MITSUBISHI HEAVY INDUSTRIES, LTD.
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TOKYO, JAPAN

April 20, 2010

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-10112

Subject: MHI's Responses to US-APWR DCD RAI No.553-4357 Revision 2

References: 1) "REQUEST FOR ADDITIONAL INFORMATION 553-4357 REVISION 2, SRP Section: 06.02.04 – Containment Isolation System Application Section: 6.2.4, QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)" dated March 16, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document as listed in Enclosures.

Enclosed are the responses to questions 6.2.4-53 and 54 of the RAI (Reference 1). This completes the response for this RAI.

As indicated in the enclosed materials, this submittal contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2), a copy of the non-proprietary version (Enclosure 3), and the Affidavit of 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 this submittal. His contact information is provided below.

Sincerely,

Atsushi Kumaki for

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

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NRO

Enclosures:

1. Affidavit of Atsushi Kumaki
2. Response to Request for Additional Information No. 553-4357, Revision 2 (Proprietary Version)
3. Response to Request for Additional Information No. 553-4357, Revision 2 (Non-Proprietary Version)

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

Contact Information

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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-10112

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Atsushi Kumaki, state as follows:

1. I am Group Manager, Licensing Promoting Group in 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. 553-4357, Revision 2", and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages contain 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 technique of the hydrogen burning analysis results related to the US-APWR severe accident analytical models developed by MHI.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

A. Loss of competitive advantage due to the costs associated with the development of the methodology related to the analysis.

B. Loss of competitive advantage of the US-APWR created by the benefits of the modeling information.

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 20th day of April 2010.

Atsushi Kumaki

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

Enclosure 3

UAP-HF-10112
Docket No. 52-021

Response to Request for Additional Information No. 553-4357,
Revision 2

April 2010
(Non-Proprietary)

4/19/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 553-4357 REVISION 2**
SRP SECTION:	**06.02.04 – CONTAINMENT ISOLATION SYSTEM**
APPLICATION SECTION:	**6.2.4**
DATE OF RAI ISSUE:	**3/16/2010**

QUESTION NO.: 06.02.04-53
RAI 6.2.4-53:

Clarify test, vent and drain configurations on the spare and the electrical penetrations such that an evaluation can be made if each connection can be leak rate tested in accordance with RG-1.163. Clarify severe accident performance requirements for containment penetrations and other instrumentation.

The staff requested in RAI 6.2.4-22 that the applicant provide descriptions of the accommodations for leakage testing that are provided for in the spare penetration design.

In a letter dated September 22, 2008, Mitsubishi responded to RAI 6.2.4-22 that MHI will revise the DCD to provide descriptions of the accommodations for leakage testing for the spare penetrations in DCD Subsection 6.2.6.2 and that MHI will revise Table 6.2.4-3 to add available data for the spare penetrations.

MHI also indicated that Figure 6.2.4-1 will be updated to show the required test connections.

Based on a review of DCD Revision 2 the following additional information is needed:

1) The staff notes that the revised Figure 6.2.4.1 contains no sheet for the spare penetrations. Please describe the configuration of the 14 spare penetrations and provide a figure. Revise Table 6.2.4-3 to reference the arrangement configuration illustrated for the spare penetrations in Figure 6.2.4-1.

2) The staff notes that sixty one electrical penetrations were added. Figure 6.2.4-1 sheet 51 was added to illustrate the test connection configuration. Revise Table 6.2.4-3 to reference sheet the arrangement configuration illustrated for the spare penetrations in Figure 6.2.4-1 sheet #51.

3) Revise DCD Tier 2 Table 6.2.4-2 to add the spare penetration and electrical penetration quality and seismic information.

4) The staff noted that the CCWS supply lines to the RCPs, penetrations#234 and 249 are listed as GDC 55 penetrations on table 6.2.4-3. However DCD Tier 2 paragraph 6.2.4.3.2 lists these penetrations as subject to GDC 56. Please clarify the classification of these lines in the DCD.

5) DCD Tier 2 section 19.2.3.3.7 has identified containment penetrations among others as components used in severe accident mitigation. The severe accident equipment survivability analysis The analysis states the following:

"An environmental condition under hydrogen burning by hydrogen ignition system operation has been evaluated using GOTHIC code. The peak temperature is approximately 1000°F in some compartments and in a specific timing such as core melt, RCS depressurization, and reactor vessel failure. The analysis results show that the duration with very high temperature such as 1000°F is considered sufficiently short and does not significantly damage the devices. The temperatures in most of the compartments are around 200°F.

Referring to existing experiments and the literatures (References 19.2-11, 19.2-12, and 19.2-13), it is confirmed through these studies that the systems and components in the US-APWR design are able to maintain safe shutdown and containment structural integrity with high confidence and to keep their functions under the postulated severe accident environmental conditions created by hydrogen burning."

How is this confirmed? 10 CFR 50.44(c)(3) requires all equipment and instrumentation in containment needed to establish and maintain safe shutdown and containment structural integrity must be capable of performing their function during and after exposure to the environmental conditions created by the burning of hydrogen, in an amount equivalent to that generated from a fuel clad-coolant reaction involving 100% of the fuel cladding.

Please provide the tier 2 design requirement for the containment penetrations that assure that the design insight from this study will be carried forward in procurement documents.

In addition to containment penetrations the chapter 19 equipment survivability analysis identified other equipment is mentioned such as depressurization valves. Some instrumentation would also be required to function after a severe accident.

Provide a specific list of equipment and instruments in the containment that is required to function after a severe accident, or provide a reference where such list is in the DCD.

Justify that this equipment and instrumentation will perform their severe accident function during and following a severe accident in containment at the environmental conditions created by hydrogen burning, or indicate where such justification is in the DCD.

Justify that the containment isolation valves, containment penetrations, air locks, hatches and gaskets will maintain their leak tightness during and following the environmental conditions created by hydrogen burning or indicate where such justification is in the DCD.

Provide the pressure and temperature conditions in containment during hydrogen burning that these instruments and components would be subject to and what each component will be procured to withstand. Identify design features, test results, or analyses which would confirm the equipment survivability, that is specific to the US-APWR design, or alternatively, provide the DCD design requirement for each cited instrument/ equipment that provides assurance that the results of the study are carried forward to procurement documents.

ANSWER:

1) The configuration of spare penetration will be added in Figure 6.2.4-1. Table 6.2.4-3 will be revised to add sheet number of spare penetration.

2) Table 6.2.4-3 will be revised to add sheet 51 for electrical penetration.

3) Table 6.2.4-2 will be revised to add the spare penetration and electrical penetration quality and seismic information.

4) Penetrations #234 and #249 are not subject to GDC 55 because these lines are not part of RCPB. So, these are subject to GDC 56. Table 6.2.4-3 will be revised to replace "55" with "56" in

these penetrations.

5) The detailed equipment survivability study is presented in Section 15.7 of the PRA technical report (MUAP-07030). The containment penetration to be important during severe accident is the electrical penetration which provides power to the hydrogen igniters. Mechanical penetrations are made by steel and tightly welded with the containment body. It has very strong robustness against temperature and pressure in nature. The containment penetrations considered in the equipment survivability study are therefore limited to the specific electrical penetration which is utilized as power supply to hydrogen igniters. Other electrical and mechanical penetrations are eliminated from the scope of this study.

The pressure and temperature transitions under hydrogen burning conditions have been evaluated and it shows that the peak temperature after hydrogen burn reaches higher than 1000°F. However, the peak temperature depends on the location in the containment, and this highest temperature greater than 1000°F is at the location that any containment penetrations do not exist. The temperature transitions where the considered electrical penetration exists are extracted from the PRA technical report Figures 15-63 and 15-67, as shown below.

Considering the above findings, the environmental condition required for the electrical penetration is determined that it must maintain its functions to supply power to hydrogen igniters and to maintain the leak-tightness for greater than 24 hours under the containment design pressure of 68psig and the design temperature of 300°F, with considering the instantaneous temperature rise due to hydrogen burn with its peak temperature to be as high as 400°F.

In order to address the above mentioned fact, MHI would like to change the description of DCD Tier 2 Section 19.2.3.3.7 to read:

The selected systems and components include containment penetrations, hydrogen igniters, depressurization valves used for severe accident mitigation, and containment pressure ~~monitors~~ (wide range).

Systems / Components	Timeframe required to be functional
(1) Containment penetration	After core damage
(2) Hydrogen igniter	After core damage
(3) Depressurization valve	After core damage till reactor vessel failure
(4) Containment pressure (wide range)	After core damage

An environmental condition under hydrogen burning by hydrogen ignition system operation has been evaluated using GOTHIC code. Detailed evaluation results are described in Section 15.7 of the PRA technical report "US-APWR Probabilistic Risk Assessment" (Reference 19.2-15). The environmental conditions above four systems/components must satisfy are following. ~~The peak temperature is approximately 1000°F in some compartments and in a specific timing such as core melt, RCS depressurization, and reactor vessel failure. The analysis results show that the duration with very high temperature such as 1000°F is considered sufficiently short and does not significantly damage the devices. The temperatures in most of the compartments are around 200°F.~~

(1) Containment penetration

The containment penetration to be important during severe accident is the electrical penetration which provides power to the hydrogen igniters. Mechanical penetrations are made by steel and tightly welded with the containment body. It has very strong robustness against temperature and pressure in nature. The containment penetrations considered in the equipment survivability study are therefore limited to the specific electrical penetration which is utilized as power supply to hydrogen igniters. Other electrical and mechanical penetrations are eliminated from the scope of this study.

The highest temperature where the considered electrical penetration exists is evaluated as slightly lower than 400°F and the steady-state temperature is around 200°F, which is lower than the containment design temperature of 300°F. The highest pressure is evaluated approximately 50 psig, which is lower than the containment design pressure of 68 psig. The amount of hydrogen burnt in this analysis is conservatively assumed to be 100% active fuel length cladding reaction, hence this analysis widely covers various uncertainties involved in the hydrogen generation and burn.

Considering the above findings, the environmental condition required for the electrical penetration is determined that it must maintain its functions to supply power to hydrogen igniters and to maintain the leak-tightness for greater than 24 hours under the containment design pressure of 68psig and the design temperature of 300°F, with considering the instantaneous temperature rise due to hydrogen burn with its peak temperature to be as high as 400°F.

(2) Hydrogen igniter

The hydrogen igniters can perform its function during and after exposure to the environmental conditions created by hydrogen burn. Through the equipment survivability study, it is evaluated that the peak temperature of containment atmosphere becomes as high as approximately 1200°F, and the temperature rise from 400°F and reduced back to 400°F due to hydrogen burn takes approximately 10 minutes. The amount of hydrogen burnt in this analysis is conservatively assumed to be 100% active fuel length cladding reaction, hence this analysis broadly covers various uncertainties involved in the hydrogen generation and burn.

Therefore, in terms of the equipment survivability, it is required that the hydrogen ignition system must keep its function longer than 10 minutes under the condition of containment atmosphere with higher than 400°F and its peak temperature to be as high as 1200°F.

(3) Depressurization valve

The severe accident scenarios have been further evaluated in the equipment survivability study, when and what conditions the depressurization valve (DV) is considered significant to establish and maintain safe shutdown and containment structural integrity. LOCA scenario is eliminated in nature, and only transient scenarios with high RCS pressure are in the focus. Accordingly, it has been concluded that the hydrogen burning condition does not directly affect the functionality of DV, which is to depressurize RCS after core is significantly damaged. This is because the condition of hydrogen-burn is resulted from the DV opening operation. DV is utilized to reduce the RCS pressure, i.e. if DV is not opened, hydrogen is not released to containment atmosphere. After DV is opened and hydrogen is released to the containment, DV is not necessary to work anymore. DV is only operated under severe accident conditions, in which core has already been significantly damaged. Under such situation, closing operation may not be significant and can be negligible.

Considering above insight, DV is not subject to hydrogen burning condition.

(4) Containment pressure (wide range)

The highest temperature where the containment pressure (wide range) exists is evaluated slightly below 800°F and the temperature rise from 400°F and reduced back to 400°F due to hydrogen burn takes approximately 2 minutes. The highest pressure evaluated from this study is approximately 50 psig, which is lower than the containment design pressure of 68 psig. The amount of hydrogen burnt in this analysis is conservatively assumed to be 100% active fuel length cladding reaction, hence this analysis widely covers various uncertainties involved in the hydrogen generation and burn.

Considering the above findings, the environmental condition required for the containment pressure (wide range) is determined that it must maintain its functions for longer than 2minutes under 400°F atmosphere, with considering the instantaneous temperature rise due to hydrogen burn with its peak temperature to be as high as 800°F.

These specific environmental conditions obtained from the equipment survivability study are addressed for the type test or analyses of these systems and components. It will be confirmed through the type test or analyses that the systems and components in the US-APWR design are able to maintain safe shutdown and containment structural integrity with high confidence and to keep their functions under the postulated severe accident environmental conditions created by hydrogen burning. These system design specifications will be appropriately carried forward in procurement documents.

~~Referring to e~~Existing experiments and the literatures (References 19.2-11, 19.2-12, and 19.2-13) are also appropriately referred to evaluate the US-APWR equipment survivability.~~, it is confirmed through these studies that the systems and components in the US-APWR design are able to maintain safe shutdown and containment structural integrity with high confidence and to keep their functions under the postulated severe accident environmental conditions created by hydrogen burning.~~

Impact on DCD

DCD will be revised in accordance with this RAI answer.

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA.

4/19/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: NO. 553-4357 REVISION 2

SRP SECTION: 06.02.04 – CONTAINMENT ISOLATION SYSTEM

APPLICATION SECTION: 6.2.4

DATE OF RAI ISSUE: 3/16/2010

QUESTION NO.: 06.02.04-54

RAI 6.2.4-54:

Clarify GDC 55 description in DCD.

The staff requested in RAI 6.2.4-34 that the applicant correct a typographical error in GDC 55 as described in Section 3.1.5.6. It appears that item #2 is the same as item #1 in the paragraph. Item #2 reads: One locked closed isolation valve inside and one locked closed isolation valve outside containment; or..."

The staff requested the applicant confirm that #2 should read: "One automatic isolation valve inside and one locked closed isolation valve outside containment; or..."

Mitsubishi responded to RAI 6.2.4-34 that DCD will be changed to incorporate the following:

Item #2 in subsection 3.1.5.6 will be revised "One automatic isolation valve inside and one locked closed isolation valve outside containment; or"

The staff has noted that this change was not made in DCD Revision 2. Clarify the DCD.

ANSWER:

Item #2 should be read as: "One automatic isolation valve inside and one locked closed isolation valve outside containment; or"

Impact on DCD

Subsection 3.1.5.6 of the DCD will be changed to incorporate the following:

Item #2 will be revised "One **automatic** ~~locked closed~~ isolation valve inside and one locked closed isolation valve outside containment; or"

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA.