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

March 24, 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-11076

Subject: MHI's Response to US-APWR DCD RAI No. 716-5527 Revision 2 (SRP 06.03)

Reference: 1) "Request for Additional Information No. 716-5527 Revision 2, SRP Section 06.03 – Emergency Core Cooling System - Application Section: 6.3 dated March 16, 2011.

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. 716-5527 Revision 2."

Enclosed are the responses to Question 06.03-98 through 06.03-99 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 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 the submittals. His contact information is below.

Sincerely,

Y. Ogata

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

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NRO

Enclosure:

1. Affidavit of Yoshiki Ogata

2. Response to Request for Additional Information No. 716-5527, Revision 2 (Proprietary)

3. Response to Request for Additional Information No. 716-5527, Revision 2 (Non-proprietary)

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

Contact Information
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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-11076

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 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 "Responses to Request for Additional Information No. 716-5527, Revision 2," and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. All pages contain proprietary information as 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 documents 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 test facilities design of the core inlet blockage test, testing results related to the US-APWR specific 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 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 development of the unique design parameters.

   B. Loss of competitive advantage of the US-APWR created by the benefits of the steel concrete module 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 24th day of March, 2011.

Y. Ogata

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

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Enclosure 3

UAP-HF-11076
Docket No. 52-021

Response to Request for Additional Information No. 716-5527
Revision 2

March 2011
(Non-proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2011

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	**NO. 716-5527 REVISION 2**
SRP SECTION:	**06.03 – Emergency Core Cooling System**
APPLICATION SECTION:	**6.3**
DATE OF RAI ISSUE:	**3/16/2011**

QUESTION NO.: 06.03-98

Per teleconferences in December and January, MHI indicated that the test rig used for housing the mock fuel assembly during the GSI-191 in-vessel downstream effects testing included a gap between the assembly and test wall equal to the full gap between two adjacent assemblies in the core. This would in effect increase the bypass area available around the assembly and therefore the test results do not support a safety justification.

Provide additional justification to demonstrate that the limits associated with GSI-191 in-vessel downstream effects are not violated.

ANSWER:

In the test, the gap size is defined as the distance between the outer surface of the grid strap and interior wall surface of the flow shroud. In the MHI core inlet blockage test, gap size is selected to be equivalent to the distance between the outer surfaces of the grid straps of two adjacent fuel assemblies in the US-APWR core, which is called "full gap." This "full gap" only exists in the core. Therefore, MHI regards that the "full gap" test configuration is an appropriate representation of the actual core in post LOCA flow conditions and adequately addresses debris capture behavior geometrically. In the MHI test, one fuel assembly with a surrounded "full gap" is simulated as a representative configuration of the core.

In the actual core, fuel assemblies are precisely positioned with positioning pins in upper and lower core plates. Assuming all fuel assemblies are straight without bowing (bending), the nominal distance between fuel assemblies is the "full gap." Therefore, the full gap represents an existing flow path in the core. In the core of an operating plant, fuel assemblies may experience slight bowing. When we consider the situation of bowing, there is a possibility of "half gap" and/or "over full gap" distances existing between fuel assemblies. If we assume ideal conditions, i.e. all fuel assemblies stand straight; there is no "half gap" or "over full gap" in the core.

In the core inlet blockage test, [

] In the actual core, this space is considered to be the space between two grid straps of adjacent fuel assemblies. The amount of debris captured in this space can be appropriately represented with the "full gap" rather than the "half gap."

Simulating a single assembly in the core being surrounded by "half gap" could be done if one fuel assembly is considered as one node in the analytical modeling of a core. In this type of modeling, the boundary condition should be "free-slip." However, in our testing configuration, if the flow shroud wall would be at this "half gap" position, it would create a "no-slip" boundary condition.

Figures 1-1, 2-1 and 3-1 show debris accumulation on the grid spacers after the tests for hot leg break test (HL1), cold leg break test (CL2) and hot leg switch over test (HLSO), respectively. These photos were taken from Technical Report MUAP-10021-R0-P. Figures 1-2, 2-2 and 3-2 are photos taken before the pump turn-off corresponding to Figures 1-1, 2-1 and 3-1, respectively. These pictures show [

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MHI understands that a narrower gap, such as "half gap" would produce more conservative test results. However, such conservatism is not necessary because of following two reasons.

1) The full gap adequately represents an actual core as explained above.
2) The test results suggest that conservatism by utilizing half gap would not be significant.

Figure1-1 Photographs of the mock-up assembly after HL1

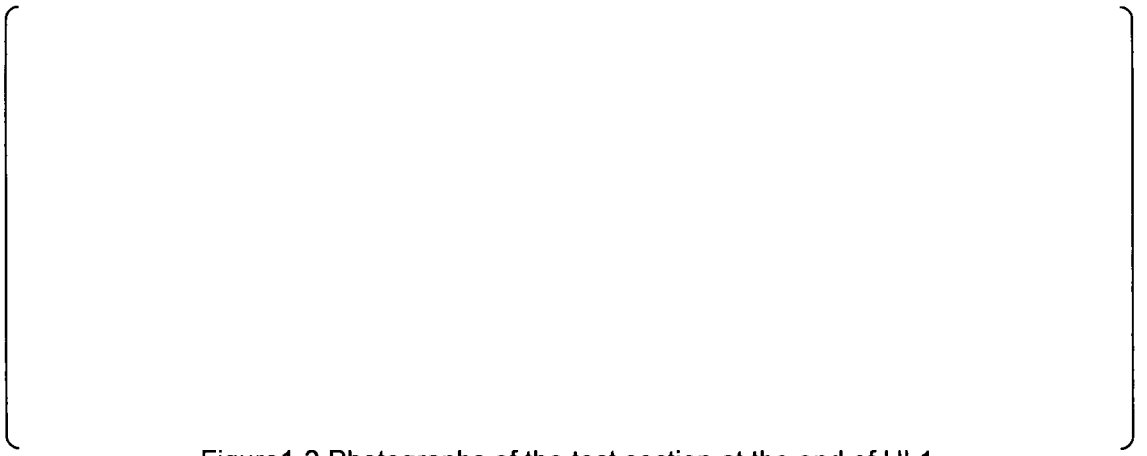

Figure1-2 Photographs of the test section at the end of HL1

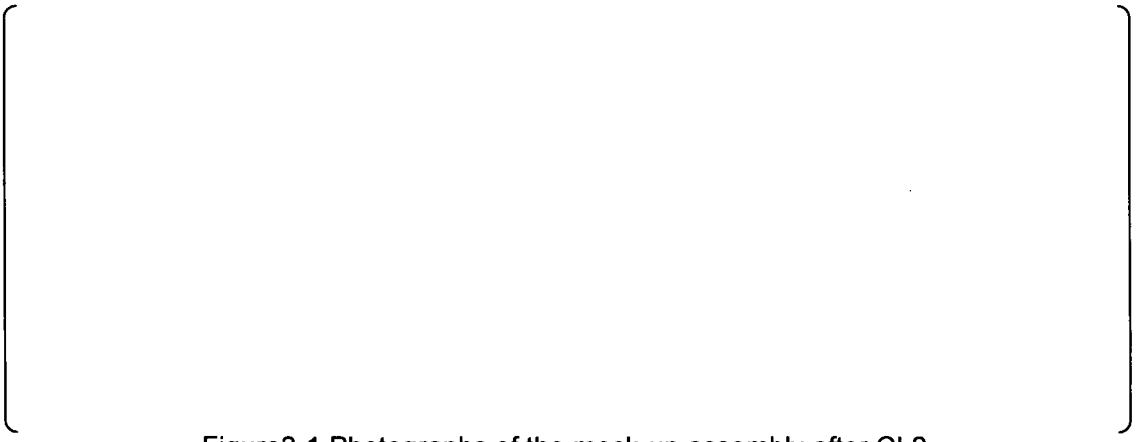

Figure2-1 Photographs of the mock-up assembly after CL2

Figure2-2 Photographs of the test section at the end of CL2

Figure3-1 Photographs of the mock-up assembly after CL(HLSO)

Figure3-2 Photographs of the test section at the end of CL(HLSO)

Impact on DCD
No impact on DCD

Impact on COLA
No impact on COLA

Impact on PRA
No impact on PRA

Analyzing these pictures, the following two things can be concluded:

- A insignificant amount of floating debris was observed after fine fibrous debris introduction.
- Floating debris was predominately small size fibers at the end of the test i.e., not fine debris, and would not bypass the strainer because of its relatively larger size.

In the fiber only bypass test, some floating debris was observed, however the floating debris does not impact the test results as discussed above.

2. Bypass Test Method

The test method of the fiber bypass test is the same as the sump strainer testing except for debris type. The test conditions and procedure were conservative as described below:

- Test debris conditions

  The test was conducted excluding coating and chemical debris. If chemical debris is introduced to the test with fibrous debris, it would form a clump and be captured by the strainer, which would make a bed on the strainer surface. The bed comprised of this mixture of debris would capture more debris compared to fiber only debris because the gap between fibrous debris would be filled with particle and chemical debris. Therefore the fiber only test was conservative compared to a test that introduced particle and chemical debris.

- Test procedure

[ ]

As discussed above, the test conditions and procedure were adequate and conservative for the strainer bypass test.

References

Ref. 1 Mitsubishi Heavy Industries, Ltd., "US-APWR Sump Strainer Performance", MUAP-08001-P Revision 3, November 2010

Impact on DCD

No impact on DCD

Impact on COLA

No impact on COLA

Impact on PRA

No impact on PRA

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/23/2011

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	NO. 716-5527 REVISION 2
SRP SECTION:	06.03 – Emergency Core Cooling System
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DATE OF RAI ISSUE:	3/16/2011

QUESTION NO.: 06.03-99

Technical Report MUAP-10021, " US-APWR Core Inlet Blockage Test," Appendix C provides details regarding a fiber-only bypass strainer test that was conducted. Appendix B of Technical Report MUAP-08001, "US-APWR Sump Strainer Performance," provides some description and photos of the test itself.

1. The photo in MUAP-08001 appears to show some debris suspended on the surface. Provide an assessment of the proportion of debris that was floating on the surface and its impact on the test results.
2. The method used in the test appears to be the same method as was used for the sump strainer testing (except for the exclusion of the particulates and chemicals). The sump strainer test was designed to minimize the debris bypass, whereas the bypass only test should maximize the debris bypass. Provide justification as to why this is conservative for developing the fiber bypass source term for downstream in-vessel effects testing.

ANSWER:

1. Floating Debris

As shown in Figure 10-3 of Technical Report MUAP-08001 R3 (Ref. 1), some floating debris can be observed in the test tank. The floating debris was not quantified and inspected.

In the fiber only bypass test, fibrous debris was introduced in three batches. The type and the quantity introduced in each batch are shown in Table C-1 of Technical Report MUAP-1021 R0.

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