

  
**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
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TOKYO, JAPAN

April 6, 2010

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

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021  
MHI Ref: UAP-HF-10095

**Subject: MHI's Response to US-APWR DCD RAI No. 548-4331 Revision 4**

**Reference:** 1) "Request for Additional Information No. 548-4331 Revision 4, SRP Section: 05.04.07 – Residual Heat Removal (RHR) System – Application Section: 5.4.7" dated March 15, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 548-4331 Revision 4."

Enclosed is the response to Question 05.04.07-12 that is contained within Reference 1.

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

Sincerely,



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

Enclosure:

1. Response to Request for Additional Information No. 548-4331 Revision 4

CC: J. A. Ciocco  
C. K. Paulson

Contact Information

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NRR

Docket No. 52-021  
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Enclosure 1

UAP-HF-10095  
Docket No. 52-021

Responses to Request for Additional Information No. 548-4331  
Revision 4

April 2010

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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4/6/2010

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** NO. 548-4331 REVISION 4  
**SRP SECTION:** 05.04.07- RESIDUAL HEAT REMOVAL (RHR) SYSTEM  
**APPLICATION SECTION:** 5.4.7  
**DATE OF RAI ISSUE:** 3/15/2010

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**QUESTION NO.: 05.04.07-12**

In UAP-HF-09511, the RAI response to question 5.4.7-9 (d), referenced DCD Subsection 14.2.8.2.1, Natural Circulation Testing which addresses natural circulation and boron mixing for subsequent plants. Subsection 14.2.12.2.3.9, Natural Circulation Test appears to describe the initial APWR plant testing but does not address if adequate boron mixing will be determined.

Please explain why Subsection 14.2.12.2.3.9 does not address BTP 5-4 (d) to confirm that adequate boron mixing can be achieved under natural circulation conditions.

Reference: MHI's Responses to US-APWR DCD RAI No. 464-3520; MHI Ref: UAP-HF-09511; dated November 4, 2009; ML093100116.

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**ANSWER:**

The prototype (first plant) testing for natural circulation described in DCD Revision 2 Subsection 14.2.8.2.1 includes verification of boron mixing. MHI is revising DCD Subsection 14.2.8.2.1 to refer to Subsection 14.2.12.2.3.9 for details of the natural circulation test abstract, which are applicable to the prototype test. Subsection 14.2.12.2.3.9 is also being revised to address boron mixing.

**Impact on DCD**

DCD Tier 2 Subsections 14.2.8.2.1 and 14.2.12.2.3.9 are revised as follows:

**14.2.8.2.1 Natural Circulation Testing**

Natural circulation testing for the first plant is performed in accordance with Subsection 14.2.12.2.3.9. For subsequent plants, the COL applicant either performs the test or provides a justification for not performing the test based on an evaluation of the results of previous natural circulation tests and comparison of RCS hydraulic resistance coefficients applicable to normal flow conditions provided that

- Test results from the US-APWR reference prototype plant indicate that natural circulation flow rates are adequate to ensure that core decay heat removal, boron mixing, plant cooldown/depressurization, and stable natural circulation conditions are maintained throughout the test.
- The as-built plant and US-APWR reference prototype plant configurations are the same relative to the general configuration of the piping and components in each reactor coolant loop, the general arrangement of the reactor core and internals, and similar elevation head represented by these components and the system piping.
- The hydraulic resistance coefficients applicable to normal flow conditions and temperature data, and loss of coolant flow delay-time data (as measured during the RCS Flow Measurement Test in Subsection 14.2.12.2.4.12 and during the RCS Flow Coastdown Test in Subsection 14.2.12.2.1.13) are comparable with the US-APWR reference prototype plant.
- The results of the natural circulation test from the US-APWR reference prototype plant are incorporated into a plant-referenced simulator that meets the requirements of 10 CFR § 55.46 (c) and used in the operator training program to provide training on plant evaluation and off-normal events for each operating shift.

#### **14.2.12.2.3.9 Natural Circulation Test**

(Perform on first plant. For subsequent plants, see discussion in Subsection 14.2.8.2.)

##### **A. Objectives**

1. To demonstrate the capability to remove decay heat by natural circulation.
2. To demonstrate boron mixing occurs during natural circulation.

##### **B. Prerequisites**

1. RCPs are operating.
2. Primary system is at normal operating temperature and pressure.
3. The feedwater system is available for decay heat removal.
4. RCS boron concentration has been determined via multiple primary liquid sampling points.

##### **C. Test Method**

1. The test is initiated by tripping all RCPs.
2. Heat removal is achieved via feedwater system operation and natural circulation.
23. Natural circulation is verified by observing the response of the hot leg and cold leg temperature instrumentation in each loop for natural circulation stabilization period and the ability to maintain the cooling mode.
4. RCS boration is performed during the test, with samples taken from multiple primary liquid sampling points.

##### **D. Acceptance Criteria**

1. Decay heat removal capability is demonstrated by maintaining natural circulation conditions.
2. RCS boration and boron mixing is achieved during natural circulation.

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PRA.