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

March 13, 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-09093

Subject: **MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY"**

Reference: 1) Letter from the NRC (ML090300061) to Y. Ogata (MHI), " MITSUBISHI HEAVY INDUSTRIES, INC. - REQUEST FOR ADDITIONAL INFORMATION ON TOPICAL REPORT MUAP-07009-P, REVISION 0, " THERMAL DESIGN METHODOLOGY "" dated on February 13, 2009

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY"".

Enclosed are the responses to 2 RAIs contained within Reference 1.

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 (Enclosure 2), a copy of non-proprietary version (Enclosure 3), and the Affidavit of Yoshiki Ogata (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 this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

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

D081
NRO

Enclosures:

1. Affidavit of Yoshiki Ogata

2. MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY" (proprietary)

3. MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY" (non-proprietary)

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-09093

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki 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 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 "MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY"" and have determined that portions of the report contain 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 technical report indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a).

3. The information in the report identified as proprietary by MHI 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 design of the Thermal Design, developed by MHI and not used in the exact form by any 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.

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 the costs or risks associated with the design of new fuel systems and components. Disclosure of the information identified as proprietary would therefore 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 development of the Thermal Design. Providing public access to such information permits competitors to duplicate or mimic the methodology without incurring the associated costs.

B. Loss of competitive advantage of the US-APWR created by benefits of enhanced plant safety, and reduced operation and maintenance costs associated with the Thermal Design.

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 13rd day of March, 2009.

Y. Ogata

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

Docket No. 52-021
MHI Ref: UAP-HF-09093

Enclosure 3

UAP-HF-09093, Rev.0

MHI's Response to the NRC's Request for Additional Information on Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY"

March 2009
(Non Proprietary)

MHI's Response to the NRC's Request for Additional Information on

Topical Report MUAP-07009-P, Revision 0, "THERMAL DESIGN METHODOLOGY"

Non-Proprietary Version

1. *Provide a description or a reference of the fuel which MHI intends to use in the US-APWR, which includes the number of grid spacers and the distance between grid spacers.*

Response:

The US-APWR fuel design is comparable with that of US typical 4-loop plants as shown in Table 1-1. The US-APWR fuel has 11 grid spacers for 14-ft heated length fuel assembly. This design renders grid spacing of [ ], which is consistent with the MHI DNB test bundles. The topical report MUAP-07009 covers the MHI designed Z2 and Z3 grids, while the Z3 grid is currently planned for the US-APWR fuel.

Table 1-1 Comparison of Fuel Design Specifications

2. *MHI needs to demonstrate that the US-APWR fuel can be conservatively predicted by the WRB-1 and WRB-2 correlations. In the past, this has been accomplished through test data specific to the fuel design in question. In response to RAI DNB-1, and subsequent MHI presentation to the ACRS on October 23 – 24, 2008, MHI indicated that the fuel used in the US-APWR would differ from fuel used in the WRB-1 and WRB-2 data bases, as well as differ from the fuel and data presented in Appendix C of the US-APWR Thermal Design Methodology (MUAP-07009-P). Compared with the fuel used in generating the WRB-1 and WRB-2 correlations, the US-APWR fuel will have different grid designs (Z2 and Z3). Compared with the fuel in Appendix C, the US-APWR fuel will have a 14 foot heated length instead of a 12 foot heated length, will have additional grid spacers, and may have a different grid spacing (it is not clear what the grid spacing of the US-APWR fuel will be). To demonstrate that US-APWR fuel can be conservatively predicted by the WRB-1 and WRB-2 correlations, MHI must provide one of the following:*

   A. *MHI will need to provide the NRC with data confirming the WRB-1 and WRB-2 correlations ability to conservatively predict CHF for the US-APWR fuel. This data must be from a test assembly which matches all of the relevant parameters which effect the CHF performance of the US-APWR fuel (such as hydraulic diameter, grid type, grid spacing, heat length, etc ...).*

   B. *MHI will need to provide the NRC with a substantial technical justification as to the similarities between the US-APWR fuel and the fuel for which MHI does have data. This justification would need to contain arguments specifically related to the thermal hydraulic phenomena occurring in a fuel bundle, as well as some demonstrate that those phenomena are understood sufficiently as to allow MHI to predicted with a high degree of certainty the behavior of an untested fuel design.*

   C. *Finally, MHI must provide test data to validate the applicability of the WRB-1 and the WRB-2 correlations specific to fuel design intended for use in the US-APWR.*

Response:

WRB-1 and WRB-2 were originally developed based on test data with conventional grids. While Z2 and Z3 grids have certain improvements for the mechanical integrity, the structural features and mixing mechanism (i.e., egg crate type structure with springs and dimples, and mixing vanes) are stayed the same. Therefore, Z2 and Z3 grid designs provide similar DNB characteristics to those of the conventional grid designs.

Applicability of the WRB-1/-2 correlations to Z2 and Z3 grids is presented in Figure 2-1 through 2-4. Statistical parameters in the figures show conservatism of the MHI designed grids. However, MHI decided not to take credit for the conservatism. The same DNBR limits for the conventional grids are applied to the US-APWR design.

The above results for the Z2 and Z3 grids were obtained from the MHI generated

DNB tests at Columbia University. These tests were conducted with rod bundles having 9 grid spacers for the 12-ft heated length. It renders grid spacing of [ ].

Since the US-APWR fuel has 11 grid spacers for the 14-ft heated length fuel assembly, its grid spacing is [ ]. [ ]. Since the effect of the grid location on DNB heat flux can be characterized by the grid spacing, the MHI DNB test results are representative for the US-APWR fuel design.

The designed heated length of DNB test bundle for Z2 and Z3 grids is 12-ft, but it fully reflects the heating effects of 14-ft US-APWR fuel design. The reasons are shown in the following.

DNB is a highly localized phenomenon, where the vapor blanket starts to form and cover the heated spot on the surface under the extremely high heat flux condition. The condition for the onset of DNB is dominated by the local coolant conditions.

Heated length effect on DNB heat flux has been empirically studied, and it is observed that the DNB heat flux is not significantly affected by the heated length for the fully developed flow. Stevens et al. showed this in their technical paper as presented in Figure 2-5 (Reference 2-1). This figure shows that the DNB heat flux does not depend on the heated length greater than 20 inches. In addition, Groeneveld et al. summarized the CHF look-up table (LUT) based on a database consisting of more than 30,000 points of worldwide DNB test data (Reference 2-2). The LUT table is able to provide CHF values based on pressure, mass flux, steam quality, and tube diameter. Heated length is not a function. The LUT table is applicable for the heated length greater than 100 times of the channel diameter.

[

].

[

].

Thus, the heated length of the test section is not a parameter of concern for the DNB testing. Therefore, the applicability of WRB-1 and WRB-2 correlations to the Z2 and Z3 grids are valid for the 14-ft US-APWR fuel design as they are for the existing 12-ft fuel bundle designs.

Based on the discussions above, MHI believes that WRB-1 and WRB-2 correlations are applicable for US-APWR fuel design. [

].

Reference

2-1. Stevens, G. F., Elliot, D. F., Wood, R. W., "An Experimental Investigation into Forced Convection Burn-out in Freon 12, with Reference to Burn-out in Water - Uniformly Heated Round Tubes with Vertical Up-flow," AEEW-R321 (1964)

2-2 Groeneveld, D.C., et al., "The 2006 CHF Look-up Table," Nuclear Engineering and Design, 237, pp 1909-1922 (2007)

Figure 2-1 Comparison of measured and predicted DNB heat flux between WRB-1 correlation database and Z2 test data

Figure 2-2 Comparison of measured and predicted DNB heat flux between WRB-1 correlation database and Z3 test data

Figure 2-3 Comparison of measured and predicted DNB heat flux between WRB-2 correlation database and Z2 test data

Figure 2-4 Comparison of measured and predicted DNB heat flux between WRB-2 correlation database and Z3 test data

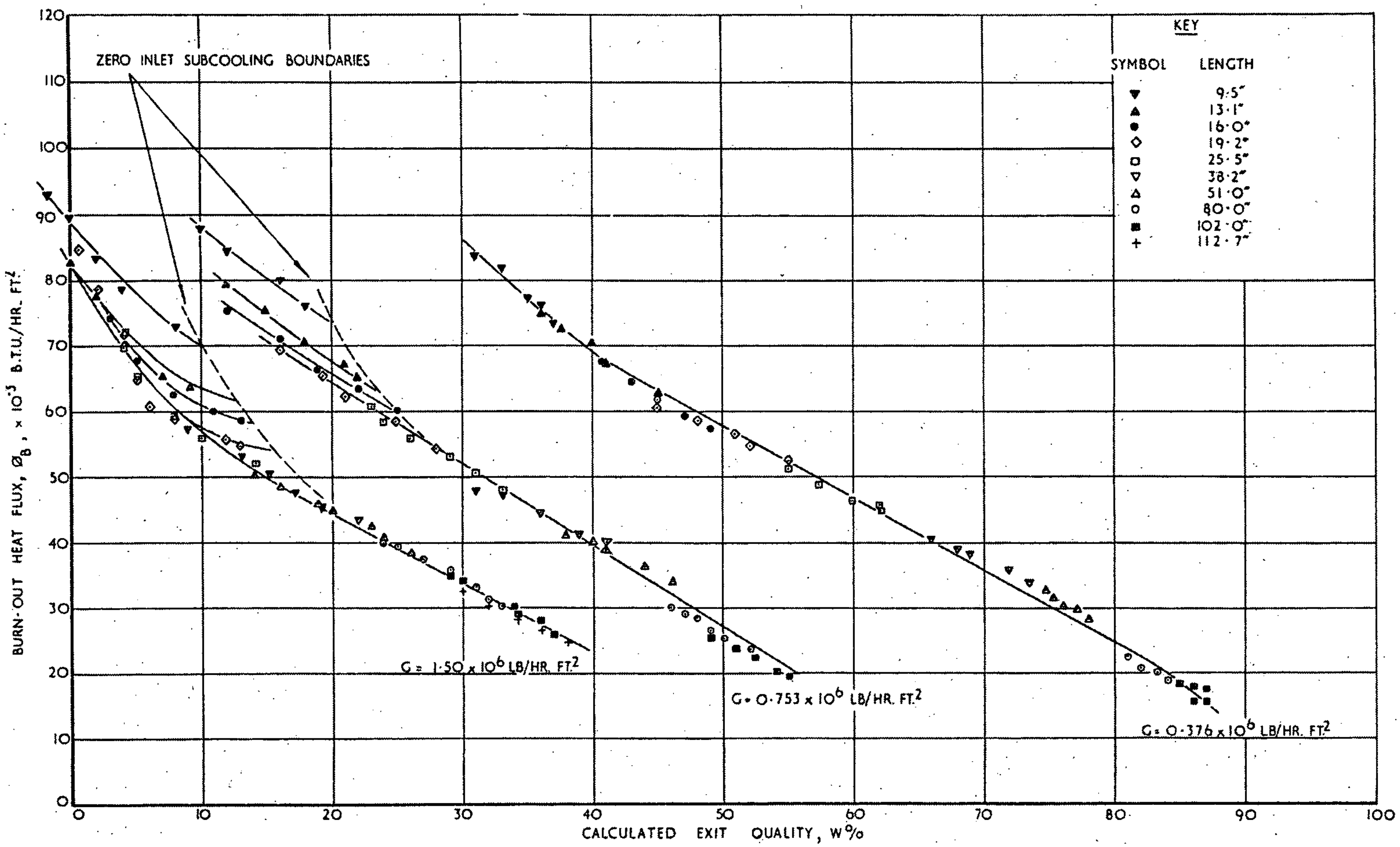

Figure 2-5 Heated length effect on DNB heat flux (Reference 2-1)

Freon 12, Tube diameter=0.334", Inlet Pressure=155psia

Figure 2-6 Comparisons of the DNB heat fluxes [ ]

[

]

Figure 2-7 Comparisons of the DNB heat fluxes [

]

Figure 2-8 Comparisons of the DNB heat fluxes [

]

Figure 2-9 WRB-1 prediction [ ]

Figure 2-10 WRB-2 prediction [ ]