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March 3, 2009

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-09072

Subject: MHI's Response to US-APWR DCD RAI No. 180-1594

References: 1) "Request for Additional Information No. 180-1594 Revision 0, SRP Section: 03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment, Application Section: 3.6.1," dated 2/05/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 180-1594 Revision 0."

Enclosed are the responses to 6 RAIs contained within Reference 1.

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,

Y. Ogata

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

Enclosures:

1. Response to Request for Additional Information No. 180-1594, Revision 0

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

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NRO

Contact Information

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Enclosure 1

UAP-HF-09072
Docket No. 52-021

Response to Request for Additional Information No. 180-1594, Revision 0

March, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/3/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-1

Branch Technical Position 3-3 Section B.2 "Design Features" states that protective structures and compartments should be designed to seismic Category I requirements. The staff's review of Tier 2 DCD Section 3.6.1 did not find confirmatory statement that the protective structures and compartments used to protect SSCs from pipe rupture would be designed to seismic standards.

The staff requests the applicant to include in the Final Safety Analysis Report (FSAR) the seismic standards that the protective structures and equipment use to protect SSCs from pipe rupture would be designed to.

ANSWER:

Subsection 3.6.1.2.2.2 of DCD Tier 2 will be revised to clarify that the protective structures, including compartments as applicable, are designed to withstand the effects of a postulated piping failure in combination with loadings associated with seismic Category I requirements, within the respective design load limits for the structures.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Subsection 3.6.1.2.2.2, Revision 2, changes to be incorporated:

- Change the third sentence of the first paragraph in Subsection 3.6.1.2.2.2 to "The barriers, including compartments as applicable, are designed to withstand loading generated by postulated jet forces and pipe whip impact forces in combination with loadings associated with seismic Category I requirements, within the respective design load limits for the structures."

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

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US-APWR Design Certification

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Docket No. 52-021

RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-2

In DCD Tier 1 and Tier 2, the applicant identified high- and moderate-energy piping (greater than 2.5 cm (1 inch) diameter) within the containment vessel and the reactor building. The staff was unable to confirm that US-APWR systems are properly identified all high- and moderate-energy piping systems since the maximum normal operating pressures and temperatures are not specified. The staff also noted that some systems that typically are considered high or moderate energy system for a PWR were not included in these lists.

The staff requests the applicant to update the FSAR to include the maximum normal operating pressures and temperatures for all the fluid containing systems.

ANSWER:

The design documents for the US-APWR provide the maximum normal operating pressures and temperatures for all fluid containing systems, which use the criteria and assumptions presented in Branch Technical Position (BTP) 3-3 to identify high- and moderate-energy piping systems. A survey of the NRC's Standard Review Plans (SRPs) and the Design Control Documents (DCDs) for other nuclear plant designs has concluded that maximum normal operating pressures and temperatures for all fluid containing systems are not traditionally controlled within the DCD.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-3

In DCD Tier 2, Appendix 3D "US-APWR Equipment Qualification List Safety and Important To Safety Electrical And Mechanical Equipment" the applicant identifies the systems and components important to plant safety or shutdown. However, the applicant has not identified which of the safety systems are located near to high- or moderate-energy piping systems. The applicant also failed to provide the layout of the site piping systems (the drawing should present the location of all the safety-related/important to safety SSCs, the pipe layout, and the barriers), in order to allow the staff to verify that all the SSCs that need to be protected have been identified.

The staff requests the applicant to provide detailed layout drawings of the site piping systems (the drawing should present the location of all the safety-related/important to safety SSCs, the pipe layout, and the barriers).

ANSWER:

Detailed layout drawings of the site piping systems, which include the location of all the safety-related/important to safety SSCs, the pipe layout, and the barriers, are available as part of US-APWR design documents. A survey of the NRC's Standard Review Plans (SRPs) and the Design Control Documents (DCDs) for other nuclear plant designs has concluded that the location of all the safety-related/important to safety SSCs, the pipe layout, and the barriers, are not traditionally controlled within the DCD.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

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Docket No. 52-021

RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-4

In DCD Tier 1 Section 2.2 "Structural and System Engineering," Table 2.2-4 "Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)," ITAAC 2.2-17 states that safety-related SSCs are designed to withstand the dynamic effects of pipe breaks. As described in DCD Tier 1 Section 1.4.5, all ITAAC items must be completed before fuel load. The staff finds that this closure schedule is inappropriate for ITAAC 2.2-17. In order to provide sufficient time for the staff evaluation of the applicant's measures for the protection against pipe failure the staff requests that the pipe break hazards analysis report should be completed before the start of construction phase.

The staff requests the applicant justify why ITAAC 2.2-17 cannot be completed before the start of the construction phase.

ANSWER:

The Design Commitment (DC) for ITAAC Item 2.2-17 is based on Standard Review Plan (SRP) Acceptance Criterion 9 in NUREG-0800 Subsection 14.3.2.II, which states in part:

> "Pipe Break. To ensure that the applicable requirements of GDC 4 have been adequately addressed, ITAAC should be established to verify that the safety-related SSCs have been designed to the dynamic effects of pipe breaks."

The same SRP acceptance criterion further states:

> "In addition, ITAAC should be established to verify by inspections of as-built, high-energy pipe break mitigation features and of the pipe break analysis report that safety-related SSCs be protected against the dynamic and environmental effects associated with postulated high-energy pipe breaks."

MHI believes that both of these criteria should be addressed for the as-built condition by documenting conformance to the acceptance criteria of ITAAC #4 in Table 2.3-2 (erroneously listed as ITAAC #6 in DCD Revision 1).

MHI recognizes that the ITAAC closure schedule is tied to the initial fuel load milestone. In order to provide sufficient time for NRC staff evaluation of the measures for the protection against pipe failure, MHI will provide sufficient design information for NRC review before the start of the construction phase of a plant whose COLA references the US-APWR DCD.

Impact on DCD

See Attachment 2 for a mark-up of DCD Tier 1, Section 2.2, Revision 2, changes to be incorporated:

- Change ITAAC Item 17 in DCD Tier 1 Table 2.2-4 to read as follows:

17. Safety-related SSCs are designed to withstand the dynamic effects of pipe breaks.	17. Refer to Section 2.3 ITAAC #4	17. Refer to Section 2.3 ITAAC #4

See Attachment 3 for a mark-up of DCD Tier 1, Section 2.3, Revision 2, changes to be incorporated:

- Change ITAAC Item 4 in DCD Tier 1 Table 2.3-2 to read as follows:

4. Safety-related SSCs have adequate high-energy pipe break mitigation features.	4. A pipe break analysis of the as-built high-energy lines will be performed.	4. The results of the pipe break analysis of the as-built high-energy pipe lines concludes that, for each postulated piping failure, the reactor can be shut down safely and maintained in a safe, cold shutdown condition without offsite power. For postulated pipe breaks, the report confirms whether (A) piping stresses in the containment penetration area are within allowable stress limits, (B) pipe whip restraints and jet shield designs can mitigate pipe break loads, (C) loads on safety-related SSCs are within design load limits and (D) SSCs are protected or qualified to withstand the environmental effects of postulated failures.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/3/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-5

In DCD Tier 1 Table 2.2-4, ITAAC 2.2-17 makes reference to Tier 1 Section 2.3 "Piping Systems and Components" ITAAC #6 for the required tests/analyses and acceptance criteria. The staff could not find this ITAAC. Section 2.3 has only 4 ITAACs.

The staff requests the applicant to correct this reference in Tier 1.

ANSWER:

The reference to "ITAAC #6" is a typographical error, and is corrected to "ITAAC #4" by the answer to RAI 180-1594, Question No. RAI 3.6.1-4.

In addition, it is noted that ITAAC 2.2-8 in DCD Tier 1 Table 2.2-4, makes reference to Section 2.3 ITAAC #5 for the required ITA and AC. The reference to "ITAAC #5" is a typographical error, and will be corrected to "ITAAC #3".

Impact on DCD

See Attachment 2 for a mark-up of DCD Tier 1, Section 2.2, Revision 2, changes to be incorporated:

- Change ITAAC Item 8 in DCD Tier 1 Table 2.2-4 to read as follows:

8. The ASME Code, Section III, Class 2 or 3 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design-basis loads.	8. Refer to Section 2.3 ITAAC #3	8. Refer to Section 2.3 ITAAC #3

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/3/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.: **NO. 180-1594 REVISION 0**

SRP SECTION: **03.06.01 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment**

APPLICATION SECTION: **3.6.1**

DATE OF RAI ISSUE: **02/05/09**

QUESTION NO. : RAI 3.6.1-6

The staff reviewed DCD Tier 1 Section 2.2 and Section 2.3 and found that the applicant has not proposed an ITAAC to re-evaluate the pipe break hazards analysis after the construction phase is completed.

The staff requests the applicant to justify why there is no need for a reconciliatory evaluation of the pipe break hazards analysis.

ANSWER:

The response to RAI 180-1594, Question RAI 3.6.1-4 clarifies that ITAAC 2.2-17 will verify that the safety-related SSCs have been designed to the dynamic effects of pipe breaks before start of the construction phase. ITAAC 2.3-4 in DCD Tier 1, Table 2.3-2 is intended to verify the statement in SRP 14.3.2, Acceptance Criterion 9, to verify by inspections of as-built, high-energy pipe-break mitigation features and of the pipe break analysis report that safety-related SSCs are protected against the dynamic and environmental effects associated with postulated high-energy pipe breaks.

To clarify that as-built verification of ITAAC 2.3-4 in DCD Tier 1, Table 2.3-2 is also a reconciliatory evaluation of the pipe break hazards analysis, the ITAAC 2.3-4 will be modified to reflect reconciliation of the as-built configuration with the design configuration after completion of the construction phase.

Impact on DCD

See Attachment 3 for a mark-up of DCD Tier 1, Section 2.2, Revision 2, changes to be incorporated:

- Change the first sentence of ITAAC Item 4 Acceptance Criteria in DCD Tier 1, Table 2.3-2 from: "The results of the pipe break analysis of the as-built high-energy pipe lines ..." to: "The reconciliation of the as-built configuration of high-energy pipe lines ..."

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

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

ATTACHMENT 1
to RAI 180-1594

3.6.1.2.2 Basic Protection Measures

3.6.1.2.2.1 Separation

Separation by distance, compartments or enclosures is used as much as practicable to protect redundant safety-related systems and trains. Deliberate separation protects against the dynamic effects of postulated pipe failures of the systems and components. Redundant safety systems and components are arranged to prevent the loss of the safety function as a result of a postulated pipe failure.

A multi-step process is used to develop the placement of safety-related systems and components which consider the following means for separation.

- Wherever practical, locate safety-related systems away from high-energy piping
- Locate redundant safety systems in separate compartments
- If necessary, enclose specific components required to function as a result of a postulated pipe failure
- Design drainage routing and flood control to maintain adequate separation from equipment required to function as a result of a postulated pipe failure

Each of the four safety trains are separated into four quadrants around the outside of the PCCV. Each train is isolated by physical barriers as well as isolating the radiological control area from the non-radiological control area of the R/B. The concrete walls are designed to prevent events on one safety train from impacting another train. The segregation also includes segregation of fluid containing SSCs of a train from the electrical SSCs of the same train to the extent practical. In general, cable trays are routed at higher elevations than piping. Chases are provided between the cable trays and piping to maintain the electrical/mechanical separation if required. Physically, individual train equipment within the four quadrants is located to provide the maximum separation between the same equipment of the other three trains within the confines of the R/B footprint. This separation minimizes the probability of an event affecting more than one of the safety trains at a given time. Where components must cross between isolating barriers, the penetrations are located above flood levels to the extent possible. In addition, penetration seals maintain compartment to compartment separation.

3.6.1.2.2.2 Barriers and Shields

Where physical separation is not sufficent to protect safety-related systems and components from postulated pipe failures, structural elements such as walls, floors, columns, and foundations are designed to serve as protective barriers and shields whenever possible. Other barriers, deflectors or shields are provided where additional protection is required. The barriers<u>, including compartments as applicable,</u> are designed to withstand loading generated by postulated jet forces and pipe whip impact forces <u>in combination with loadings associated with seismic Category I requirements, within the respective design load limits for the structures</u>. Refer to Subsection 3.6.2.4 for additional discussion on the design of barriers, deflectors and shields.

Portions of the containment internal structure provide a series of protective barriers. The reactor coolant loops (RCLs) are shielded from the containment liner by the secondary

ATTACHMENT 2

to RAI 180-1594

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. The ASME Code, Section III, Class 2 or 3 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design-basis loads.	8. Refer to Section 2.3 ITAAC ~~#5~~ #3	8. Refer to Section 2.3 ITAAC ~~#5~~ #3
9.a Divisional flood barriers are provided in the R/B and the PS/B to protect against the internal and external flooding.	9.a An inspection will be performed to verify that the as-built divisional flood barriers exist in the R/B and the PS/B.	9.a The as-built divisional flood barriers exist at the appropriate locations in the R/B and the PS/B against the internal and external flooding.
9.b Water-tight doors are provided in the R/B to protect against the internal and external flooding.	9.b An inspection of the as-built water- tight doors will be performed.	9.b The as-built water-tight doors exist at the appropriate locations in the R/B against the internal and external flooding.
10. Penetrations in the divisional walls of the R/B and the PS/B, except for water-tight doors, are provided appropriately against the internal and external flooding.	10. An inspection of the as-built penetrations will be performed.	10. The as-built penetrations in the divisional walls of the R/B and the PS/B are installed at an acceptable level above the floor, and are sealed up to the internal and external design flood levels.
11. Safety-related electrical, instrumentation, and control equipment are located to protect against the design flood level.	11. An inspection of the as-built equipment will be performed.	11. The as-built safety-related electrical, instrumentation, and control equipment are located at sufficient height the floor surface against the design flood level.
12. For the R/B and the PS/B, external wall thickness below flood level are provided to protect against water seepage.	12. An inspection of the as-built external wall thickness for the R/B and the PS/B will be performed.	12. For the R/B and the PS/B, the as-built external wall below flood level are provided with adequate thickness to protect against water seepage.
13a. Flood barriers of the R/B and the PS/B are installed up to the finished plant grade level to protect against water seepage.	13a. Inspections of the as-built flood barriers will be performed.	13a. The as-built flood barriers are installed up to the finished plant grade level for the R/B and the PS/B to protect against water seepage.

ATTACHMENT 2

to RAI 180-1594

Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13b. Flood doors and flood barrier penetrations of the R/B and the PS/B are provided with flood protection features.	13b. Inspections of the as-built flood doors and flood penetrations will be performed.	13b. For the R/B and PS/B, the as-built flood doors and flood barrier penetrations are provided with flood protection features to protect against water seepage.
14. Penetrations in the external walls, including those up to the subgrade level if necessary, of the R/B and PS/B are provided with flood protection features below flood level.	14. An inspection will be performed to verify that the flood protection features of the as-built penetrations in the external walls of the R/B and the PS/B exist below flood level.	14. The as-built penetrations in the external walls of the R/B and the PS/B are provided with flood protection features below flood level.
15. Redundant safe shutdown components and associated electrical divisions outside the containment and the control room complex are separated by 3-hour rated fire barriers to preserve the capability to safely shutdown the plant following a fire. The 3-hour rated fire barriers are placed as required by the FHA.	15. An inspection of the as-built fire barriers will be performed.	15. The 3-hour rated as-built fire barriers are placed as required by the FHA.
16. All penetrations and openings through the fire barriers are protected against fire.	16. An inspection will be performed to verify that the as-built components are provided to protect the penetrations and openings through fire barriers.	16. All as-built penetrations and openings are protected with rated components (i.e. fire doors in door openings, fire dampers in ventilation duct openings, and penetration seals).
17. Safety-related SSCs are designed to withstand the dynamic effects of pipe breaks.	17. Refer to Section 2.3 ITAAC ~~#6~~ #4	17. Refer to Section 2.3 ITAAC ~~#6~~ #4
18. The key dimensions of the RV conform with the licensed design and are documented in an as-built report.	18. Refer to Section 2.4.1 ITAAC #5	18. Refer to Section 2.4.1 ITAAC #5

ATTACHMENT 3

to RAI 180-1594

Table 2.3-2 Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The ASME Code Section III, Class 1 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads.	1. An analysis of the ASME Code, Section III, Class 1 piping systems and components will be performed.	1. The results of the analysis conclude that the design requirements of the ASME Code Section III are met.
2. RCPB and MSS piping systems are designed in accordance with the LBB method.	2. A LBB analysis using the LBB method will be performed for each RCPB and MSS piping system.	2. The results of the LBB analysis conclude that the stress values conform to the LBB acceptance criteria using the LBB assumptions.
3. The ASME Code Section III, Class 2 or 3 piping systems and components are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads.	3. An analysis of representative ASME Code, Section III, Class 2 or 3 piping systems and components that significantly contribute to risk will be performed	3. The results of the analysis for the representative ASME Code, Section III, Class 2 or 3 piping systems and components conclude that the design requirements of the ASME Code Section III are met and design specifications are provided for all ASME Code Section IIII, Class 2 or 3 piping system and components.
4. Safety-related SSCs~~, required to be functional during and following an SSE,~~ have adequate high-energy pipe break mitigation features.	4. A pipe break analysis of the as-built high-energy line will be performed.	4. ~~The results of the pipe break analysis~~ The reconciliation of the as-built configuration of high-energy pipe lines concludes that, for each postulated piping failure, the reactor can be shut down safely and maintained in a safe, cold shutdown condition without offsite power. For postulated pipe breaks, the report confirms whether (A) piping stresses in the containment penetration area are within allowable stress limits, (B) pipe whip restraints and jet shield designs can mitigate pipe break loads, (C) loads on safety-related SSCs are within design load limits and (D) SSCs are protected or qualified to withstand the environmental effects of postulated failures