MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

November 22, 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-11406

Subject: **MHI's Responses to US-APWR DCD RAI No. 840-6096 Revision 3 (SRP 06.02.02)**

Reference: 1) "Request for Additional Information No. 840-6096 Revision 3, SRP Section: 06.02.02 – Containment Heat Removal System – Application Section: 6.2.2" dated October 18, 2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 840-6096 Revision 3".

Enclosed are the responses to Question 06.02.02-74 through 06.02.02-84 that are contained within Enclosure 2 and 3.

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 Atsushi Kumaki (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,

Atsushi Kumaki for

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

D081
NRO

Enclosure:

1. Affidavit of Atsushi Kumaki

2. Responses to Request for Additional Information No. 840-6096 Revision 3 (Proprietary)

3. Responses to Request for Additional Information No. 840-6096 Revision 3 (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-11406

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Atsushi Kumaki, 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 "MHI's Response to US-APWR DCD RAI No. 840-6096 Revision 3 (SRP Section 06.02.02)" dated October 2011, 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 US-APWR 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 unique design parameters. Providing public access to such information permits competitors to duplicate or mimic the US-APWR design without incurring the associated costs.

B. Loss of competitive advantage of the US-APWR created by benefits of approach to justification for the system 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 22nd day of November, 2011.

Atsushi Kumaki

Atsushi Kumaki,
Group Manager- Licensing Promoting Group in APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Docket No. 52-021
MHI Ref: UAP-HF- 11406

Enclosure 3

UAP-HF-11406
Docket No. 52-021

Responses to Request for Additional Information No. 840-6096
Revision 3
(Non-proprietary)

November 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/22/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 840-6096 REVISION 3**
SRP SECTION:	**06.02.02 – CONTAINMENT HEAT REMOVAL SYSTEM**
APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-74

Table 3.2-3 of technical report MUAP-08013-P (R2) lists Characteristic Size for debris – is this dimension the maximum diameter? Based on this table, what is the maximum length for each type of debris and explain how this was determined?

ANSWER:

The characteristic debris sizes in Table 3.2-3 of MUAP-08013 (R2) are taken from Table 3-5 of MUAP-08001 (R5), which provides additional discussion. These are characteristic sizes of the debris (e.g., break-generated or latent debris) reaching the refueling water storage pit (RWSP) and are derived from NRC testing and NRC guidance (Refs. 1, 2, 3).

For the plugging evaluation, the maximum size of debris which could pass through the strainer is compared to the downstream orifice sizes. This maximum size conservatively bounds the characteristic debris sizes. Per the NRC SE on TR-WCAP-16406-P (Ref. 4), the maximum length of deformable particulates that may pass through the strainer is two times (2x) the maximum linear dimension of the penetration in the sump screen (0.066-in). For non-deformable particulates, the maximum size is the maximum linear dimension of the penetration in the sump screen.

References

5. NEI 04-07, Revision 0, "Pressurized Water Reactor Sump Performance Evaluation Methodology," December 2004, Volume 1 (Methodology) and Volume 2 (USNRC SE).
6. NUREG/CR-6808
7. NUREG/CR-6877
8. USNRC Safety Evaluation of TR-WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Pressurized Water Reactors Owner's Group, December 2007.

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 Technical/Topical Report.

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RAI NO.: **NO. 840-6096 REVISION 3**

SRP SECTION: **06.02.02 – CONTAINMENT HEAT REMOVAL SYSTEM**

APPLICATION SECTION: **6.2.2**

DATE OF RAI ISSUE: **10/18/2011**

QUESTION NO.: 06.02.02-75

Table 3.2-4 of technical report MUAP-08013-P (R2) is titled Debris Concentration Components. Is this the amount of debris that will bypass the filters and be ingested into the ECCS? Staff requests the applicant to provide the debris concentration in PPM. Also specify the volume of water used in the PPM calculation and explain how this volume of water was determined.

ANSWER:

Table 3.2-4 defines the amount of debris assumed to bypass the strainers and is suspended in the post-LOCA fluid.

MHI will revise Table 3.2-4 of MUAP-08013-P (R2) to include a PPM column, as shown below. Table 3.1-1 of MUAP-08006-NP, Rev. 1, "US-APWR Sump Debris Chemical Effects Test Plan," was used as the design input for the PPM calculations. The mass of water used for the PPM calculation was the sum of the minimum post-LOCA recirculation sump water volume (43,930 ft^3 at the long-term sump water temperature of 149°F) and the reactor coolant system water volume (699,000 lbm).

Table 3.2-4. Debris Concentration Components

TYPE	Debris Quantity	Density	Mass (lbs)	PPM
NUKON	2.25 lbm	N/A	2.25	1
Latent fiber	30 lbm	N/A	30	9
Epoxy coatings	482 lbm	N/A	482	143
Latent particle	170 lbm	N/A	170	50
RMI	5.3 ft^3	490	2597	773
		SUM	**3281.25**	**976**

Note: The sump water volume may change due to responses to other RAI questions. The concentrations above are for information and will be updated accordingly for the next revision of MUAP-08013.

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

Technical Report MUAP-08013 will be revised based on this response.

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SRP SECTION:	**06.02.02 – CONTAINMENT HEAT REMOVAL SYSTEM**
APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-76

Section 3.2.6.4 of technical report MUAP-08013-P (R2) states that flow velocity through a normal Hx is 3 to 10 ft/sec and the flow velocity through the RHR Hx is assumed to be 15 ft/sec. To verify this assumption is accurate and conservative, the applicant needs to determine actual flow through RHR Hx and compare it to the assumed flow of 15ft/sec. If Hx is not designed, is the vendor performing this evaluation?

ANSWER:

The design engineer will specify the operating conditions to which the heat exchanger manufacturer must design, including normal, minimum and maximum expected operating conditions. The vendor will confirm that the heat exchanger is designed in accordance with the purchase specifications, and provide a Heat Exchanger Data Sheet for the final as-designed heat exchanger.

MHI will verify that the as-designed normal flow velocity through the RHR Hx is less than 15 ft/sec. This is part of the normal procurement acceptance review process for plant equipment and will be part of the Heat Exchanger Data Sheet review for every plant heat exchanger.

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 Technical/Topical Report.

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SRP SECTION:	**06.02.02 – CONTAINMENT HEAT REMOVAL SYSTEM**
APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-77

Section 3.3.1 of technical report MUAP-08013-P (R2) describes the wear rate evaluation for piping and orifice. What is the wear rate equation and how does it relate to actual post-LOCA debris abrasiveness and concentration? Was this wear rate evaluation based on sand (Table 3.2-5) or actual debris properties? If the wear evaluation was based on sand, explain the relationship between sand and the downstream debris and explain why this assumption is conservative.

ANSWER:

The wear rate equation and how it relates to debris abrasiveness and debris concentration are contained in the methodology section of the wear rate calculation. This calculation can be reviewed in a technical audit by the NRC staff if necessary. Note that it is consistent with industry methods (e.g., Refs. 1 and 2) and those used at all current US PWRs (e.g., Ref. 3).

The wear rate increases with debris concentration and debris abrasiveness. The calculated wear rate is based on the debris concentrations discussed in the response to 06.02.02-75 above. The debris abrasiveness is based on using wear rate data for coarse sand from Reference 1 used in TR-WCAP-16406-P. Although Reference 1 does not report specific hardness values, silica sand generally has a Brinell hardness number (i.e., abrasiveness) ranging from approximately 500 to 700. This is larger than that expected for the majority of post-LOCA debris (i.e., reflective metal insulation), based on the Brinell hardness numbers given for stainless steel in MUAP-08013 (R2).

References

4. ADS-Pipe Technical Note 2.116, "Abrasion Resistance of Piping Systems," Goddard, J., Hillard, Ohio, November 1994.
5. Experiences with a Numerical Method of Calculating Slurry Pump Casing Wear, Addie, G., Visintainer, R., Roco, M., 4th International Pump Symposium, 1987.
6. USNRC Safety Evaluation of TR-WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Pressurized Water Reactors Owner's Group, December 2007.

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 Technical/Topical Report.

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APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-78

Section 3.3.2 of technical report MUAP-08013-P (R2) describes the CS/RHR heat exchanger evaluation and states that Hx plugging, fouling, and wear evaluation are done in context of the equipment specifications. Discuss if the specification will identify both the post-LOCA debris conditions and the normal operating fluid conditions and require the vendor to evaluate the Hx performance and wear for both conditions.

ANSWER:

The specified design conditions for the CS/RHR heat exchanger will include normal, minimum and maximum (i.e., post-LOCA) expected operating conditions. Operating conditions include the fluid constituents for each operating case. The heat exchanger vendor will be required to confirm compliance with the specification. This is a common engineering practice and is part of QME-1-2007 as discussed in the response to 06.02.02-80 below.

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 Technical/Topical Report.

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QUESTION NO.: 06.02.02-79

Section 3.3.3 of technical report MUAP-08013-P (R2) describes valve wear evaluation and states that valve procurement specifications will note the constituents of the post-LOCA fluid and require that the valve be able to operate reliably under those conditions for a minimum of 30 days. Will the specifications contain details of the post-LOCA fluid such as material abrasiveness, type, and quantity of debris? Also, in order to confirm that valves operate reliably under post-LOCA conditions, the valves are to be qualified per QME-1-2007 as endorsed by RG 1.100, Revision 3, for their intended function using the post-LOCA fluid as a process fluid for 30 days in addition to being qualified with normal process fluid? Staff requests the applicant to revise Section 3.3.3 of MUAP-08013-P (R2) to state that valves are to be qualified per QME-1-2007 as endorsed by RG 1.100, Revision 3, for their intended function using the post-LOCA fluid.

ANSWER:

The valve procurement specification will contain its service conditions. It will include details such as the type and quantity of post-LOCA debris and the quality and type of post-LOCA fluid. These are standard (and required) valve specifications and design inputs.

RG 1.100, Revision 3, Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants, is applicable to the valve design. Valves will be qualified to QME-1-2007 and they will be designed to operate under normal operating and post-LOCA conditions.

MHI will revise Section 3.3.3 of MUAP-08013-P (R2) to state that valves are to be qualified per QME-1-2007 as endorsed by RG 1.100, Revision 3, for their intended function using the post-LOCA fluid.

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

Technical Report MUAP-08013 will be revised based on this response.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/22/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

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RAI NO.:	**NO. 840-6096 REVISION 3**
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APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-80

Section 3.4.1.1 of technical report MUAP-08013-P (R2) describes the design and procurement specifications for the ECCS pumps. Staff has the following questions for this section:

f. Staff position is that ECCS pumps are to be qualified for operation in the post-LOCA environment. Therefore, staff request that Section 3.4.1.1 be revised to specify that, "The pumps, including the mechanical seal, shall be qualified per QME-1-2007 as endorsed by RG 1.100, Revision 3 to operate in post-LOCA fluids for at least 30 days."
Confirmatory items and any potential malfunctions identified by the vendor shall be considered in the qualification process.

g. Section 3.4.1.1 of MUAP-08013-P (R2) states "At the procurement stage, the pump vendor will provide a table listing the materials and hardness's of all wetted pump surfaces (wear rings, pump internals, bearing, casings, etc)."
To better describe the evaluation methodology and acceptance criteria, the NRC staff would consider it the vendor's design and qualification action to provide documentation confirming the pump wetted surface material (such as wear rings, pump internals, bearing, and casing) wear rates provide acceptable operation in post-LOCA fluids during the 30 day mission time. A list of materials of the wetted pump surfaces and the hardness of each material are to be recorded in the pump design and qualification documentation.

h. Section 3.4.1.1 of MUAP-08013-P (R2) states, "At the procurement stage, the pump vendor will provide a table listing the design or specified opening sizes and internal running clearances.
To better describe the evaluation methodology and acceptance criteria, the NRC staff would consider it the vendor's design and qualification action to provide documentation confirming the pump opening sizes and internal running clearances provide acceptable operation in post-LOCA fluids during the 30 day mission time. The vendor will record the opening sizes and internal running clearances in the pump design and qualification documentation.

i. Section 3.4.1.1 of MUAP-08013-P (R2) states that "The ECCS pumps will be specified to meet the intent of American Petroleum Institute (API) Standard 610 in the context of rotor dynamic analysis. Details will be provided in the procurement specifications." Staff requests

the applicant to provide examples of the API-610 details that will be provided in the procurement specifications?

j. Section 3.4.1.2 of MUAP-08013-P (R2) describes the design and procurement specifications for the CS/RHR pumps. Staff has similar comments to a through d above for the CS/RHR pumps and requests the applicant to answer these same questions for the CS/RHR pumps.

ANSWER:

f) RG 1.100, Revision 3, Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants, is applicable to the pump design. The pumps will be qualified to QME-1-2007 and they will be designed to operate under normal operating and post-LOCA conditions.

MHI will revise Section 3.4.1.1 of MUAP-08013-P (R2) to state that the pumps, including the mechanical seal, shall be qualified per QME-1-2007 as endorsed by RG 1.100, Revision 3 to operate in post-LOCA fluids for at least 30 days.

g) MHI also considers it the vendor's design and qualification action to provide documentation confirming the pump wetted surface material (such as wear rings, pump internals, bearing, and casing) wear rates provide acceptable operation in post-LOCA fluids during the 30 day mission time. This is a standard aspect of pump specification and procurement activities.

A list of materials of the wetted pump surfaces and the hardness of each material will be recorded in the pump design and qualification documentation. These are part of standard pump vendor O&M documents. It is also referred to in both the HI and API Standards. This is a normal aspect of pump specification and procurement.

h) MHI also considers it the vendor's design and qualification action to provide documentation confirming the pump opening sizes and internal running clearances provide acceptable operation in post-LOCA fluids during the 30 day mission time. This is a standard aspect of pump specification and procurement activities.

The vendor will record the opening sizes and internal running clearances in the pump design and qualification documentation and are part of standard pump vendor O&M documents. It is also referred to in both the HI and API Standards. This is a normal aspect of pump specification and procurement.

i) Examples of API-610 details that may be provided include those contained in:

Annex H Materials and material specifications for pump parts
Annex I Lateral analysis
Annex J Determination of residual unbalance
Annex L Vendor drawing and data requirements
Annex M Test data summary
Annex N Pump datasheets.

j) The responses in "a" through "d" above, also apply to the CS/RHR pumps.

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

Technical Report MUAP-08013 will be revised based on this response.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

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QUESTION NO.: 06.02.02-81

Section 3.4.3 of technical report MUAP-08013-P (R2) states, "the are specified to maintain a leak rate of less than [xxx]." Under complete seal failure conditions, the leak rate is specified to be less than 50 gpm." The applicant is requested to identify the design parameters in Appendix A and B, Pump Design Parameters of MUAP-08013-P.

ANSWER:

ECCS and CS/RHR pumps leak rate information will be added to the tables in Appendices A and B of MUAP-08013-P (R2), as the following note:

2. The leak rate through the mechanical seal shall be less than [ ] cc/h (under normal seal conditions). When the mechanical seal has failed, the leak rate shall be less than 50 gpm.

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

Technical Report MUAP-08013 will be revised based on this response.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-82

Appendix A and B of technical report MUAP-08013-P (R2) list design parameters for the ECCS and CSS Pumps. Staff requests the applicant revise the table to include the following parameters:

c. Table A-1 for the ECCS pump design parameters lists the Fluid as Boric Acid Water. This table should be revised to include,1) Post-LOCA Downstream Fluid (for 30-day mission time), and 2) seal leakage criteria of [ ] cc/hr and failure leak rate less than 50 gpm. Also, the applicable portions of DCD Section 6.3 for the ECCS should be revised to incorporate this data.

d. Table B-1 for the CSS/RHR pump design parameters lists the Fluid as Reactor Coolant and Boric Acid Water. This table should be revised to include,1) Post-LOCA Downstream Fluid (for 30-day mission time), and 2) seal leakage criteria of [xxx] cc/hr and failure leak rate less than 50 gpm. Also, the applicable portions of DCD Section 6.3 for the ECCS should be revised to incorporate this data.

ANSWER:

c) MHI will revise MUAP-08013-P (R2) Table A-1 to include the assumed post-LOCA fluid constituents and seal leakage criteria.

These specifics are too detailed for including directly in the DCD. Instead, MHI will modify the DCD as discussed in the response to 06.02.02-84 to refer to MUAP-08013-P (R2) as a source of additional design requirements.

d) MHI will revise MUAP-08013-P (R2) Table B-1 to include the assumed post-LOCA fluid constituents and seal leakage criteria.

These specifics are too detailed for including directly in the DCD. Instead, MHI will modify the DCD as discussed in the response to 06.02.02-84 to refer to MUAP-08013-P (R2) as a source of additional design requirements.

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

Technical Report MUAP-08013 will be revised based on this response.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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APPLICATION SECTION:	**6.2.2**
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QUESTION NO.: 06.02.02-83

The NPSH available and required for the SI Pump and CS/RHR Pump listed in Tables A-1 and B-1 of technical report MUAP-08013-P (R2) are not consistent with the NPSH values listed in Tables 3-11 and 3-12 of technical report MUAP-08001-P(R5). The applicant is request to explain the inconsistency.

ANSWER:

The NPSH available and required for the SI pump and CS/RHR pump in Table A-1 and B-1 of MUAP-08013 will be revised to be consistent with the NPSH values in MUAP-08001.

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

Technical Report MUAP-08013 will be revised based on this response.

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Docket No. 52-021

RAI NO.:	**NO. 840-6096 REVISION 3**
SRP SECTION:	**06.02.02 – CONTAINMENT HEAT REMOVAL SYSTEM**
APPLICATION SECTION:	**6.2.2**
DATE OF RAI ISSUE:	**10/18/2011**

QUESTION NO.: 06.02.02-84

Section 6.3.2.5, "System Reliability," of the DCD states that "requirements for functional testing of ECCS valves and pumps are provided in Subsection 3.9.6." Section 6.3.2.5 of the DCD (and 6.2.2.1.4 for Containment Spray reliability) should be revised to reference technical report MUAP-08013-P and state "MUAP-08013-P contains requirements for design and evaluation of ECCS and CSS ex-vessel downstream components to ensure the ECCS and CSS systems and their components will operate as designed under post-LOCA conditions."

ANSWER:

MHI agrees that the reference is applicable. The statement: "MUAP-08013-P contains requirements for design and evaluation of ECCS and CSS ex-vessel downstream components to ensure the ECCS and CSS systems and their components will operate as designed under post-LOCA conditions." will be added to Sections 6.3.2.5 and 6.2.2.1.4.

Impact on DCD

The statement: "MUAP-08013-P contains requirements for design and evaluation of ECCS and CSS ex-vessel downstream components to ensure the ECCS and CSS systems and their components will operate as designed under post-LOCA conditions." will be added to DCD Sections 6.3.2.5 and 6.2.2.1.4.

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 Technical/Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/22/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

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QUESTION NO.: 06.02.02-85

The ITAAC in DCD Tier 1, Sections 2.4.4, "Emergency Core Cooling System (ECCS)," and 2.11,"Containment Systems (for CSS) do not address operation of the SI or CS/RHR pumps in post-LOCA fluid conditions. Staff requests the applicant to add new ITAAC in Tier 1, Sections 2.4.4 and 2.11 to address operation of the pumps in post-LOCA fluid conditions. Suggested ITAAC is as follows.

Design Commitment: [SI or CS/RHR] pumps will operate as designed in post-LOCA fluid conditions.

Inspection, Test, Analyses: Test/analyses will be performed to confirm that [SI or CS/RHR] pumps will operate as designed in post-LOCA fluid conditions for a 30-day mission time.

Acceptance Criteria: A report exists and concludes that [SI or CS/RHR] pumps will operate as designed in post-LOCA fluid conditions for a 30-day mission time.

ANSWER:

US-APWR DCD Revision 3 Tier 1 Table 2.4.4-5, Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 10), ITAAC #7.b.ii verifies operation of the safety injection pump "during design basis events," which includes post-LOCA fluid conditions for the duration of the analyzed accident. The ITAAC acceptance criterion verifies that "... each as-built safety injection pump has a pump differential head of no less than 3937 ft and no more 4527 ft at the minimum flow, and injects no less than 1259 gpm and no more than 1462 gpm of RWSP water into the reactor vessel at atmospheric pressure."

US-APWR DCD Revision 3 Tier 1 Table 2.4.4-5, Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 7 of 10), ITAAC #7.d verifies operation of the safety injection pump, including an analysis that considers vendor test results of required NPSH and the effects of pressure losses and minimum water level. The ITAAC acceptance criterion verifies that "as-built NPSH available to each safety injection pump is greater than the NPSH required."

DCD Tier 1 Table 2.11.3-5, Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7), ITAAC #7.b verifies CS/RHR pump ability to deliver full flow during design basis accidents, which includes post-LOCA fluid condition for the duration of the analyzed accident. The ITAAC acceptance criterion verifies that "each as-built CS/RHR pump

delivers no less than 2645 gpm of RWSP water into the containment under design basis conditions."

DCD Tier 1 Table 2.11.3-5, Containment Spray System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 7), ITAAC #7.c verifies operation of the CS/RHR pump, including an analysis that considers vendor test results of required NPSH and the effects of pressure losses and minimum RWSP water level. The ITAAC acceptance criterion verifies that "NPSH available exceeds the NPSH required."

SRP 14.3 calls for Tier 1 to include "top level information" that includes "the principal performance characteristics and safety functions of SSCs" and that these top level, principal performance characteristics and safety functions "should be verified appropriately by ITAAC." RIS 2008-05 calls for ITAAC to be clear and inspectable in order to avoid situations where poor quality ITAAC may not be closeable.

Thus, performance capability of the safety injection and CS/RHR pumps, including their ability to operate in post-LOCA fluid conditions for the duration of the analyzed design basis accident, are verified by existing ITAAC that have an appropriate level of detail in accordance with SRP 14.3 and RIS 2008-05. No additional ITAAC are needed for this purpose and none are provided.

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 Technical/Topical Report.