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TOKYO, JAPAN

March 24, 2009

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-09123

Subject: MHI's Response to US-APWR DCD RAI No. 224-2067 REVISION 1

Reference: 1) "Request for Additional Information No. 224-2067 Revision 1, SRP Section: 05.02.03 - Reactor Coolant Pressure Boundary Materials, Application Section: DCD Tier 2, Section 5.2.3" dated February 26, 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. 224-2067 Revision 1."

Enclosed is the response to the 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 below.

Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 224-2067 Revision 1

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

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Enclosure 1

UAP-HF-09123
Docket Number 52-021

Response to Request for Additional Information
No. 224-2067 Revision 1

March 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/24/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.CIB1 224-2067 REVISION 1**
SRP SECTION:	**05.02.03 – REACTOR COOLANT PRESSURE BOUNDARY MATERIALS**
APPLICATION SECTION:	**5.2.3**
DATE OF RAI ISSUE:	**2/26/2009**

QUESTION NO. : 05.02.03-1

a. What recommendation(s) can the applicant make to the combined operating license (COL) applicant(s) referencing the US-APWR standard design with respect to maintaining the primary water chemistry control program current with industry standards? Such recommendations should be captured via a COL information item.

b. Clarify which year edition and revision of the EPRI Primary Water Chemistry Guidelines is consistent with the standard and limiting values for RCS chemical parameters in the US-APWR.

Background

To ensure compatibility of reactor coolant pressure boundary materials with the environment in accordance with GDC 4, and to ensure compliance with GDC 14 by minimizing the probability of gross rupture of the RCPB due to corrosion induced failure, SRP Section 5.2.3 indicates that the chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion is reviewed using the guidance of SRP Section 9.3.4. SRP Section 9.3.4 recommends that the reviewer evaluates the proposed chemistry program with respect to that described in the latest version in the Electric Power Research Institute (EPRI) report series, "PWR Primary Water Guidelines."

The US-APWR DCD Section 5.2.3.2.1 stated that the standard and limiting values for RCS chemical additive and impurities are consistent with the EPRI Primary Water Chemistry Guidelines, and referenced the 2003 edition (Rev. 4) of these guidelines. However, the guidelines are periodically updated by EPRI to reflect the latest best practices in water chemistry control. Also, the 2003 edition of the guidelines was actually Revision 5.

ANSWER:

As described in NEI 97-06, MHI will refer Revision 6 of EPRI PWR Primary Water Chemistry Guidelines, the latest version at the time of DCD submittal. And also MHI will recommend to COL applicant in DCD Subsection 5.2.3.2.1 to refer the latest version of EPRI PWR Primary Water Chemistry Guideline as SRP Section 9.3.4 recommended.

Impact on DCD

In Section 5.2.3.2.1 and 5.2.7 of the DCD, reference 5.2-27 will be change as the Answer above.

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

3/24/2009

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RAI NO.:	**NO.CIB1 224-2067 REVISION 1**
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APPLICATION SECTION:	**5.2.3**
DATE OF RAI ISSUE:	**2/26/2009**

QUESTION NO. : 05.02.03-2

How is pH (at operating temperature) determined from Li and B inventories, and how does the plant ensure the pH remains within a range that ensures materials integrity? Explain any algorithms to be used and how they would involve online measurements and additions of either quantity. What is the limiting value for pH which would provoke major corrective action? Are there conditions (e.g. shutdown) in which pH would be permitted to deviate significantly from standard conditions?

Background

To ensure compatibility of reactor coolant pressure boundary materials with the environment in accordance with GDC 4, and to ensure compliance with GDC 14 by minimizing the probability of gross rupture of the RCPB due to corrosion induced failure, SRP Section 5.2.3 indicates that the chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion is reviewed using the guidance of SRP Section 9.3.4. SRP Section 9.3.4 recommends that the reviewer evaluates the proposed chemistry program with respect to that described in the latest version in the Electric Power Research Institute (EPRI) report series, "PWR Primary Water Guidelines."

The DCD (Table 5.2.3-2) states that the standard value for pH at 25°C is between 4.2 and 10.5. However, DCD Section 9.3.4.2.3.2 says pH will be maintained in the range 7.2-7.4, which is inconsistent with Table 5.2.3-2. The EPRI Guidelines4 mention that pH at nominal operating temperature (usually around 300°C) should be above 6.9 and not exceed 7.4, with a target of operating in the range 7.1-7.3 (see Ref. 4, p. 3-4). Table 5.2.3-2 does not give a limiting value for pH and the value in Section 9.3.4.2.3.2 suggests that normal operation might reach the upper limit of EPRI recommendations. However, neither section of the DCD mentions a maximum value which would provoke significant corrective action to ensure materials integrity, as recommended by the EPRI Guidelines.

As stated in the DCD, pH is determined from concentrations of boric acid and LiOH, although no details are given. The staff requests that the applicant clarify the acceptable pH values and how they are determined.

ANSWER:

pH range (7.3 ± 0.1) described in DCD section 9.3.4.2.3.2 is high temperature pH range(at 285°C, 545°F) . This pH range is shown in Figure-5.2.3-1"Lithium Control Band" as follows:

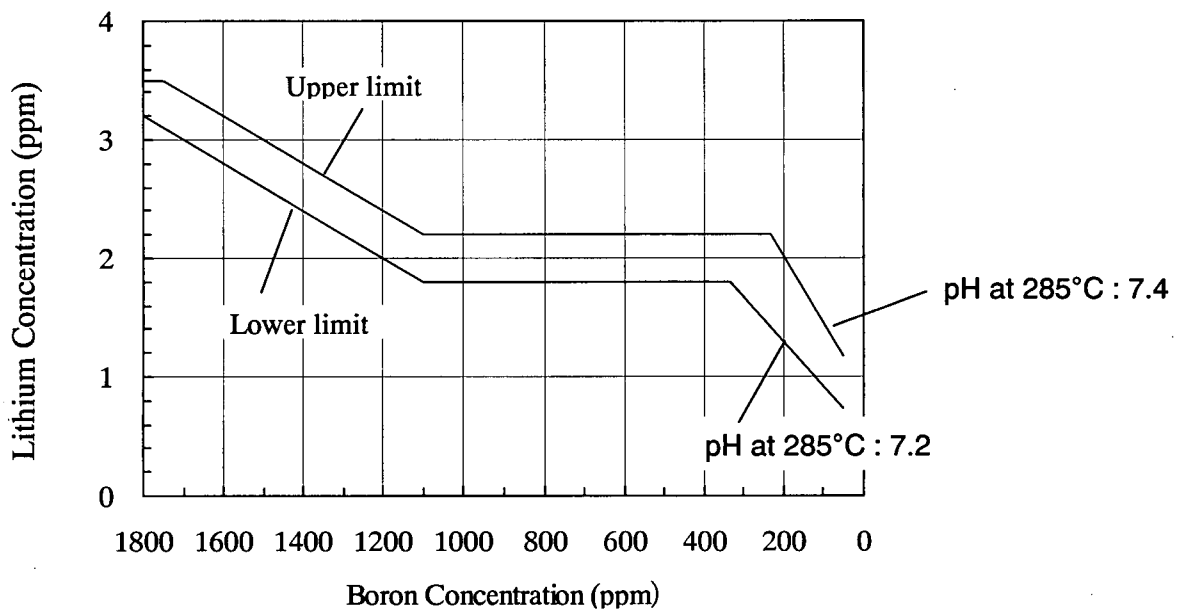

Figure-5.2.3-1 Lithium Control Band

Optimum pH at 285°C is considered as 7.3, and at this value corresponds to pH 7.4 at 300°C.

On the other hand, pH range is described in Table-5.2.3-2. These values are at 25°C, and pH is determined by boric acid and lithium concentration. In this table minimum and maximum values are written.

MHI will revise Figure-5.2.3-1 as above.

Moreover, MHI calculate high temperature pH, based on EPRI Primary Water Chemistry Guideline. And modified pH control shown in DCD is adopted in all Japanese PWRs, and actual result shows that fuel clad corrosion is low. MHI also wants to apply this good result for US-APWR.

Impact on DCD

The DCD Figure-5.2.3-1 will be changed as the above figure.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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APPLICATION SECTION:	**5.2.3**
DATE OF RAI ISSUE:	**2/26/2009**

QUESTION NO. : 05.02.03-3

How is sulfate controlled in the reactor coolant? What limiting values are tolerated and what corrective action would be taken if these limits were violated? What strict limits are placed on Li inventory to ensure materials integrity?

Background

To ensure compatibility of reactor coolant pressure boundary materials with the environment in accordance with GDC 4, and to ensure compliance with GDC 14 by minimizing the probability of gross rupture of the RCPB due to corrosion induced failure, SRP Section 5.2.3 indicates that the chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion is reviewed using the guidance of SRP Section 9.3.4. SRP Section 9.3.4 recommends that the reviewer evaluates the proposed chemistry program with respect to that described in the latest version in the Electric Power Research Institute (EPRI) report series, "PWR Primary Water Guidelines."

EPRI Guidelines specify certain inventories as control parameters, which require strict adherence to limits in order to achieve material protection. Control parameters include the concentrations of SO_4, and Li, but the DCD does not list any limits for these quantities.

ANSWER:

Sulfate acid ion is control parameter (not more than 50ppb) in ERPI Guideline.

"From the viewpoint of preventing stress corrosion cracking in hot water in austenite stainless steel, sulfuric acid ion seems to exert no effect in the reduction atmosphere conditions with hydrogen. However, concentration of sulfuric acid ion is known to increase in time of shutdown possibly caused by the coolant mix bed demineralizer resin being exposed to solution containing hydrogen peroxide. In order to identify the deterioration of ion exchange resin and provide the index of broken fine resin, 0.05 ppm

was set as standard value and 0.15 ppm as limiting value, as the same as chloride ion and fluoride ion."

MHI add these sentences in the DCD.

Also, MHI amend the Table-5.2.3-2 as follows:

	Analysis item	Unit	Standard value	Limiting value	Standard value for recommended analysis
13	Sulfate acid ion	ppm	≦ 0.05	≦ 0.15	-

Impact on DCD

The DCD Section 5.2.3.2.1 will be changed to add the sentence above, and DCD Table-5.2.3-2 will be changed to add the standard value for recommended sulfate acid ion.

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.