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

May 26, 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-09267

Subject: MHI's Response to US-APWR DCD RAI No. 331-935 Revision 0

Reference: 1) "Request for Additional Information No. 331-935 Revision 0, SRP Section: 06.02.01, Application Section: 6.2.1" dated April 13, 2009.

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. 331-935 Revision 0."

Enclosed are the responses to 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 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.

D081
NRO

Enclosure:

1 - Affidavit of Yoshiki Ogata

2 - Response to Request for Additional Information No. 331-935 Revision 0 (proprietary)

3 - Response to Request for Additional Information No. 331-935 Revision 0 (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-09267

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 "Response to Request for Additional Information No. 331-935 Revision 0" dated May 2009, and have determined that portions of the document 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 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 design of the safety analysis developed by MHI and 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 the performance of detailed hardware design and software development 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 and testing 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 development of the unique plant design of the safety analysis. 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 analysis costs.

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 26th day of May, 2009.

Y. Ogata

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

Enclosure 3

UAP-HF-09267
Docket Number 52-021

Response to Request for Additional Information
No. 331-935 Revision 0

May 2009
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-7

In DCD Section 6.2.1.1.1, Mitsubishi notes that Table 6.2.1-1 "summarizes containment temperature and pressure, for a broad range of postulated breaks", yet this table only has one break included. Please, revise either the table to include additional breaks, or the table description in the text.

ANSWER:

This question was answered in the response to RAI 126-1558, 06.02.01-2 (Reference 1).

Reference

1 UAP-HF-09022, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", January 29, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-8

Please, provide design details on how the drain paths are accounted for in the analysis, ie., the split between retained and returned water, and the timing of the water being returned, and the assumptions used in determining these values.

ANSWER:

Whole containment region including the subcompartments is modeled as single lumped volume for US-APWR maximum containment pressure analysis. Therefore, all liquid in the containment such as break flow, containment spray and condensed water are assumed to directly return to the refueling water storage pit (RWSP). The timing of the water being returned to the RWSP was not considered in the maximum containment pressure analysis, thus the US-APWR initially has water resource in the containment subtracted the ineffective pool volume.

As noted in the DCD Tier-2 Table 6.2.1-4, RWSP water volume (i.e. 44,000 ft^3) includes RWSP minimum inventory and return water, but does not include the ineffective pit volume in the containment. Following is the definition of each water volumes:

a. RWSP minimum inventory
   Minimum water volume contained in the RWSP during normal operation was considered as RWSP minimum inventory. The RWSP that contains nominal 2,463.2 m^3 of water (651,000 gallons defined in the DCD Tier-2 Table 6.2.1-3) is designed to maintain minimum 96% level of the RWSP (i.e., 2371.1 m^3). This volume includes water below 0% level of the RWSP.

b. Return water
   In a postulated LOCA, the RWSP water returns from containment spray nozzle, broken pipe and vapor condensation. The features of drain paths (return water) were discussed in the DCD Tier-2 subsection 6.2.1.1.2, and a schematic flow of return water was shown in the DCD Tier-2 Figure 6.2.1-9.

   The water volume calculation in the containment during accident was provided in the subsection 3.7.1 of the technical report MUAP-08001(Reference 1). This calculation was aim

to define "hold-up volumes" in the containment that were used for determination of minimum RWSP water level which was the basis for net positive suction head (NPSH) evaluation of safety-related pumps during accident. (Reference 1)

The return water on the way to the RWSP was defined as a "hold-up volumes", because it will decrease the initial RWSP water level after the accident. Following was the source of return water to the RWSP:

- Containment spray water droplets and saturated steam (includes the empty spray header rings and pipes)
- Condensate water on all of the containment surfaces (includes equipment, walls and ceiling, etc.)
- Water stream on the containment floors (includes refueling cavity floor)

A breakdown of the above water volumes was provided in Table 3-10 "Upstream effect Hold-up volumes" in the report (Reference 1), and total volume of return water (i.e., 519.7m^3) was calculated.

In the minimum water level calculation of the report (Reference 1), return water (i.e., 519.3m^3) was subtracted from initial RWSP water volume, because it will not contribute the RWSP water level. However, in the maximum containment pressure analysis, since the return water on the way to the RWSP (i.e., 519.3m^3) exists and flows in the containment, this volume was accounted for liquid phase of the analytical model.

c. Ineffective pit volume (retained water)
An ineffective pit volume was also defined as a "hold-up volume" in the report (Reference 1) that entraps return water which will not contribute to recovering the RWSP water level. The following was considered as the ineffective pool:

- Reactor cavity
- Containment recirculation air distribution chamber
- Containment reactor coolant drain pump room
- Recessed pits in the refueling cavity

A breakdown of the above water volumes was provided in Table 3-10 "Upstream effect Hold-up volumes" in the report (Reference 1), and total volume of ineffective pools (i.e., 1124.1m^3) was calculated. In the maximum containment pressure analysis, it was conservatively assumed that ineffective pools was not accounted for liquid phase of the analytical model, and the volume (i.e., 1124.1m^3) was subtracted from RWSP minimum inventory (i.e., 2371.1m^3).

In result of the above a), b), and c), the water volume (i.e., 44,000ft^3) used for liquid phase of the analytical model was calculated by subtracting ineffective pools volume (i.e., 1124.1 m^3) from RWSP minimum inventory (i.e., 2371.1 m^3).

A summary calculation is provided in following table:

Table1 Summary of Water Volume Distribution during LOCA

Water volumes		Remarks
a. RWSP minimum inventory	2371.1 m^3	RWSP (0-96%) plus water volume below 0% level.
(b. Return water)	(519.3m^3)	This volume was not subtracted from RWSP inventory for analytical model.
c. Ineffective pools	1124.3 m^3	This volume was not account for liquid phase of the analytical model.
Liquid phase in the containment [a)-c)]	1766.1 m^3 (44,000 ft^3)	Water volume used for the analysis.

Reference

1. MUAP-08001-P Revision 2, "US-APWR Sump Strainer Performance", December 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-9

The RWSP is assumed to be a pool at the bottom of containment, with "appropriate assumptions on the heat and mass transfer at the pool." The staff cannot locate the details of these assumptions and sensitivities to these assumptions in the DCD. Please, provide a reference for the details of these assumptions, including its basis and sensitivity of the results to these assumptions.

ANSWER:

This question was answered in the response to RAI 126-1558, 06.02.01-3 (Reference 1).

Reference

1 UAP-HF-09102, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", March 19, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-10

Please, provide sufficient information for the staff to develop an independent containment model for confirmatory calculation, including the GOTHIC input model.

ANSWER:

This question was answered in appendix F, item 19 of "Response to Follow-up Request dated January 30, 2008" (Reference 1).

Reference

1 MUAP-07012 Revision 2, "LOCA Mass and Energy Release Analysis Code Applicability Report for US-APWR", May 2008

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-11

Provide details of the GOTHIC heat structures modeling, including what materials were lumped together as described in the DCD. In addition, provide an assessment of the calculation error associated with the adopted analytical approach.

ANSWER:

This question was answered in the response to RAI 126-1558, 06.02.01-4 (Reference 1).

Reference

1 UAP-HF-09102, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", March 19, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-12

Justify the selection of the 0.99 mm (0.039 inch) spray droplet diameter used in the GOTHIC model. Provide any sensitivity of calculated pressure and temperature to this diameter.

ANSWER:

The nominal value of containment spray droplet used for the maximum containment pressure analysis includes a margin to Sauter mean diameter, 880 micron as previously discussed in Reference 1.

Sensitivity study for the containment spray droplet diameter was performed in the maximum containment analysis and the affects were discussed in Reference 2. Calculated results of the peak containment pressure and additionally to the previous discussion, vapor phase temperature for the sensitivity cases are presented in the following table.

Table Resulted Peak Containment Pressure and Temperature by Sensitivity Study of Containment Spray Droplet Diameter

	Nominal Case	Sensitivity Case 1	Sensitivity Case 2
Containment Spray Drop Diameter, inch	0.04	0.08	0.02
Calculated Peak Containment Pressure, psia (psig)	74.2(59.5)	[ ]	[ ]
Calculated Peak Containment Temperature, F	284	[ ]	[ ]

Reference

1 UAP-HF-08255, "MHI's Responses to US-APWR DCD RAI No. 84-796 Revision 0", November 7, 2008

2 UAP-HF-09102, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", March 19, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-13

A statement is made that since evaporation rates are reasonably predicted by GOTHIC models, condensation rates should be as well. Please justify this statement, including justification of the droplet condensation coefficients used in this analysis and sensitivity to this parameter.

ANSWER:

This question was answered in the response to RAI 126-1558, 06.02.01-5(Reference).

Reference

1 UAP-HF-09102, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", March 19, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-14

The containment design temperature limit seems to be 148.9°C (300°F). However, there are periods of time during the postulated MSLB accident that the calculated atmospheric temperature exceeds this limit. Please, confirm if the 148.9°C (300°F) temperature is the design limit, and if so, discuss the periods of time the containment temperatures exceeds this limit and its potential adverse effects on containment structures and equipment.

ANSWER:

This question was answered in the response to RAI 113-786, 06.02.01.04-2 (Reference).

Reference

1 UAP-HF-09007, "MHI's Response to US-APWR DCD RAI No.113-786 Revision 0", January 15, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-15

RAI M-3.2-1 in the review of MUAP-07031 report requested expanding Table 3-1 in that document. Since Table 6.2.1-17 in the DCD is the same table, please revise the DCD table.

ANSWER:

This question was answered in the response to RAI 111-932, 06.02.01.02-5 (Reference).

Reference

1 UAP-HF-09006, "MHI's Response to US-APWR DCD RAI No.111-932 Revision 0", January 16, 2009

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

5/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-16

In section 6.2.1.3, multiple energy sources were accounted for in the Mitsubishi mass and energy release analysis. Mitsubishi states that conservative assumptions were made in calculating the available energy. Please, justify and/or discuss the basis for these assumptions.

ANSWER:

The assumptions shown in Table 1 are considered as conservatism for available energy in the mass and energy release analysis. These assumptions are described in topical report MUAP-07012-P and MUAP-07012-NP Revision 2 (Reference 1).

Reference

1 MUAP-07012 Revision 2, "LOCA Mass and Energy Release Analysis Code Applicability Report for US-APWR", May 2008

Table 1 Conservative Assumptions for the Mass and Energy Release Analysis

	Value	Note
Initial system conditions		
Power level	+2 %	Allowance for calorimetric error
Fluid temperature	+4 F	Allowance in RCS fluid temperature for instrument error and dead band
RCS pressure	+30 psi	Allowance for RCS pressure uncertainty
System volume	+3 %	Margin in volume (1.6 % allowance for thermal expansion and 1.4 % for uncertainty)
Steam generator secondary mass	+3 %	3 % margin is consistent with system volume (Based on 100 % power, B.E. for maximizing steam generator mass inventory)
Metal stored energy	maximized	Initial temperature of metal except the neutron reflector is consistent with fluid temperature. The neutron reflector metal temperature is higher than the fluid temperature due to the heat generated by gamma ray absorption.
Decay heat	maximized	Based on ANSI/ANS-5.1-1979 (ANS-1979 model)
Core stored energy	+20 %	Margin in core stored energy (Based on maximum core stored energy considering fuel burn-up and uncertainty in the calculation of fuel temperature)
Metal-water reaction	1 % of the zirconium in the active core cladding	Much higher than the actual whole core oxidation presented in the LOCA analysis on the DCD Chapter 15
Blowdown modeling		
Core heat transfer coefficient	maximized	Maximizing the heat release from the core
Reflood modeling		
Carryover fraction correlation	ECCS type application	Increasing the releases to the containment
Steam water mixing pressure drop	excluded	Decreasing the flow to the intact loop
Exit steam generator fluid conditions	saturated	Maximizing the releases to the containment
Post-reflood modeling		

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

5/26/2009

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

RAI NO.:	**NO.331-935 REVISION 0**
SRP SECTION:	**06.02.01 - CONTAINMENT FUNCTIONAL DESIGN**
APPLICATION SECTION:	**SRP 6.2.1**
DATE OF RAI ISSUE:	**4/13/2009**

QUESTION NO. : 06.02.01-17

Provide all of the LOCA and MSIV DBA long term calculations to determine the containment pressure at 24 hours into the accident.

ANSWER:

This question was answered in the response to RAI 126-1558, 06.02.01-6 (Reference).

Reference

1 UAP-HF-09183, "MHI's Response to US-APWR DCD RAI No. 126-1558 Revision 0", April 21, 2009

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

This completes MHI's responses to the NRC's questions.