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

Oct 21, 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-10284

Subject: MHI's Responses to US-APWR DCD RAI No. 631-5056 Revision 2

Reference: [1] "Request for Additional Information No. 631-4988 Revision 2, SRP Section: 06.02.02 – Containment Heat Removal System - Design Certification and New License Applicants, Application Section: 6.2." dated Sep 13, 2010.

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. 631-5056 Revision 2".

Enclosed are the responses to 2 questions that are contained within Reference [1].

As indicated in the enclosed materials, this submittal contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2), a copy of the non-proprietary version (Enclosure 3), and the Affidavit of Atsushi Kumaki (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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.

D081
NRO

Sincerely,

Y. Ogata

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

Enclosures:

1. Affidavit of Yoshiki Ogata
2. Responses to Request for Additional Information No. 631-5056 Revision 2 (Proprietary Version)
3. Responses to Request for Additional Information No. 631-5056 Revision 2 (Non-Proprietary Version)

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

Contact Information
C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-10284

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshoki Ogata, state as follows:

1. I am General Manager, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Response to Request for Additional Information No. 631-5056, Revision 2", and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages contain proprietary information are identified with the label "Proprietary" on the top of the page, and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique technique of the chemical effect evaluation regarding GS-191 Issue developed based on the US-APWR chemical effects tests implemented by MHI.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

   A. Loss of competitive advantage due to the costs associated with the empirical data obtained under MHI's chemical effects test program.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 21st day of October 2010.

Y. Ogata

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

Enclosure 3

UAP-HF-10284
Docket No. 52-021

Responses to Request for Additional Information
No. 631-5056 Revision 2

October 2010
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 631-5056 REVISION 2**

SRP SECTION: **06.02.02 – Containment Heat Removal System**

APPLICATION SECTION: **6.2.2**

DATE OF RAI ISSUE: **09/13/2010**

QUESTION NO.: 06.02.02-56

At the head loss testing performed in June 8-9 the staff was informed that the test assumes no chemical debris is present when the sump fluid is above 140°F. Please provide the technical justification for assuming no chemical debris will exist above a containment sump fluid temperature of 140°F. According to Section 3.9 of MHI document 4CS-UAP-20080045, Rev. 4 ("Technical Information and Requirements for ECC/CS Sump Strainer"), the allowable head loss for the strainer system does not consider chemical debris when the temperature of the sump fluid temperature is above 140°F. It is not clear to the staff that this temperature value is based on plant-specific conditions in accordance with the staff's guidance for crediting solubility in chemical effects evaluations (e.g., ML080910298, Section 9.d.iii, p 16)

ANSWER:

The transition temperature at which chemical debris begins to precipitate and contribute to strainer head losses will depend on the post-LOCA chemical constituents, concentrations, solubility limits, and cooling water pH. Chemical effects tests for various representative plant chemistry conditions were performed by Los Alamos National Laboratories (see References 1 and 2). The US-APWR is a low fiber plant that uses sodium tetraborate as a buffer and is best represented by the NUREG/CR-6914 Integrated Chemical Effects Test (ICET) #5. This is discussed in the US-APWR plant-specific chemical effects test plan (Reference 3), along with the expected US-APWR chemistry conditions. The results of the US-APWR plant-specific chemical effects testing are presented in Reference 4.

References

8. U.S. Nuclear Regulatory Commission NUREG / CR-6914 Volume 1, "Integrated Chemical Effects Test Project: Consolidated Data Report," Dec. 2006 (ML062560105).
9. U.S. Nuclear Regulatory Commission NUREG / CR-6914 Volume 6, " Integrated Chemical Effects Test Project : Test #5 Data Report, " pg 29, Dec. 2006.
10. Mitsubishi Heavy Industries Ltd., US-APWR Sump Debris Chemical Effects Test Plan, MUAP-08006, Revision 1, November 2008. (ML083390119)
11. Mitsubishi Heavy Industries Ltd., US-APWR Sump Debris Chemical Effects Test Result, MUAP-08011-P, Revision 0, pg 54, Dec. 2008. (ML083390118)
12. Argonne National Laboratory, "Aluminum Solubility in Boron Containing Solutions as a Function of pH and Temperature", Sep. 2008. (ML091610696)
13. Thermochemical Data of Pure Substances, Third Edition, Ihsan Barin, VCH, 1989.
14. U.S. Nuclear Regulatory Commission NUREG / CR-6915, "Aluminum Chemistry in a Prototypical Post-Loss-of-Coolant-Accident, Pressurized Water Reactor Containment Environment", pg 55, Figure 41

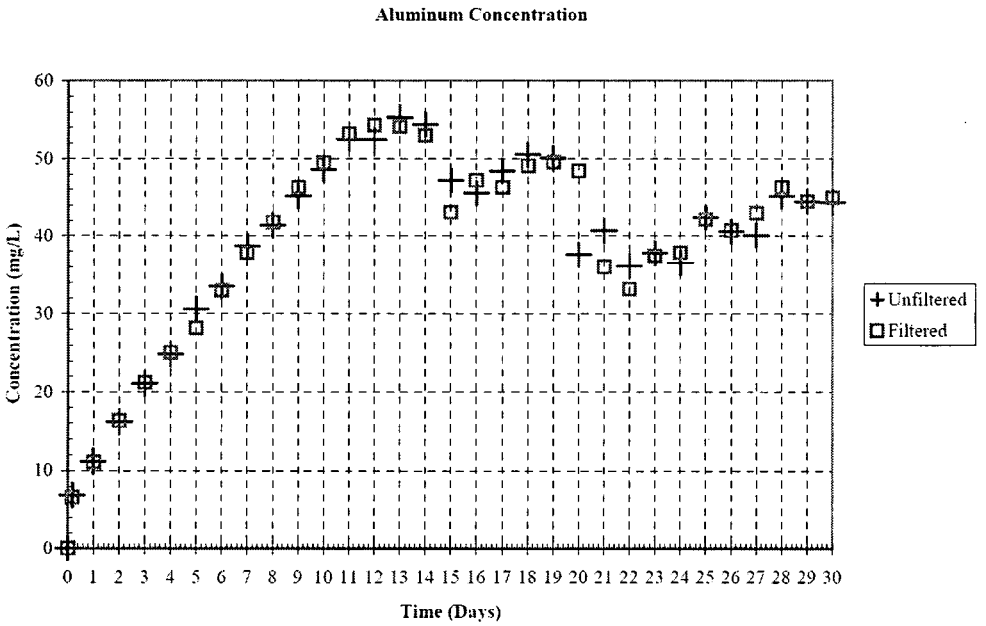

Figure 1. Aluminum concentration at pH=8.5 and 140ºF in ICET #5 (Reference 2)

Impact on DCD

There is no impact on the DCD.

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

10/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 631-5056 REVISION 2**

SRP SECTION: **06.02.02 – Containment Heat Removal System**

APPLICATION SECTION: **6.2.2**

DATE OF RAI ISSUE: **09/13/2010**

QUESTION NO.: 06.02.02-57

Please clarify how the amount of chemical debris used during the head loss testing (Jun 8-9 2010), incorporated the amount expected to be lost during water level management. Attachment 4 to the test plan indicates the percentage of the debris that would be lost in water management, but it was not apparent how that percentage was used to calculate a debris mass that was included in the amount of chemical debris prepared.

ANSWER:

The amount of debris lost during water management was not explicitly used to calculate the total debris mass prepared. Instead, it was shown that the amount lost would be within the margin introduced from other conservatisms in calculating the total mass to be prepared.

Based on the US-APWR debris allocation sheets (TDI-6032-02) contained in the US-APWR Test Plan audited by the NRC, the US-APWR strainer has a total strainer surface area of 2,754.067 ft^2. There are nine (9) strainer modules of the same design and size, with each having 306.0074 ft^2. Implementing the scaling factor based simply on one (1) strainer module divided by the total of nine (9) US-APWR strainer modules will result in a scaling value of 11.11%.

However, for conservatism, a theoretical manufacturing tolerance is applied to various US-APWR strainer module components in support of the ITAAC minimum strainer surface area. The US-APWR test strainer has a theoretical surface area of 303.414 ft^2 including the reduction for the manufacturing tolerances. Dividing the theoretical test strainer surface area including tolerances (i.e., 303.414 ft^2) by the theoretical total strainer surface area (i.e., 2,754.067 ft^2) will result in a scaling value of 11.02%.

Since there is the potential for unknown debris quantities within the US-APWR containment, a further margin is applied. A theoretical 200 ft^2 sacrificial area to address any unknown or unforeseeable issues is subtracted from the total nominal strainer surface area (i.e., 2,754.067 ft^2), resulting in a final total nominal US-APWR strainer area of 2,554.067 ft^2. Implementing the scaling factor based on the final nominal US-APWR test strainer (i.e., 303.414 ft^2) including the sacrificial area reduction (i.e., 2,754.067 ft^2) will result in a scaling value of 11.88%.

The conservative scaling factor of 11.88% was utilized for the US-APWR test program since the

greater the scaling factor, the more conservative the respective test parameters of debris quantities and strainer flow rate. The US-APWR strainer was tested with more debris (i.e., 11.88%) at a higher flow rate (i.e., 11.88%), then the actual scaling factor of 11.11% assuming nine (9) modules divided by one (1) module, or the scaling factor of 11.02% assuming a minimum ITAAC strainer surface area and a test strainer based on the inclusion of manufacturing tolerances (303.414 ft^2).

The total revised US-APWR Design Basis (i.e., scaled at 70%) chemical precipitate debris for the US-APWR is 213.50 lbs (i.e., 112.0 lbs sodium aluminum silicate and 101.5 lbs aluminum oxyhydroxide [AlOOH]). Based on the debris allocation sheets for the US-APWR head loss test program, there was a total of 25.41 lbs of chemical precipitate debris as AlOOH based on upward rounding of values. If the actual scaling factor of 11.88% was utilized, a minimum of 25.36 lbs of chemical precipitate was required. These values are documented in Attachments 2 and 3 of the debris allocation sheets.

The chemical precipitate debris lost to the combination of the overflow and water management process was estimated in the test plan. The estimated loss of chemical precipitate is 0.53% over the course of the entire US-APWR test program.

Based on the most conservative scaling factor (i.e. 11.88%), 0.53% of the total minimum chemical precipitate debris quantity (i.e., 25.36 lbs) is 0.1344 lbs. In reality, the actual chemical debris quantity generated is 23.5277 lbs or 23.7199 lbs based on theoretical US-APWR strainer module scaling factors of 11.02% or 11.11%, respectively. This results in a chemical precipitate debris quantity difference of 1.8323 lbs (i.e., 25.36 – 23.5277) or 1.6401 lbs (i.e., 25.36 – 23.7199, respectively.

It can be concluded that a loss of 0.53% or 0.1344 lbs of chemical precipitate debris based on the most conservative chemical precipitate debris quantity of 25.36 lbs, is bounding (i.e., 1.8323 = 0.1344, or 1.6401 = 0.1344) for the actual US-APWR strainer module scaling factor of 11.11%, or including manufacturing tolerances of 11.02%.

Impact on DCD

There is no impact on the DCD

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA.