MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

September 5, 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-12237

Subject: MHI's Response to US-APWR DCD RAI No. 941-6465 Revision 3 (SRP Section 14.03.04)

Reference: 1) "Request for Additional Information No. 941-6465 Revision 3, SRP Section: 14.03.04, dated May 21, 2012.

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. 941-6465 Revision 3".

Enclosed is the response to the questions that are 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 of the response (Enclosure 2), a copy of the non-proprietary version of the response (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.

D081
NRO

Enclosure:

1. Affidavit of Yoshiki Ogata

2. Response to Request for Additional Information No. 941-6465 Revision 3 (proprietary version)

3. Response to Request for Additional Information No. 941-6465 Revision 3 (non-proprietary version)

CC: J. A. Ciocco
J. Tapia

Contact Information
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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-12237

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, 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 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. 941-6465 Revision 3" dated September 5, 2012 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 includes instrumentation and dimensional details for MHI's advanced accumulator being used in the US-APWR.

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 advanced accumulator.

B. Loss of competitive advantage of the US-APWR created by benefits of the advanced accumulator instrumentation or dimensional specifications.

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 September, 2012.

Y. Ogata

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

Enclosure 3

UAP-HF-12237
Docket No. 52-021

Response to Request for Additional Information No. 941-6465
Revision 3

September 2012
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/5/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 941-6465 REVISION 3**
SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-43

In Tier 1 Table 2.4.1-2, ITAAC 14, the ITAAC lacks sufficient details/specificity to assure successful completion (e.g. required location of the specimen guides on the RV).

ANSWER:

The DD and DC of Tier 1 Table 2.4.1-2, ITAAC 14 will be revised to verify the surveillance guide baskets are attached to the core barrel and hold the surveillance specimens

The ITA and AC of Tier 1 Table 2.4.1-2, ITAAC 14 will be separated into two parts:

1) Inspection to verify that four as-built surveillance capsule guide baskets are attached to the as-built core barrel in accordance with the design basis (i.e., as shown in DCD Tier 2 Figure 5.3-1), and
2) Determine that the surveillance capsules are in the locations required the by analyses and to inspect verify that the six as-built surveillance capsules are placed at the required location in the as-built surveillance capsule guide baskets.

DCD Tier 2 Figure 5.3-1 will be revised to clarify the design basis location of the four surveillance capsule guide baskets that hold six surveillance capsules.

Impact on DCD

DCD Tier 1 Table 2.4.1-2, ITAAC 14 will be revised as shown in Attachment 1. DCD Tier 2 Figure 5.3-1 will be revised as shown in Attachment 1.

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 Reports

There is no impact on the Technical / Topical Reports.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

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SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-44

In Tier 1 Table 2.4.2-5, ITAAC 10.a.ii "Tests and analyses in accordance with ASME Code Section III of the pressurizer safety valves identified in Table 2.4.2-2 will be performed to confirm set pressure." It appears testing is sufficient, what is the analysis included in the ITA for?

ANSWER:

"Analyses" will be deleted from the ITA of Tier 1 Table 2.4.2-5, ITAAC 10.a.ii, because according to ASME Code Section III a "test" is sufficient to verify the set pressure of the ASME Code Section III safety valves identified in Table 2.4.2-2.

Impact on DCD

Tier 1 Table 2.4.2-5, ITAAC 10.a.ii will be revised as shown in Attachment 2.

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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-45

Tier 1 Table 2.4.4-5, ITAAC 1 references Tier 1, Figure 2.4.4-1. This figure is not consistent with the SRP. Not all components specified in the SRP are included (e.g. ASME CL 2 seismic category 1 relief valves and HCV, important alarms and instrumentation, etc...).

ANSWER:

MHI will not revise Tier 1, Figure 2.4.4-1 to incorporate information on ASME CL 2 seismic category 1 relief valves, HCV or important alarms and instrumentation due to the following reasons:

1. Important alarms and instrumentation
   - Table 2.4.4-4, Emergency Core Cooling System Equipment, Alarms, Displays and Control Functions list all the equipment including alarms and instruments for verification of their function, which will be verified by ITAAC 2.4.4-5 #8, 2.4.4-5 #10.a, 2.4.4-5 #11, 2.4.4-5 #12.i and 2.4.4-5 #12.ii. SRP 14.3 Appendix C I.B.v requests "As a minimum, the instruments (pressure, temperature, etc.) required to perform Generic Technical Guidelines (e.g., ERGs, EPGs) (as described in the DCD Tier 2 Chapter 18) should be shown on the figures, **or described in the DD**."
   - In addition, instrument connection configurations may change as detailed engineering progresses.

2. HCVs
   - The Emergency Core Cooling System (ECCS) has two remote manual control valves (hand control valves, HCV), SIS-HCV-017 and SIS-HCV-089. Neither HCV has an active safety function nor receives a safety injection signal: SRP 14.3 Appendix C, I.B. ix does not stipulate that this kind of valve should be shown on a P&ID. In addition, the risk significance of these valves has been evaluated to be low and neither valve is included in DCD Table 17.4-1, "Risk Significant SSCs". Therefore, neither valve will be included in the figure.

SRP 14.3 Appendix C I.B. ix

Figures for safety-related systems should include most of the valves on the DCD Tier 2 P&ID except for items, such as fill, drain, test tees, and maintenance isolation valves. The scope of valves to be included on the figures are those MOVs, POVs, and check valves with a safety related active function, a complete list of which is contained in the IST plan. Valves remotely operable from the Control Room should be shown if their mispositioning could affect system safety function. Other valves are evaluated for exclusion on a case-by-case basis. Figures for non-safety related systems may have less detail.

3. ASME CL 2 seismic category 1 relief valves

- Five (5) ECCS relief valves, SIS-SRV-116 and SIS-SRV-126 A, B, C, D, protect the accumulator nitrogen supply piping and/or the accumulators from overpressurization. These valves do not have specific active safety function that is assumed in the accident analyses and their risk significance has been determined to be low so neither valve is included in DCD Table 17.4-1, "Risk Significant SSCs". Therefore these valves are below threshold for an ITAAC entry.

  SRP 14.3 Appendix A states as follows:

  The level of detail in Tier 1 is governed by a graded approach to the SSCs of the design, based on the safety significance of the functions they perform. [underline added by author]

- Although SRP 14.3 Appendix C Section I.B. "Figures", item ix states that MOVs, POVs and check valves with a safety related active function should be included in Tier 1, relief valves are not stipulated as valves that need be illustrated in P& ID diagrams in Tier 1.

- SRP 14.3, Appendix C, Section I.B. "Figures", item iv states that ASME Code class boundaries for mechanical equipments and piping are shown on the figure. Although these relief valves in the ECCS would form the code class boundaries between class 2 and Non code, it is MHI's policy, in order to simplify the figures, that not all ASME Code class boundaries like local vent/drain valves should be identified in the Tier 1. The figures focus only on the design features highly important to safety that are assumed in the plant accident analyses. For example, major safety valves such as the Pressurizer safety valves, Main Steam safety valves, and RHR suction relief valves, which protect ASME Code class 1 components from overpressurization beyond design pressure, have been shown on the figure of the respective system.

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 Reports

There is no impact on the Technical / Topical Reports.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/5/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 941-6465 REVISION 3**
SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-46

Tier 1 Table 2.4.4-2 does not contain all required SSC's. See another RAI question shown below in regards to the inconsistency of Figure 2.4.4-1.

> "Tier 1 Table 2.4.4-5, ITAAC 1 references Tier 1, Figure 2.4.4-1. This figure is not consistent with the SRP. Not all components specified in the SRP are included (e.g. ASME CL 2 seismic category 1 relief valves and HCV, important alarms and instrumentation, etc...)."

ANSWER:

MHI will not revise Table 2.4.4-2 Emergency Core Cooling System Equipment Characteristics to incorporate information on ASME CL 2 seismic category 1 relief valves and HCV, important alarms and instrumentation, with regard to the question No.14.03.04-46 due to the following reasons:

1. Important alarms and instrumentation
    - Table 2.4.4-4, Emergency Core Cooling System Equipment, Alarms, Displays and Control Functions lists all the equipment including alarms and instruments for verification of their function, which will be verified by ITAAC 2.4.4-5 #8, 2.4.4-5 #10.a, 2.4.4-5 #11, 2.4.4-5 #12.i and 2.4.4-5 #12.ii. SRP 14.3 Appendix C.I.B.v requests "As a minimum, the instruments (pressure, temperature, etc.) required to perform Generic Technical Guidelines (e.g., ERGs, EPGs) (as described in the DCD Tier 2 Chapter 18) should be shown on the figures, **<u>or described in the DD</u>**."

2. HCVs
    - SIS-HCV-017 and SIS-HCV-089 are the HCVs in the ECCS. Neither of these valves has an active safety function and can be considered part of the ECCS piping system. In addition, the risk significance of these valves has been evaluated to be low so neither valve is included in DCD Table 17.4-1, "Risk Significant SSCs".

    - SRP 14.3 Appendix C, II.B.xi stipulates that "the flow control capability of control valves does not have to be tested in ITAAC".

3. ASME CL 2 seismic category 1 relief valves

- Five (5) ECCS relief valves, SIS-SRV-116 and SIS-SRV-126 A, B, C, D, protect the accumulator nitrogen supply piping and/or the accumulators from overpressurization. These valves do not have specific active safety function that is assumed in the accident analyses and thus MHI considers the importance of these valves is comparatively low. In addition, their risk significance has been determined to be low so none of these valves are included in DCD Table 17.4-1, "Risk Significant SSCs". Therefore, these valves are under threshold for an ITAAC entry.

  SRP 14.3 Appendix A states as follows:

  The level of detail in Tier 1 is governed by a graded approach to the SSCs of the design, based on the safety significance of the functions they perform. (underline by author)

- SRP 14.3 Appendix D, ITAAC ENTRIES – EXAMPLES does not specifically stipulate relief valves as for ITAAC entry.

- The relief valves in the ECCS form the ASME Code class boundary between Class 2 and the non code portion of the system. However, it is MHI's policy to apply a graded approach so that not all ASME code class boundaries like local vent/drain valves are identified in the Tier 1 Tables.

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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-47

Tier 1 Table 2.4.4-3, as written the 4th row does not contain all required piping. Please correct.

ANSWER:

All of the piping shown on Tier 2 Figure 6.3-2 is included in either the 2nd or 4th row of Tier 1 Table 2.4.4-3. Comparison of the 4th row of Tier 1 Table 2.4.4-3 and Tier 2 Figure 6.3-2 "ECCS Piping and Instrumentation Diagram" shows that no piping in the segment has been omitted from the 4th row in Table 2.4.4-3 "Hot leg injection piping upstream of but excluding the 4 motor operated valves SIS-MOV-014 A, B, C, D". This segment represents the piping between the MOVs and the branch from the SIS reactor vessel direct injection (DVI) lines. These lines are listed in the 2nd row of the same table identified as "SI piping and valves upstream of and excluding the check valve SIS-VLV-012 A, B, C, D upstream of the DVI Penetration."

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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-48

Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a, "An injection test **with low tank pressure** condition for each as-built accumulator will be conducted. The test will be initiated by opening isolation valve(s) in the piping being tested. Each as-built accumulator will be **partially filled with water** and **pressurized with nitrogen.** All valves in these lines will be open during the test. An analysis will be performed to determine the water volume injected." The ITA lacks specificity to ensure a successful test (e.g. low tank pressure, partially filled).

ANSWER:

The exact test conditions are not considered to be necessary to specify in the ITA in Tier 1 Table 2.4.4-5, ITAAC 7.b.1.a. However, the pre-operational test will be performed with similar conditions as those used in Case 7 in the advanced accumulator topical report (MUAP-07001). The pre-operational test will be performed at a lower accumulator pressure (MUAP-07001-R4, p. 4.2.4-7) than during design-basis conditions. In addition, the exact accumulator tank water level for the test is not an important parameter.

An analysis will be performed to extrapolate the pre-operational test conditions to design-basis conditions to verify that the injected water volumes from the accumulator meet the minimum Tier 2 injected volumes during design-basis conditions. Design-basis conditions for the accumulator consist of a pressure of 586 – 695 psig (DCD Tier 2 Ch. 16, SR 3.5.1.3) and a water volume of 19,338 – 19,734 gallons (DCD Tier 2 Ch. 16, SR 3.5.1.2).

The ITA and AC criteria for Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a will be revised as shown in Attachment 3 to indicate that the specified acceptance criteria are for design-basis conditions.

Impact on DCD

Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a will be revised as shown in Attachment 3.

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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-49

Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a – "The water volume injected from each accumulator into reactor vessel at large flow rate (prior to flow switching to small flow rate) is ≥ 1326.8 ft3." The AC is not consistent with the Tier 2 information which specifies ≥ 1,342 ft3.

ANSWER:

DCD Tier 2, Rev. 3, Table 6.3-5 lists the (minimum) large flow injection volume as 1326.8 ft^3 with a note explaining that the nominal large flow injection volume is 1,342 ft^3.

The minimum large flow injection volume includes a margin for water-level uncertainty in the switchover from large flow injection to small flow injection, as discussed in the advanced accumulator topical report (MUAP-07001). This margin is calculated from the maximum flow switching water level observed during scale testing and the nominal accumulator diameter. The maximum flow switching uncertainty, including instrument error, was [ ] mm ([ ] inches) above the anti-vortex cap (MUAP-07001-R4, Table 5.2-1), and the nominal accumulator diameter is [ ] mm ([ ] inches) (MUAP-07001-R4, Fig. 3.2-1). This corresponds to a maximum large flow injection volume uncertainty of 15.2 ft^3.

DCD Tier 2, Subsection 6.3.2.2.2 and Table 6.3-5, will be revised as shown in Attachment 4 to clarify use of the switchover volume uncertainty.

Impact on DCD

DCD Tier 2, Subsection 6.3.2.2.2 and Table 6.3-5, will be revised as shown in Attachment 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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-50

Tier 1 Table 2.4.4-5, ITAAC 7.b.i.b refers to Tier 1 Table 2.4.4-6, which contains formulas for accumulator resistance coefficients with and uncertainty factor. What constitutes the uncertainty (%)?
Also, for ITAAC 7.b.i.b, what are the conditions for the test? Is this a DAC?

ANSWER:

DCD Tier 1 Table 2.4.4-6 includes requirements for the accumulator system resistance, which includes the advanced accumulator as well as the attached injection piping and valves. The advanced accumulator resistance is calculated from the characteristic equation as a function of the cavitation factor and was developed from tests of its hydraulic performance as discussed in MUAP-07001 Rev. 4. MUAP-07001, Sections 5.1 and 5.4, discuss the components of the accumulator uncertainty.

The pre-operational test conditions for ITAAC 7.b.i.b will be similar to those used for Case 7 in the advanced accumulator topical report (MUAP-07001). This test will be performed at a lower accumulator pressure than during normal operation and with the reactor vessel at atmospheric pressure. A single injection will be performed and accumulator tank, flow, and injection pipe discharge pressure will be measured. An analysis will be performed to calculate the system resistance coefficients during the injection to demonstrate that as-built accumulator system resistance is within the uncertainty band of the accumulator hydraulic performance characteristic equation in Tier 2.

The characteristic equation and its uncertainty are not part of the design acceptance criteria since neither is dependent on the as-built equipment. This information is documented in MUAP-07001, which is incorporated by reference into Tier 2.

DCD Tier 1 Table 2.4.4-6 will be revised as shown in Attachment 5 to refer to and use consistent terminology as MUAP-07001. MUAP-07001 is revised as shown in Attachment 6 to include discussion of the resistance and uncertainty range for the as-built full-scale accumulator. Resistance coefficients and uncertainty for the accumulator injection piping are given in DCD Tier 2 Table 6.3-5.

Impact on DCD

DCD Tier 1 Table 2.4.4-6 will be revised as shown in Attachment 5 and MUAP-07001 will be revised as shown in Attachment 6.

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 Reports

MUAP-07001, "The Advanced Accumulator", Revision 4, will be revised as shown in Attachment 6.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-51

Tier 1 Table 2.4.4-5, ITAAC 7.b.ii – The ITA lacks specificity to assure a successful test. What is the minimum flow rate? Is the RV filled and at ATM pressure or empty (i.e. is there any backpressure)? There is no AC specified for the design condition. Was there meant to be?

ANSWER:

The test condition and the design condition are same. The intent of the analysis is to convert measured test values into pump differential head (i.e., in order to calculate differential total pressure).

Safety injection pump flow performance requirements are shown in DCD Tier 2 Figure 6.3-4. Safety injection flow characteristics for minimum and maximum safeguards are provided for the system in DCD Tier 2 Figure 6.3-15 and Figure 6.3-16. These curves are used for the basis to evaluate the safety injection flow rate in the safety analyses and the Safety Injection Pump differential head and flow rate requirements. This is the original intent of this ITAAC.

The ITA for Tier 1 Table 2.4.4-5, ITAAC 7.b.ii will be revised as shown in Attachment 7 to clarify the purpose of analysis.

Impact on DCD

The ITA for Tier 1 Table 2.4.4-5, ITAAC 7.b.ii will be revised as shown in Attachment 7.

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 Reports

There is no impact on the Technical / Topical Reports.

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APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-52

Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.a – Performance of the ITAAC should be completed by a vendor test measuring the amount of water to fill it. How do you accurately account for the materials/components inside the accumulator?

ANSWER:

Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.a will be revised as shown in Attachment 1 to require inspections and analyses of each as- built accumulator. Inspection will measure dimensions of each accumulator at vendor facility and the analyses will be used determine the net volume of the accumulator. This verification at the vendor facility ensures that the as-built accumulators have appropriate volume as specified in the acceptance criteria.

Impact on DCD

The DC and ITA of Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.a will be revised as shown in Attachment 1.

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 Reports

There is no impact on the Technical / Topical Reports.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/5/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 941-6465 REVISION 3**
SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-53

Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.b – Performance of the ITAAC should be by test measuring the amount of water to fill it. How do you account for the materials/components inside it?

ANSWER:

Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.b will be revised to require inspection and analysis of each as built RWSP. The analyses will conservatively calculate the volume of materials and components inside the RWSP.

Impact on DCD

The ITA and AC of Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.b will be revised as shown in Attachment 7.

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 Reports

There is no impact on the Technical / Topical Reports.

9/5/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 941-6465 REVISION 3**
SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-54

Tier 1 Table 2.2.4-5, Should an ITAAC exist for the accumulator and N2 header relief valves?

ANSWER:

The accumulator and N2 header relief valves are not required to be in the scope of the ITAAC due to the same reasons as the response to Question 14.03.04-46.

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 Reports

There is no impact on the Technical / Topical Reports.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/5/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 941-6465 REVISION 3**
SRP SECTION:	**14.03.04 – REACTOR SYSTEMS – INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA**
APPLICATION SECTION:	**TIER 1 2.4**
DATE OF RAI ISSUE:	**5/21/2012**

QUESTION NO.: 14.03.04-55

Tier Table 2.4.6-5, ITAAC 6.a – "The Class 1E equipment identified in Table 2.4.6-2 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function." Table 2.4.6-2 appears to be inconsistent with Table 3D-2 in Tier 2 (e.g. Table 3D-2 identifies CVS-MOV-151 & 152 as being EQ for a harsh radiation environment yet Table 2.6.4-2 identifies them as not being Qual. for a Harsh Environment.

ANSWER:

Refer to the answer in the response to RAI 945-6452 question 14.03-13.

Impact on DCD

Refer to the impact on DCD in the response to RAI 945-6452 question 14.03-13.

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 Reports

There is no impact on the Technical / Topical Reports.

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

8. The seismic Category I equipment identified in Table 2.4.1-1 can withstand seismic design basis loads without loss of safety function.

9. The reactor internals can withstand flow-induced vibration.

10. The Class 1E equipment identified in Table 2.4.1-1 as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.

11. Class 1E equipment, identified in Table 2.4.1-1, is powered from its respective Class 1E division.

12. Separation is provided between redundant divisions of reactor system Class 1E cables, and between Class 1E cables and non-Class 1E cables.

13. Displays identified in Table 2.4.1-1 are provided in the MCR.

14. ~~Irradiation specimen guides~~Surveillance capsule guide baskets are attached to the core barrel to hold capsules with material surveillance specimens. DCD_14.03.04-43

2.4.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.1-2 describes the ITAAC for the reactor system.

Table 2.4.1-2 Reactor System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria	
14.i ~~Irradiation specimen guides~~Surveillance capsule guide baskets are attached to the core barrel to hold capsules with material surveillance specimens.	14.i Inspection of the as-built core barrel will be performed for the existence of the ~~irradiation specimen guides and existence of surveillance capsules~~surveillance capsule guide baskets.	14.i ~~Irradiation specimen guides~~Four surveillance capsule guide baskets are attached to the as-built core barrel ~~and a minimum of three as-built surveillance capsules are provided~~as described in the design basis.	DCD_14.03.04-43
	14.ii Analysis and inspection will be performed to determine the existence and location of the surveillance capsules in the as-built surveillance capsule baskets.	14.ii Six surveillance capsules are provided at the location in the as-built surveillance capsule guide baskets determined by the analysis.	DCD_14.03.04-43

DCD_14.03.
04-43

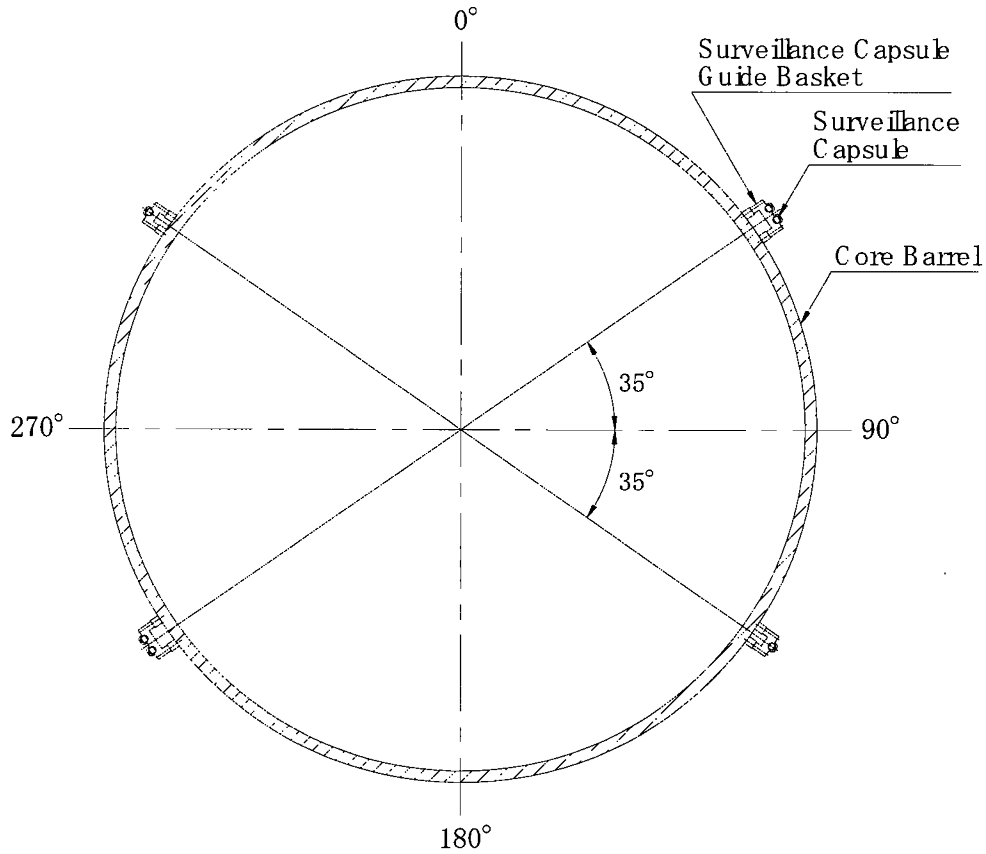

Figure 5.3-1 Orientation of Surveillance Capsules

Table 2.4.2-5 Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.c Separation is provided between redundant divisions of RCS Class 1E cables, and between Class 1E cables and non-Class 1E cables.	9.c Inspections of the as-built Class 1E divisional cables will be performed.	9.c Physical separation or electrical isolation is provided in accordance with RG 1.75, between the as-built cables of redundant RCS Class 1E divisions and between Class 1E cables and non-Class 1E cables.
10.a The pressurizer safety valves identified in Table 2.4.2-2 provide overpressure protection in accordance with the ASME Code Section III.	10.a.i Inspections of the pressurizer safety valves identified in Table 2.4.2-2 will be conducted to confirm that the value of the ASME Code nameplate rating is greater than or equal to system relief requirements.	10.a.i The minimum capacity of each pressurizer safety valve identified in Table 2.4.2-2 is greater than or equal to 432,000 lb/hr.
	10.a.ii Tests~~ and analyses~~ in accordance with ASME Code Section III of the pressurizer safety valves identified in Table 2.4.2-2 will be performed to confirm set pressure.	10.a.ii ~~A report exists and concludes the following as-built~~The pressurizer safety valves~~,~~ identified in Table 2.4.2-2~~, set pressure;~~ have a set pressure of ≥ 2435 psig and ≤ 2485 psig.
10.b Each RCP flywheel assembly can withstand a design overspeed condition.	10.b Tests of each as-built RCP flywheel assembly will be performed at overspeed conditions.	10.b Each as-built RCP flywheel assembly can withstand an overspeed condition of no less than 125% of operating speed.
10.c RCPs have a rotating inertia to provide RCS flow coastdown on loss of power to the pumps.	10.c Tests will be performed to determine the RCP flow coastdown curve.	10.c The RCP flow coastdown provides RCS flows greater than or equal to the flow shown in Figure 2.4.2-3.
10.d The RCS provides circulation of coolant through the reactor core.	10.d Tests and analyses to measure RCS flow with the as-built four reactor coolant pumps operating at no-load RCS pressure and temperature conditions will be performed. Analyses will be performed to convert the measured pre-fuel load flow to post-fuel load flow with 10% steam generator tube plugging.	10.d A report exists and concludes that the calculated reactor coolant flow rate per loop with 10% steam generator plugging is at least 112,000 gallons per minute.

DCD_14.03.05-44

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 5 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.b Class 1E equipment, identified in Table 2.4.4-2, is powered from its respective Class 1E division.	6.b A test will be performed on each division of the as-built Class 1E equipment identified in Table 2.4.4-2 by providing a simulated test signal only in the Class 1E division under test.	6.b The simulated test signal exists at the as-built Class 1E equipment identified in Table 2.4.4-2 under test.
6.c Separation is provided between redundant divisions of ECCS Class 1E cables, and between Class 1E cables and non-Class 1E cables.	6.c Inspections of the as-built Class 1E divisional cables will be performed.	6.c Physical separation or electrical isolation is provided in accordance with RG 1.75, between the as-built cables of redundant ECCS Class 1E divisions and between Class 1E cables and non-Class 1E cables.
7.a Deleted.	7.a Deleted.	7.a Deleted.
7.b The ECCS provides RCS makeup, boration, and safety injection during design basis events.	7.b.i.a An injection test with low tank pressure condition for each as-built accumulator will be conducted. The test will be initiated by opening isolation valve(s) in the piping being tested. Each as-built accumulator will be partially filled with water and pressurized with nitrogen. All valves in these lines will be open during the test. An analysis will be performed to determine the water volume injected under design-basis conditions.	7.b.i.a A report exists and concludes that the total water volume injected from each as-built accumulator into the reactor vessel is ≥2126 ft^3 under design-basis conditions. DCD_14.03. 05-48 The water volume injected from each accumulator into reactor vessel at large flow rate (prior to flow switching to small flow rate) is ≥1326.8 ft^3 under design-basis conditions. DCD_14.03. 05-48
	7.b.i.b Tests and analyses of the as-built accumulator system will be performed to calculate the resistance coefficients of the as-built accumulator system.	7.b.i.b A report exists and concludes that the calculated resistance coefficients of the as-built accumulator system (based on a cross-section area of 0.6827 ft^2) meet the requirements shown in Table 2.4.4-6.

three accumulators to account for unavailability of flow from the accumulator installed on the broken loop during a LOCA whose contents are assumed to spill to the containment so that it does not contribute to the core injection. One third of the remaining accumulator volume is also assumed to be lost to the spill through the postulated pipe break. Two thirds of the remaining accumulator volume is available for injection. The required capacity of each accumulator at the large injection flow rate is approximately 1,307 ft^3, which is increased to ~~approximately~~a nominal value of 1,342 ft^3 to include design margin. Uncertainty for switching between the large flow and small flow injection modes is also considered. Based on the water level uncertainty for switchover and nominal accumulator tank diameter given in Ref. 6.3-3, 15.2 ft^3 is included for switchover volume uncertainty. This gives a minimum required large flow injection volume for the as-built accumulators of 1326.8 ft^3. DCD_14.03.05-49

To maintain downcomer water level and establish post-LOCA core re-flood conditions, large accumulator injection flow is followed by an assumed 180 seconds of accumulator injection flow at a small flow rate (followed by the injection flow from the SI pumps). The required capacity of each accumulator at the small injection flow rate is approximately 724 ft^3, which is increased to approximately 784 ft^3 (Ref. 6.3-3).

The volume of each accumulator (2,126 ft^3) includes the volume (1,342 ft^3 plus 784 ft^3) associated with both the large and small injection flow rates, respectively. Considering the total water volume (2,126 ft^3) and adding the volume of gas space and dead water volume, the required volume of a single accumulator is 3,180 ft^3 (Ref. 6.3-3).

The design temperature of the accumulator is 300°F which is consistent with the design temperature of the containment where the accumulators are located. The design pressure of the accumulator is 700 psig. This value provides margin to the normal operating pressure (i.e., nitrogen pressure) of 640 psig.

The flow rate coefficient and uncertainty of the flow damper is described in Ref. 6.3-3 and Ref. 6.3-4.

6.3.2.2.3 Refueling Water Storage Pit

The RWSP is designed to have a sufficient inventory of boric acid water for refueling and long-term core cooling during a LOCA. ~~A minimum of 81,230~~84,750 ft^3 ~~of available water~~ is required in the RWSP. Sufficient submerged water level is maintained to secure the minimum NPSH for the SI pumps. The RWSP capacity includes an allowance for instrument uncertainty and the amount of holdup volume loss within the containment. The capacity of the RWSP is optimized for a LOCA in order to prevent an extraordinarily large containment. Therefore, a refueling water storage auxiliary tank containing 29,410 ft^3 is provided separately outside the containment to ensure that the required volume for refueling operations is met. Table 6.3-5 presents the relevant RWSP data. Detail description of structure and capacity of RWSP is provided in Subsection 6.2.2.2. MIC-03-06-00070

The temperature during normal operation is in a range of 70 to 120°F. ~~The peak temperature following a LOCA is approximately 250°F.~~The peak temperature following a LOCA is 256°F, and the maximum design temperature is 270°F. MIC-03-06-00051 MIC-03-06-00070

Table 6.3-5 Safety Injection System Design Parameters (Sheet 2 of 3)

Description	Specification
Accumulator Safety Valve	1,500 ft^3/min (N_2) at 700 psig
Accumulator N_2 Supply Line Safety Valve Capacity	1,500 ft^3/min (N_2) at 700 psig
Fluid	Boric Acid Water (Approximately 4,000 ppm)
Material of Construction	Carbon steel vessel with stainless steel cladding
Auxiliaries	Flow Damper
Water Volume	≥2,126 ft^3 Note 1
Large Flow Injection Volume	≥1,326.8 ft^3 Note 2
Equipment Class	2
Seismic Category	I
Accumulator Injection Line Resistance	
Piping and Valves Equivalent Length (L/D)	≥ 461.7 ≤ 564.3
Orifice and Pipe Exit Resistance Coefficient	≥ 1.99 ≤ 2.21
NaTB Basket	
Type	Rectangular
Number	23
Total Buffering Agent Quantity (minimum)	44,100 pounds
Design Pressure	Atmosphere
Design Temperature	300°F
Normal Operating Temperature	70 ~120°F
Buffering Agent	Sodium Tetraborate Decahydrate
Material of Construction	Stainless Steel
Equipment Class	2
Seismic Category	I

Note:

1. This volume does not include dead volume.
2. Nominal value is 1,342 ft^3 including 15.2 ft^3 for switchover volume uncertainty.
3. Detail of NPSH available is described in Reference 6.2-34.

DCD_14.03.05-49
MIC-03-06-00064

Table 2.4.4-6 Requirement for Accumulator System Resistance Coefficient (Sheet 1 of 2)

DCD_14.03.04-50

Operation mode	Resistance coefficient of accumulator system (based on a cross-section area of 0.6827 ft^2)
Large flow injection	$\geq \frac{1}{[x\{0.7787-0.6889\exp(-0.5238\sigma_V)\}]^2}+461.7f+1.99$ $\leq \frac{1}{[y\{0.7787-0.6889\exp(-0.5238\sigma_V)\}]^2}+564.3f+2.21$ Where ~~σ_V :cavitation factor~~ ~~$x = 1+\frac{uncertainty(\%)}{100}$~~ ~~$y = 1-\frac{uncertainty(\%)}{100}$~~ ~~f : friction factor of piping~~ σ_V: Cavitation Factor σ_i: 1/2-scale test instrument standard uncertainty σ_D: 1/2-scale dispersion standard uncertainty σ_m: Manufacturing standard uncertainty δCv_{scale}: Scale effect bias u_{scale}: Scale effect standard uncertainty f: Friction Factor $x = 1+\left[1.96(\sigma_i^2+\sigma_D^2+\sigma_m^2+u_{scale}^2)^{1/2}+\delta Cv_{scale}\right]$ $y = 1-\left[1.96(\sigma_i^2+\sigma_D^2+\sigma_m^2+u_{scale}^2)^{1/2}+\delta Cv_{scale}\right]$

DCD_14.03.04-50

DCD
14.03.05-50

Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 6 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria	
	7.b.ii The as-built safety injection pump injection test will be performed. Analysis will be performed to convert the test results ~~from the test conditions to the design condition~~into a pump differential head.	7.b.ii A report exists and concludes that each as-built safety injection pump has a pump differential head of no less than 3937 ft and no more than 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.	DCD_14.03.04-51
	7.b.iii.a Inspections and analyses of each as-built accumulator will be conducted.	7.b.iii.a ~~The~~A report exists and concludes that the volume of each as-built accumulator is at least 3,180 ft^3	DCD_14.03.04-52
	7.b.iii.b Inspections and analyses of the as-built RWSP will be conducted.	7.b.iii.b ~~The~~A report exists and concludes that the volume of the as-built RWSP is at least ~~81,230~~84,750 ft^3	DCD_14.03.04-53 MIC-03-T1-00006
	7.b.iv Inspection and analysis of the as-built ECC/CS suction strainers will be conducted.	7.b.iv A report exists and concludes that each of the four as-built ECC/CS suction strainers have the following features: stainless steel materials of construction for corrosion resistance; a minimum strainer surface area ~~of 3510 square feet~~of 2,754 ft^2; perforated plate with maximum hole diameter of 0.066 inches; remains submerged under design basis accident conditions; achieves head loss consistent with design basis NPSH evaluations	MIC-03-T1-00003 MIC-03-T1-00006
	7.b.v Inspections and analyses of the as-built coatings used in the containment will be conducted.	7.b.v A report exists and concludes that the as-built coatings used in the containment are consistent with the ECC/CS suction strainer debris generation, debris transport and downstream effects evaluations.	