


MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

May 16, 2011

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-11138

Subject: 2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0 (SRP 15.06.05)

Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") the document entitled "2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0". The enclosed materials provide MHI's response to Question 15.06.05-91 of the NRC's "Request for Additional Information (RAI) 719-5352 Revision 0," dated March 17, 2011.

As indicated in the enclosed materials, this document 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 in this package (Enclosure 3). In the non-proprietary version, the proprietary information, bracketed in the proprietary version, is replaced by the designation "[]".

This letter includes a copy of the proprietary version of the RAI response (Enclosure 2), a copy of the non-proprietary version of the RAI response (Enclosure 3), and the Affidavit of Yoshiaki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all material designated as "Proprietary" in Enclosure 2 be withheld from 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 this submittal. His contact information is provided below.

Sincerely,



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

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MRO

Enclosures:

1. Affidavit of Yoshiki Ogata
2. 2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0 (proprietary)
3. 2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0 (non-proprietary)

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

Contact Information

C. Keith Paulson, Senior Technical Manager
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ENCLOSURE 1

Docket No. 52-021
MHI Ref: UAP-HF-11138

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, being duly sworn according to law, depose and 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 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 "2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0," and have determined that the document contains proprietary information that should be withheld from public disclosure. Those pages containing 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 basis for holding the referenced information confidential is that it describes the unique design of the safety analysis, developed by MHI (the "MHI Information").
4. The MHI Information is not used in the exact form by any of MHI's competitors. This information was developed at significant cost to MHI, since it required the performance of research and development and detailed design for its software and hardware extending over several years. Therefore public disclosure of the materials would adversely affect MHI's competitive position.
5. The referenced information has in the past been, and will continue to be, held in confidence by MHI and is always subject to suitable measures to protect it from unauthorized use or disclosure.
6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information.
7. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of supporting the NRC staff's review of MHI's application for certification of its US-APWR Standard Plant Design.
8. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without the costs or risks associated with the design and testing of new systems and components. Disclosure of the information identified as proprietary would therefore have negative impacts on the competitive position of MHI in the U.S. nuclear plant market.

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 16th day of May, 2011.

A handwritten signature in black ink, appearing to read "Y. Ogata". The signature is written in a cursive style with a large initial "Y" and a distinct "Ogata" following.

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

ENCLOSURE 3

UAP-HF-11138
Docket No. 52-021

2nd MHI's Response to US-APWR DCD RAI No. 719-5352 Revision 0

May 2011

(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

5/16/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 719-5352 REVISION 0

SRP SECTION: 15.06.05 – LOSS OF COOLANT ACCIDENTS RESULTING FROM SPECTRUM OF POSTULATED PIPING BREAKS WITHIN THE REACTOR COOLANT PRESSURE BOUNDARY

APPLICATION SECTION: 15.6.5

DATE OF RAI ISSUE: 3/17/2011

QUESTION NO.: 15.06.05-91

According to a core recriticality evaluation for small break LOCAs, as described in the response to RAI Question 15.6.5-56 provided in UAP-HF-09384 "MHI's Response to US-APWR DCD RAI No. 352-2369 Revision 1" (July 2009), the minimum core entry boron concentration during the process of dilute slug propagation towards the core is used to determine if the reactor will remain subcritical. It is stated in this response that the minimum core entry boron concentration provides a safety margin of 307 ppm when compared to the minimum core boron concentration required to maintain the reactor subcritical under certain assumed core conditions. In addition, it is explained that Assumption Number 5 in the above referenced RAI response is considered when determining the minimum core entry boron concentration.

Provide a detailed description of the analytical mixing model used to calculate the minimum core entry boron concentration during the dilute slug propagation process. As appropriate, include the modeling equations as well as any computer programs used to perform the calculations. List all assumptions used to develop the model and to perform the calculations. In particular, describe the initial conditions and provide the input values for the model calculations. Discuss the conservatisms of the obtained results and substantiate the appropriateness of the applied approach.

ANSWER:

In the core recriticality evaluation in MHI's response to RAI 15.6.5-56 (Ref. 1), a simplified assumption for the borated and deborated water mixing in the reactor vessel and downcomer was used in determining the boron concentration of the coolant entering the core when a rapid deborated water transient occurs.

The assumption is based on the statement in Reference 2 that "*The RES mixing model incorporates realistic, yet conservative, quantification of the mixing of the deborated water slug with the borated system coolant as the slug flows through the cold leg, downcomer, and lower plenum and into the core. The mixing model combines the elements of two mixing extremes, namely plug flow (no mixing) and back-mixed flow (ideally mixed). The cold leg loop seal, cold leg,*

and downcomer are treated as pipe components with plug flow while the steam generator outlet plenum, the RCP, and the reactor vessel lower plenum are modeled as a back-mixed volumes." Although the mixing model was proposed for operational PWRs in United States, the model is applicable to the US-APWR since the dimensional scaling ratio in terms of the downcomer and lower plenum is proportional to the flow rate ratio between the US-APWR and PWR as shown in **Table RAI-15.06.05-91.1**. This indicates the Reynolds number, a representative scaling parameter for turbulence behavior, is mutually similar between the US-APWR and PWR. Dimensional parameters for a four-loop PWR in Table RAI-15.06.05-91.1 are extracted from Reference 3.

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Mixing fraction effects on core recriticality were examined and the sensitivity results are summarized in **Table RAI-15.06.05-91.2**. [

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The sensitivities with respect to the volume of the deborated water flowing to the reactor vessel are summarized in **Table RAI-15.06.05-91.3**. [

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In conclusion, [

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References:

1. Mitsubishi Heavy Industries, Ltd., MHI's Response to US-APWR DCD RAI No. 352-2369 Revision 1, UAP-HF-09384, July 2009.
2. USNRC, Letter from M. V. Bonaca to N. J. Diaz, Proposed Resolution of Generic Safety Issue 185 "Control of Recriticality Following Small-Break LOCAs in PWRs", ACRSR-2099, October

22, 2004.

3. ROSA-IV Large Scale Test Facility (LSTF) System Description, JAERI-M 84-237, January 1985.

4. [

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5. [

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6. [

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7. [

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Impact on DCD

There is no impact on the DCD.

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.

This completes MHI's response to the NRC's QUESTION NO. 15.06.05-91.

Table RAI-15.06.05-91.1 Downcomer and Lower Plenum Characteristics of US-APWR

Table RAI-15.06.05-91.2 Sensitivity Results for Mixing Fraction

Table RAI-15.06.05-91.3 Sensitivity Results for Deborated Water Volume