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

September 27, 2012

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-12266

Subject: **MHI's Response to US-APWR DCD RAI No.953-6437 (SRP 04.02)**

Reference: 1) "REQUEST FOR ADDITIONAL INFORMATION 953-6437" dated on August 10, 2012

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents entitled "Response to US-APWR DCD RAI No.953-6437".

In the enclosed documents, MHI provides a response to Questions 04.02-64 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. The proprietary information is bracketed 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 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 Mr. Joseph Tapia, General Manager of Licensing Department, 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,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

DO 81
NRR

Enclosures:

1. Affidavit of Yoshiki Ogata

2. Response to US-APWR DCD RAI No. 953-6437 (Proprietary)

3. Response to US-APWR DCD RAI No. 953-6437 (Non-Proprietary)

CC: J. A. Ciocco
J. Tapia

Contact Information
Joseph Tapia, General Manager of Licensing Department
Mitsubishi Nuclear Energy Systems, Inc.
1001 19th Street North, Suite 710
Arlington, VA 22209
E-mail: joseph_tapia@mnes-us.com
Telephone: (703) 908 – 8055

ENCLOSURE 1

Docket No.52-021
MHI Ref: UAP-HF-12266

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, being duly sworn according to law, depose and state as follows:

1. I am Director, 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 "Response to US-APWR DCD RAI No.953-6437" 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 methodologies developed by MHI for the fuel of the US-APWR. These were developed at significant cost to MHI, since they required the performance of detailed calculations, analyses, and testing extending over several years. The referenced information is not available in public sources and could not be gathered readily from other publicly available information.

5. 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.

6. 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 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 27th day of September, 2012.

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

Docket No. 52-021
MHI Ref: UAP-HF-12266

Enclosure 3

UAP-HF-12266
Docket No. 52-021

Response to US-APWR DCD RAI No. 953-6437 (SRP 04.02)

September 2012
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION 953-6437

9/27/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 953-6437**
SRP SECTION:	**04.02 - Fuel System Design**
APPLICATION SECTION:	**04.02**
DATE OF RAI ISSUE:	**8/10/2012**

QUESTION NO. : 04.02-64

In Section 5.0 of Technical Report MUAP-11017-P, it is concluded that the flow induced vibration results were acceptable. Provide the basis for this conclusion, including the acceptance criteria and source reference.

ANSWER:

Acceptable amplitudes of flow induced fuel rod vibration need to be discussed in conjunction with the resultant fretting wear of the fuel cladding. The amount of fretting wear is a function of wear rate and length of time. The wear rate is dependent on the rod vibration amplitude and rod supporting configuration and geometry. The length of time that the fuel is subject to fretting wear is simply the length of time the fuel resides in reactor core of plant operation. MHI does not set a quantitative criterion for the rod vibration amplitude since the vibration amplitude is only one of the factors in determining amount of fretting wear, which less than 10% of fuel cladding thickness is acceptable. MHI has conducted a semi-empirical/analytical calculation to predict the vibration amplitude and fretting wear depth, as described in MUAP-07016 (Reference 1). This analytical calculation takes into account the full spectrum of characteristics that effect fretting wear over the life of the fuel, including the fuel rod vibration amplitude. The calculation for the amplitude and fretting wear depth is validated by hydraulic tests, as described in MUAP-11017 (Reference 2). As shown in Figure 3.4-1 of MUAP-11017, the measured vibration amplitude conservatively agreed with the calculated values, and therefore it was concluded that the evaluation of flow induced vibration amplitude of US-APWR fuel assembly was acceptable. In addition, the calculation results in MUAP-07016 and the extrapolation of the 1000 hours hydraulic test results presented in response to RAI929-6380, Question 04.02-55(UAP-HF-12156) show less than 10% fretting wear of the fuel cladding thickness and are therefore acceptable.

The NRC has expressed concern about the effect of flow induced fuel rod vibration on the fatigue failure of the grid spacer spring. Because fatigue failure is a function of both alternating stress level and number of cycles, these parameters need to be addressed. The Zr-4 grid spacer spring will significantly relax from BOL and its' spring force is reduced considerably from its' manufactured force. In addition to this rapid grid spring irradiation relaxation, grid spacer cell size growth and fuel cladding creepdown reduce the grid spring

static stresses during the assembly's first cycle of operation. As shown in Figure 3.4-1 of MUAP-11017, the amplitude at mid-span between grid spacers, even for extreme conditions, such as the gapped cells, ranges from [ ] microns. Taking into account the fuel rod mode shapes, the amplitude at the grid spacer spring is only [ ] microns. According to MHI's spring fatigue test results, the amplitude required for fatigue failure of the grid spacer spring is approximately [ ] microns, which is approximately [ ] orders of magnitude greater than the vibration amplitude of the grid spacer spring during plant operation. Given this comparison of the amplitudes, it is judged that there is no possibility of grid spring failure due to fatigue.

References

1. Mitsubishi Heavy Industries, "US-APWR Fuel System Design Evaluation", MUAP-07016-P, Revision 2, December 2009.

2. Mitsubishi Heavy Industries, "Hydraulic Test of the Full Scale US-APWR Fuel Assembly", MUAP-11017-P, Revision 0, May 2011.

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.

Impact on Technical/Topical Report

There is no impact on the Technical/Topical Report.

This completes MHI's response to the NRC's question.