**MITSUBISHI HEAVY INDUSTRIES, LTD.**
**16-5, KONAN 2-CHOME, MINATO-KU**
**TOKYO, JAPAN**

December 3, 2010

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-10327

**Subject:** MHI's Response to US-APWR DCD RAI No. 654-4640 Revision 0 (SRP 04.05.01)

**Reference**: 1) "Request for Additional Information No. 654-4640 Revision 0, SRP Section: 04.05.01 – Control Rod Drive Structural Materials, Application Section: 4.5.1," dated 11/1/2010

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents entitled "Response to Request for Additional Information No. 654-4640, Revision 0"

Enclosed is the response to 1 RAI 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 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. 654-4640, Revision 0"

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

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# Enclosure 1

UAP-HF-10327
Docket No. 52-021

Response to Request for Additional Information No. 654-4640,
Revision 0

December 2010

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**12/03/2010**

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

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|---|---|
| **RAI NO.:** | **NO. 654-4640 REVISION 0** |
| **SRP SECTION:** | **04.05.01 - CONTROL ROD DRIVE STRUCTURAL MATERIALS** |
| **APPLICATION SECTION:** | **4.5.1** |
| **DATE OF RAI ISSUE:** | **11/1/2010** |

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**QUESTION NO.: 04.05.01-11**

In RAI 04.05.01-10(3), the staff requested that the applicant discuss its use of furnace sensitized austenitic stainless steel. The staff noted that DCD Subsection 4.5.1.2 states that furnace sensitized material is allowed. In the applicant's response to the above RAI, it stated that MHI dose not use sensitized material for the CRDM housing. Although the staff finds the applicant's response acceptable, the staff requests that the applicant modify DCD Subsection 4.5.1.2, in order to provide clarity, to state that furnace sensitized material is not allowed.

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**ANSWER:**

The description concerning use of furnace sensitized material will be revised in DCD Subsection 4.5.1.2.

**Impact on DCD**

DCD Revision 3 will incorporate the following change:

- The 2nd paragraph of Subsection 4.5.1.2 will be changed as follows:

Manufacturing process controls for preventing intergranular corrosion of stainless steel components are used in accordance with the guidance in RG 1.44 (Reference. 4.5-5). Furnace sensitized material is <u>not</u> allowed <u>for the CRDM pressure housing</u>, and methods described in the guide are followed for cleaning and protecting austenitic stainless steels from contamination during handling, storage, testing, and fabrication and for determining the degree of sensitization during welding.

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PRA.

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**QUESTION NO.: 04.05.01-12**

DCD Table 1.9.1-1 does not identify Subsection 4.5.1 in the line item for RG 1.31. in addition, DCD Subsection 4.5.1.2 dose not reference RG 1.31. In order to provide clarity, the staff requests that the applicant modify DCD Section 4.5.1.2 to reference the use of RG 1.31 for the fabrication of pressure boundary and non-pressure boundary CRDM components. In addition, the staff requests that the applicant list Subsection 4.5.1 in the line item for RG 1.31 in Table 1.9.1-1 to make it clear that the applicant follows the guidance provide in RG 1.31, without exception, for all welded austenitic stainless steel CRDM components.

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**ANSWER:**

MHI will add the description of RG 1.31 in DCD Subsection 4.5.1.2 and Subsection 4.5.1 in the line item for RG 1.31 in Table 1.9.1-1.

**Impact on DCD**

DCD Revision 3 will incorporate the following changes:

- The following sentence will be inserted as the 3rd paragraph of Subsection 4.5.1.2:

·····contamination during handling, storage, testing, and fabrication and for determining the degree of sensitization during welding.

<u>Weld metals for the pressure boundary and non-pressure boundary of CRDM components are used in accordance with the guidance in RG 1.31 (Reference 4.5-9).</u>

The process controls during manufacturing for abrasive work on austenitic stainless steel surfaces are designed to prevent contamination that may result in stress corrosion cracking. These controls are consistent with Regulatory Position C of RG 1.37 (Reference 4.5-6).

- Add subsection 4.5.1 in the line item for RG 1.31 of Table 1.9.1-1 as shown in Attachment-1.

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PRA.

Table 1.9.1-1 US-APWR Conformance with Division 1 Regulatory Guides (sheet 3 of 15)

| Reg Guide Number | Title | Status | Corresponding Chapter/Section /Subsection |
|---|---|---|---|
| 1.29 | Seismic Design Classification (Rev. 4, March 2007) | Conformance with no exceptions identified. | 3.2.1, 5.2.5, 5.2.2.1, 5.4.11.1, 7.1.3.7, 8.1.5.3, 9.1.1, 9.1.2, 9.3.1 |
| 1.30 | Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment (Rev. 0, August 1972) | Conformance with exceptions. Installation is not included in Design Certification phase. | 14.2.7, 17.5 |
| 1.31 | Control of Ferrite Content in Stainless Steel Weld Metal (Rev. 3, April 1978) | Conformance with no exceptions identified. | 4.5.1, 4.5.2, 5.2.3.4.4, 5.3.1.4, 6.1.1 |
| 1.32 | Criteria for Power Systems for Nuclear Power Plants (Rev. 3, March 2004) | Conformance with no exceptions identified. | 8.1.5.3, 16.3 |
| 1.33 | Quality Assurance Program Requirements (Operation) (Rev. 2, February 1978) | Conformance with exceptions. Implementation of RG applies to a site-specific operational program for which COL Applicant will be responsible. | 12.1.3 13.5 |
| 1.34 | Control of Electroslag Weld Properties (Rev. 0, December 1972) | Not applicable. Electroslag welding is not employed in structural welds of low alloy steel. Electroslag welding is only applied for cladding. | 5.2.3.3.2, 5.2.3.4.4, 5.3.1.4 |
| 1.35 | In-Service Inspection (ISI) of Ungrouted Tendons in Prestressed Concrete Containments (Rev. 3, July 1990) | Conformance with no exceptions identified. | 3.8.1.2, 3.8.1.7, 14.2.7 |
| 1.35.1 | Determining Prestressing Forces for Inspection of Prestressed Concrete Containments (Rev. 0, July 1990) | Conformance with no exceptions identified. | 3.8.1.2, 3.8.1.7, 14.27 |
| 1.36 | Nonmetallic Thermal Insulation for Austenitic Stainless Steel (Rev. 0, February 1973) | Conformance with no exceptions identified. | 5.2.3.2, 6.1.1.2 |
| 1.37 | Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants (Rev. 1, March 2007) | Conformance with exception. Programmatic/operational aspect is not applicable to US-APWR design certification. | 3.13.1, 4.5.1, 5.2.3, 5.3.1, 6.1.1, 14.2.7 |
| 1.38 | Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants (Rev. 2, May 1977) | Not applicable. RG applies to a site-specific operational program. | N/A |
| 1.39 | Housekeeping Requirements for Water-Cooled Nuclear Power Plants (Rev. 2, September 1977) | Not applicable. RG applies to a site-specific operational program. | N/A |
| 1.40 | Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants (Rev. 0, March 1973) | Not applicable. US-APWR has no Class 1 continuous-duty motors in the containment. | N/A |

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**QUESTION NO.: 04.05.01-13**

DCD Subsection 4.5.1.1 states "The tempering temperature of martensitic stainless steels and the aging temperature of precipitation-hardened stainless steels are specified for assurance that these materials will not deteriorate from stress corrosion cracking in service. Acceptable heat treatment temperatures include aging at 1050°F for Type 410 stainless steel." The staff is unable to identify any precipitation hardened stainless steel in Table 4.5-1. The staff requests that the applicant identify any precipitation hardened austenitic steels used in CRDMs, and modify Table 4.5-1 accordingly, or delete the reference to precipitation hardened stainless steels if none are used. In addition, the staff believes that the applicant's reference to aging Type 410 stainless steel is incorrect and should be modified to state that Type 410 stainless steel is tempered at 1050°F.

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**ANSWER:**

Because precipitation hardened stainless steels are not used for CRDM components, the description concerning precipitation hardened stainless steels will be deleted from Subsection 4.5.1.1.
Since MHI applies a tempering temperature above 1050°F to martensitic stainless steels the description concerning the tempering temperature for Type 410 stainless steel will be revised.

**Impact on DCD**

DCD Revision 3 will incorporate the following change:

- The 3rd paragraph of Subsection 4.5.1.1 will be changed as follows:

All other materials for use in this system are selected for their compatibility with the reactor coolant water, as described in NB-2160 and NB-3120 of the ASME Code. The tempering temperature of martensitic stainless steels ~~and the aging temperature of precipitation-hardened stainless steels~~ are specified ~~for assurance that these materials will not deteriorate from stress corrosion cracking in service~~ to avoid temper brittleness.

~~Acceptable heat treatment temperatures include aging at 1050°F for Type 410 stainless steel~~ In the case of Type 410 stainless steel; it is tempered above 1050°F.

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PR

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**QUESTION NO.: 04.05.01-14**

In RAI 04.05.01-10, the staff requested that the applicant verify, and state in the DCD, that a stagnant primary coolant environment will not exist in any portion of the CRDM. The applicant responded and stated that the dissolved oxygen level of primary coolant is controlled to less than 0.1%. The applicant also stated that low dissolved oxygen water flows into the CRDM housing by thermal siphoning flow and as a result the environmental condition of the inside surface near the portion of CRDM housing weld is low dissolved oxygen. In order to provide clarity, the staff requests that the applicant modify the DCD to state that a stagnant primary coolant environment does not exist in any portion of the CRDM that could result in a dissolved oxygen content greater than 0.10 ppm.

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**ANSWER:**

The description concerning the environmental condition inside of the CRDM pressure housing will be added to Subsection 4.5.1.

**Impact on DCD**

DCD Revision 3 will incorporate the following change:

- The 1st paragraph of Subsection 4.5.1.1 will be changed as follows:

Austenitic stainless steel, nickel based alloys, and cobalt based alloys are selected for CRDM components that are in contact with the reactor coolant water because of their corrosion resistance. The material specifications are listed in Table 4.5-1. <u>The dissolved oxygen level of primary coolant water is controlled to less than 0.1%. This low dissolved oxygen content water flows into the CRDM housing by thermal siphoning flow and drive rod movement with CRDM stepping and rod drop testing. Thus, the dissolved oxygen level at the inside of CRDM pressure housing is the same as the primary coolant water shortly after startup. In summary, a stagnant primary coolant environment that could result in dissolved oxygen content greater than 0.10 ppm during the plant operation does not exist in any portion of the CRDM.</u>

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PRA.

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**QUESTION NO.: 04.05.01-15**

In response to RAI 04.05.01-8 (1) the applicant stated that it would modify DCD Section 4.5.1.2 to state "Austenitic stainless steel base materials for CRDM applications are the solution heat that is treated to prevent sensitization and stress corrosion cracking (SCC)." In order to provide clarity, the staff suggests that the applicant modify the above statement to state "Austenitic stainless steel base materials for CRDM applications are used in the solution annealed condition and are not heated above 800 °F after solution annealing, other than locally by welding operations, in accordance with the recommendations listed in RG 1.44."

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**ANSWER:**

The description in the 1st paragraph of Subsection 4.5.1.2 will be revised.

**Impact on DCD**

DCD Revision 3 will incorporate the following change:

- The 1st paragraph of Subsection 4.5.1.2 will be changed with response to RAI 04.05.01-8 (1) as follows:

~~Discussions of fabrication and processing of austenitic stainless steel are provided in Subsection 5.2.3. The processes for control of welding described in Subsection 5.2.3 are applicable to the pressure housing of the CRDM.~~ Austenitic stainless steel base materials for CRDM applications are used in the solution annealed condition and are not heated above 800 °F after solution annealing, other than locally by welding operations, in accordance with the recommendations listed in RG 1.44. The welding materials used for joining the austenitic stainless steels meet the requirements of the welding material specification SFA 5.9 in ASME Code Section II. In addition, the above welding materials meet the requirements of ASME Code Section III. For design temperatures up to and including 800 °F, the minimum acceptance delta ferrite is 5FN (Ferrite Number).

**Impact on COLA**

There is no impact on the COLA.

**Impact on PRA**

There is no impact on the PR