in adverse consequences.

   If the fatigue evaluation results comply with the ASME Code Section III, items 2 through 4 will not be performed in subsequent US-APWR plants.

   If the fatigue evaluation results yield noncompliance with the ASME Code Section III, items 2 through 4 below, are to be performed.

2. Plant heatup and cooldown are the most severe conditions for thermal stratifications of the pressurizer surge line due to developing the largest difference of temperature between hot leg and pressurizer, which are to be considered for mitigation of thermal stratification in the US-APWR.

3. The temperature of the surge line is to be monitored for the effects of thermal stratification at heatup and cooldown during hot functional testing.

4. Monitoring results are to be included in stress and fatigue analysis to ensure ASME Code Section III compliance.

The outline of the heatup and cooldown operation are described in the Subsection 5.2.2.2.2.1.and 5.2.2.2.2.2..

3.12.5.11 Safety Relief Valve Design, and Testing

The requirements of "Rules for the Design of Safety Valve Installations", ASME Code, Appendix O (Reference 3.12-30) are followed in the design and installation of safety valves and relief valves for overpressure protection.

Discharge forces of safety or relief valves using open vent stacks to discharge directly to the atmosphere are normally calculated using static methods and a conservative dynamic load factor. While performing stress analysis, these discharge forces are applied to evaluate stresses and restraint/support design loads using static equivalent force analysis method.