MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

April 5, 2013

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-13077

Subject: MHI's Response to US-APWR DCD RAI No.991-7026 (SRP 08.04)

Reference: 1) "Request for Additional Information No. 991-7026, SRP Section: 08.04 – Station Blackout, Application Section: 08.04", dated February 14, 2013 (ML13045B096).

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to US-APWR DCD RAI No.991-7026 (SRP 08.04)".

Enclosed is the response to the RAI 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 Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittals. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.
On behalf of Mitsubishi Heavy Industries, LTD.

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Enclosures:

1. Affidavit of Yoshiki Ogata

2. Response to US-APWR DCD RAI No.991-7026 (SRP 08.04) (Proprietary Version)

3. Response to US-APWR DCD RAI No.991-7026 (SRP 08.04) (Non-Proprietary Version)

CC: J. A. Ciocco
J. Tapia

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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-13077

MITSUBISHI HEAVY INDUSTRIES, LTD.
AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am Executive Vice President of Mitsubishi Nuclear Energy Systems, Inc., and have been delegated the function of reviewing MITSUBISHI HEAVY INDUSTRIES, LTD's ("MHI") 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 US-APWR DCD RAI No.991-7026 (SRP 08.04)" dated April 2013, 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 information and analysis of Station Blackout, 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 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 development of the US-APWR Station Blackout. Providing public access to such information permits competitors to duplicate or mimic the Station Blackout information without incurring the associated costs.

B. Loss of competitive advantage of the US-APWR created by benefits of enhanced US-APWR Station Blackout development costs associated with the Station Blackout.

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 5th day of April, 2013.

Yoshiki Ogata,
Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.

Enclosure 3

UAP-HF-13077
Docket No. 52-021

Response to US-APWR DCD RAI No.991-7026 (SRP 08.04)

April 2013
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

04/05/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 991-7026**
SRP SECTION:	**08.04 – Station Blackout**
APPLICATION SECTION:	**DCD SECTION 8.4**
DATE OF RAI ISSUE:	**2/14/2013**

Question No. : 08.04-17

On January 24, 2013, a public and closed Category 1 teleconference was held between the U.S. Nuclear Regulatory Commission (NRC), Mitsubishi Heavy Industries, Ltd. (MHI), Mitsubishi Nuclear Energy Systems (MNES), Inc., and members of the public. The purpose of the publicly noticed telecon was to discuss the NRC staff's review of the applicant's docketed response to NRC RAI No. 938-6535 related to the US-APWR DCD. The RAI had been issued by the NRC staff about the transient heat-up analysis of the Turbine-Driven Emergency Feed Water (TDEFW) pump room due to a complete loss of cooling under station black out conditions reviewed under SRP Section 8.4. The staff had issued the RAI in the light of its May 9, 2012 audit (ML12115A205) of the applicant's transient heat-up calculation report, which was mainly conducted to address the concerns raised by the Advisory Committee for Reactor Safeguards (ACRS) in their September 22, 2011 letter (ML11256A206). The ACRS letter remarked on the applicants justification for stable operation of the TDEFW pumps for at least one hour without active room cooling; and estimate when the turbine controls are expected to fail if the room heat-up continued for longer than one hour.

Hereunder are the staff's outstanding technical issues communicated to the applicant about its RAI No. 938-6535 response. They are mainly concerned about potential non-conservatism and the numerical stability of the transient heat-up scheme implemented in the applicant's Microsoft Excel model.

- The applicant used a constant heat transfer co-efficient to model the natural convection heat transfer between the air and the heat sinks, such as walls, ceiling, and floor, exposed to convective boundary conditions on both sides. The heat transfer coefficient was not computed using a correlation based on the temperature difference between the heat sink surface and the bulk air. The natural convection heat transfer coefficient would not remain constant and would change with time with the transient temperature difference between the heat sink surface and the bulk air. Therefore, the applicant should justify the constant heat transfer coefficient used in the model to be conservative for the air and heat-sink surface temperature ranges and orientations encountered inside and outside the TDEFW room. Otherwise, revise the heat-up calculations with conservative heat transfer co-efficient[s] for the room inside and outside surfaces, and have the staff review the updated model results.

- Please describe whether any commitments are being made in the DCD about some or all of the concrete thermo-physical properties (density, thermal conductivity, and specific heat) of the as-built system used in the heat-up analysis. Also document if there is any margin available between the concrete properties used in the room heat-up analysis and the ones committed in the DCD? In case of a margin, the thermo-physical property values used in the licensing basis calculations would have to be more conservative than the values committed in the DCD.
- Please show that the thermo-physical properties of air used in the model are conservative over the range of air temperatures encountered during the projected room heat-up.
- In response to RAI 938-6535, Bullet#7 question, the applicant reported 115°F to be the conservative temperature limit in the surrounding rooms used as the heat sinks outside boundary condition. However, the staff found that there are two CCW pump rooms located adjacent to the EFW Pump rooms, and Table 5.5.1-2 of MUAP-10020-P (R1) report (US-APWR Safety-Related Air Conditioning, Heating, Cooling, and Ventilation Systems Calculations) shows that the maximum design temperature of the CCW Pump rooms is 130°F. Please justify using 115°F as the conservative outside boundary condition while at least one wall's exterior might be exposed to 130°F air. Otherwise, revise the analysis with 130°F bulk air temperature in the CCW Pump room as outside boundary condition for the common wall.
- The response to RAI 938-6535, Bullet#4 question does not show how the numerical stability criteria are satisfied for the discretized 1-D transient conduction scheme that the applicant implemented in the Excel model for the heat sinks heat-up along with the room inside and outside convective boundary conditions. Please demonstrate that the scheme is numerically stable for the selected time step and solid element widths by providing a tabulation of the Fourier and Biot numbers for the internal and external elements of the thinnest and thickest walls for the concrete thermo-physical properties and the room inside and outside convective heat transfer co-efficient[s] justified in the above and used in the revised analysis submitted for the staff review.
- Please document any assumptions made for the initial heat sink temperatures. Confirm whether a conservative uniform initial temperature was assumed across the heat sink or a steady-state temperature profile was calculated across it in the model as the initial condition for time marching.

ANSWER:

The calculation of Turbine Driven Emergency Feedwater (T/D EFW) Pump Room heatup upon loss of room cooling due to station blackout (SBO) conditions is a simplified transient model of heat input and heat conduction. The calculation uses conservative inputs along with simplifying approximations for certain parameters to estimate the room temperature rise over time. The analysis was performed to assure that the T/D EFW Pump will continue to operate until room cooling is restored within one hour following a SBO event (DCD Subsection 8.4.2.1.2). The analysis also evaluates room temperature for T/D EFW Pump operation without room cooling for longer than the design basis period of one hour post-SBO in order to estimate the time to potential malfunction of temperature-sensitive instrumentation required for stable operation of the T/D EFW Pump.

Generally, the heat transfer model considers heat gain from internal heat sources and heat loss (or gain) through walls, ceiling and floor to the surrounding areas. The walls, ceiling and floor are modeled for a one-dimensional finite difference solution using explicit numerical

methods. The model is developed as a series of equations representing the thickness of the walls, ceiling and floor using five elements consisting of external elements at each outside surface and internal elements to define the thickness. The equations are solved simultaneously using Microsoft Excel software. Heat that is not transferred through the walls, ceiling or floor increases the room bulk air temperature. The solution is repeated for each successive time step at the new initial conditions established by the previous time step solution. The use of a spreadsheet for solution necessitates the development of a relatively simple model. A simplified model is justified based on the use of conservative values for heat transfer parameters and material properties.

The calculation of T/D EFW Pump Room heatup will be revised to incorporate the response to RAI 991-7026 Question 08.04-17 described below:

Response to 1st Bulleted Item

Response to 2nd Bulleted Item

Concrete thermo-physical properties (density, thermal conductivity, and specific heat) provided in several references were reviewed and the revised values to be used in the calculation are provided in Attachment 1, Part (2). Conservative values, based on the industry references, were selected for use in the revised calculation. No specific thermo-physical property commitments are made in the DCD for concrete used in the safety-related structural applications. It is noted that the revised density and specific heat values are consistent with NUREG-0800, Branch Technical Position (BTP) 6-2 (Reference 1) values recommended for containment structural concrete. The revised thermal conductivity value is conservatively lower than the value recommended in BTP 6-2.

Response to 3rd Bulleted Item

Response to 4th Bulleted Item

The room air temperature assumed in the CCW Pump Room will be changed to 130°F since this is the maximum allowable room temperature.

Response to 5th Bulleted Item

Response to 6th Bulleted Item

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The results of the T/D EFW Pump Room heatup evaluation using the conservative values of heat transfer parameters and material properties described herein are plotted in Attachment 1, Figure 1. The maximum room temperature does not exceed the limiting equipment environmental qualification temperature of 175°F after 24 hours without room cooling. Therefore, operation of the T/D EFW Pump control circuit components will not be adversely affected even without cooling for an extended period of time following a SBO event.

Reference:

(1) USNRC NUREG-0800, "Standard Review Plan," Branch Technical Position 6-2, Revision 3, "Minimum Containment Pressure Model for PWR ECCS Performance Evaluation," Table 2

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.

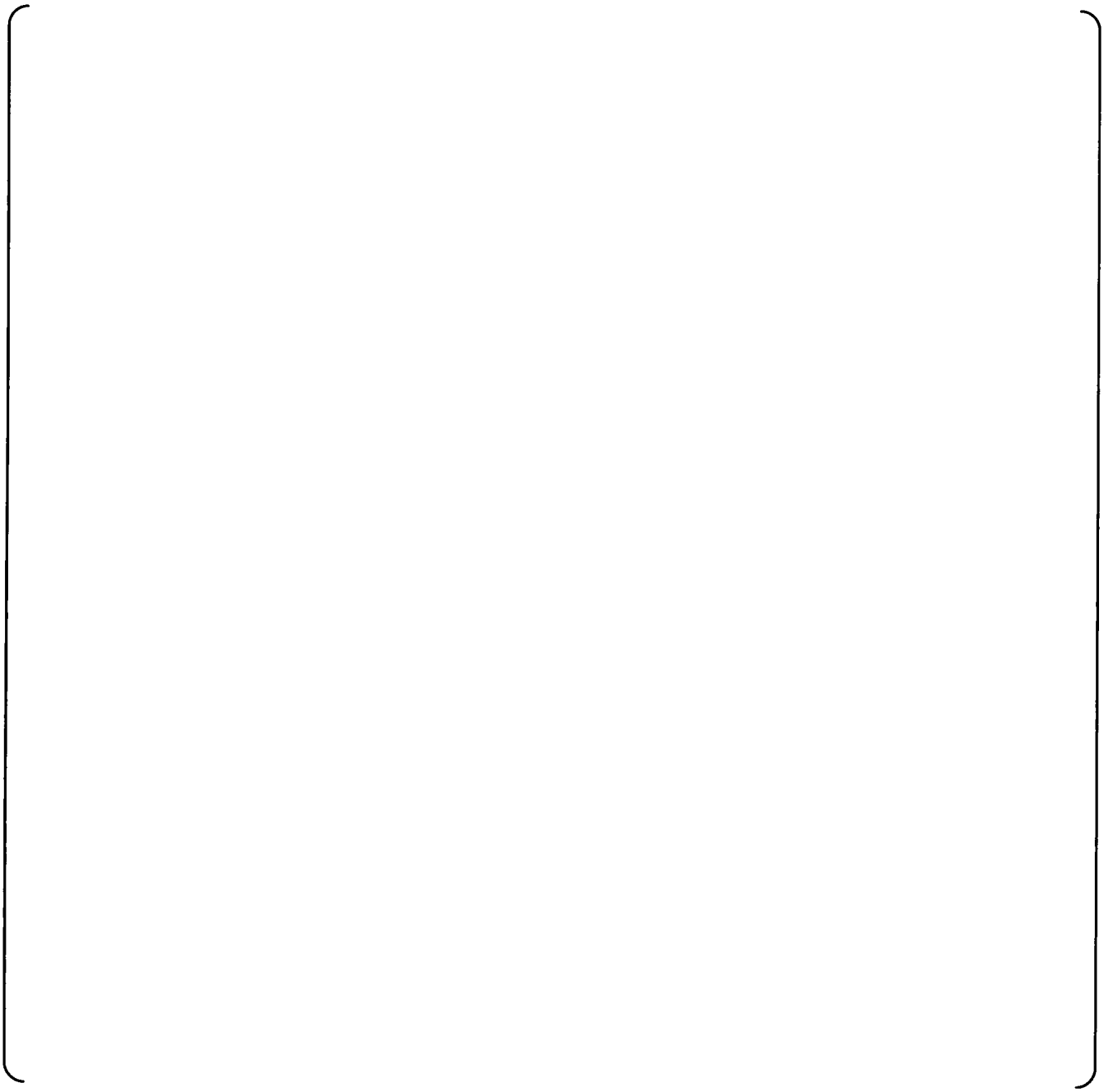
Impact on Topical Report / Technical Report

There is no impact on the Topical Report / Technical Report.

Attachment 1

Attachment 1

Attachment 1



Attachment 1

Attachment 1

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