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March 2, 2012

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-12057

Subject: MHI's Responses to US-APWR DCD RAI No. 878-6200 Revision 0 (SRP 09.02.02)

Reference: 1) "REQUEST FOR ADDITIONAL INFORMATION 878-6200 REVISION 0, SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems, Application Section: 9.2.2" dated 12/13/2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 878-6200, Revision 0."

Enclosed are the responses to one RAI contained within Reference 1. This transmittal completes the response to this RAI.

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.

Enclosure:

1. Responses to Request for Additional Information No. 878-6200, Revision 0

D081
NRO

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-12057
Docket No. 52-021

Responses to Request for Additional Information No. 878-6200, Revision 0

March, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/2/2012

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	**NO. 878-6200 REVISION 0**
SRP SECTION:	**09.02.02 – Reactor Auxiliary Cooling Water Systems**
APPLICATION SECTION:	**9.2.2**
DATE OF RAI ISSUE:	**12/13/2011**

QUESTION NO.: 09.02.02-85

Follow-up to RAI 571-4365, Question 09.02.02-48 and Question 09.02.02-57.
NRC Branch Technical Position 3-3, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," states that:

> A. General Design Criterion (GDC) 2, "Design Bases for Protections Against Natural Phenomena," requires that SSCs important to safety be designed to withstand the effects of natural phenomena such as earthquakes. The BTP 3-4 does not consider full-circumferential breaks in moderate-energy piping, only through-the-wall cracks. It is the intent of this design approach that postulated piping failures in fluid systems should not cause a loss of function of essential safety-related systems and that nuclear plants should be able to withstand postulated failures of any fluid system piping outside containment, taking into account the direct results of such failure and the further failure of any single active component, with acceptable offsite consequences.
> Appendix A, C.2.a. The following leakage cracks are postulated at the locations specified by the criteria listed under B.
> Moderate-Energy Fluid Systems: a. through-wall leakage cracks in piping and branch runs exceeding a nominal pipe size of 1 inch, where the crack opening is assumed as ½ the pipe diameter in length and 1/2 the pipe wall thickness in width.

Tier 2 US-APWR DCD, Table 3.6-1, "High and Moderate Energy Fluid Systems," described the CCWS as a moderate-energy system. Tier 2 US-APWR DCD, Section 9.2.2.3.2, "Leakage from the CCWS," describes that a decrease to the setpoint in the CCWS surge tank water level initiates automatic makeup water to the surge tank and an alarm is transmitted to the main control room (MCR) indicating a system leak. After the leak source is identified by visual inspection or by a change in individual CCW flow rate, the leak is isolated. If the water level of the surge tank further decreases, the surge tank low-low water level signal is transmitted to the MCR and the operator may close the header tie line isolation valves from the MCR.
Because the subsystem consists of two trains, the train with the leak can be isolated and the other train remains operational.
Tier 2 US-APWR DCD, Table 9.2.2-4, "Component Cooling Water System Heat Load," described that during startup and refueling operations it is possible to have two CCWS pumps in operation, coming off a common CCWS surge tank with an internal baffle plates. In this plant configuration, along with a single passive pipe leak path of the common safety-related header, and with the

header tie isolation valves open (MOV-2007A/B/C/D and MOV-020A/B/C/D), it is possible to drain both sides of the CCWS surge tank at the same time. A postulated pipe leak path has a potential to drain the CCWS surge tank, assuming non-safety related makeup is not available, and causing two trains of CCWS to become unavailable. The applicant should address the following in Section 9.2.2 of the DCD:

- Describe in the DCD how the US-APWR is designed against postulated piping leak paths in the safety-related portions of the CCWS. Also describe the bounding conditions related to piping leak size and locations.
- Describe in the DCD the consequences of such a piping leak path in the common CCWS, looking at various modes of operations, assuming the header tie isolation valves are open.
- Describe in the DCD any operator actions necessary to prevent the potential loss of two trains of CCWS once a 'low' or 'low-low' CCWS surge tank level setpoints are reached. Also describe the operator time requirements to achieve CCWS train isolation knowing there is greater than 800 gallons between the 'low-low' level set point and '0' indication in the CCWS surge tank.
- Describe in Table 9.2.2-3, "Component Cooling Water System Failure Modes and Effects Analysis," this failure mode and the effects on the CCWS system safety function.

ANSWER:

NRC Branch Technical Position 3-3, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," states that:

> The staff has evolved an acceptable approach for the design, including the arrangement, of fluid systems located outside of containment to ensure that the plant can be safely shut down in the event of piping failures outside containment. This approach is set forth in this position and in the companion Branch Technical Position (BTP) 3-4.

The Branch Technical Position (BTP) 3-4 referred to in the BTP 3-3 above defines exception from postulating leakage cracks as follows:

> B. Moderate-Energy Fluid System Piping
> (iii) Fluid Systems in Areas Other Than Containment Penetration.
> (1) Leakage cracks should be postulated in piping located adjacent to structures, systems, or components important to safety, except:
> (c) For ASME Code, Section III, Class 2 or 3 and non-safety-class piping, where the stresses calculated[2] by the sum of Eqs. (9) and (10) in NC/HD-3653 are less than 0.4 times the sum of the stress limits given in NC/ND-3653.
>
> [2]For those loads and conditions for which Level A and Level B stress limits have been specified in the design specification (including the operating basis earthquake).

US-APWR DCD Section 3.6.2.1.2.2 states that the moderate-energy fluid system piping in areas other than PCCV penetrations is designed to comply with the BTP 3-4 B(iii)(1)(c) as follows:

> Moderate-Energy Fluid System Piping in Areas Other than PCCV Penetrations
> Leakage cracks are postulated in the following piping systems located adjacent to SSCs important to safety.

- For ASME Code, Section III (Reference 3.6-9), Class 2 and 3 and non-safety class piping, at axial locations where calculated stress by the sum of Equations 9 and 10 in NC/ND-3653 exceed 0.4 times the sum of the stress limits given in NC/ND-3653.

In the US-APWR, BTP 3-4 is applicable to the safety-related portions of the CCWS, and the postulation of cracks is not required for the following reasons:

The safety-related portions of the CCWS are designed in accordance with ASME Code, Section III, Class 3, which is described as an applicable condition in BTP 3-4 for moderate-energy piping systems. Additionally, the stress levels in the US-APWR CCWS safety-related piping are less than the stress levels stated in BTP 3-4. Refer to DCD Subsections 9.2.2.3 and 3.6 for details.

The safety-related portions of the CCWS meet the requirements of the BTP 3-4 B(iii)(1)(c) and therefore are exempted from postulating leakage cracks.

Response to all bullets:
Pipe leakage is not postulated for safety-related CCWS piping.

Impact on DCD

DCD Tier 2 Subsection 9.2.2.3 will be revised as follows:

- Add a reference to DCD Subsection 3.6.2.1.2.2.
- Add explanation for why the leakage crack is not postulated in safety-related portion of the CCWS.

See Attachment-1 for details.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on topical and technical reports.

- Section 3.7, Seismic Design;

Pipe rupture protection against other ruptured piping is addressed in Section 3.6, Protection against Dynamic Effects Associated with Postulated Rupture of Piping. Leakage cracks and other type of pipe rupture are not postulated in the safety-related CCWS piping because piping is designed to comply BTP 3-4 B(iii)(1)(c) and C as stated in Subsection 3.6.2.1.2.2 and 3.6.2.1.3. DCD_09.02.02-85

The CCWS continues to perform its safety function in the event of a fire. Subsection 9.5.1 addresses fire protection.

The R/B which contains safety-related portions of the CCWS is designed and constructed as a safety-related and seismic category I structure. The safety-related portions of the CCWS are designed and constructed as seismic category I.

Relief valves are provided on the components as necessary to prevent potential thermal overpressurization against over pressure of equipment and piping.

The CCWS is a closed system that is maintained in a water solid condition with a surge tank located at the highest point in the system thus preventing the potential for water hammer.

9.2.2.3.1 Leakage from Higher Pressure Components into CCWS

If leakage from a higher pressure component to the CCWS should occur, the water level of CCW surge tank increases and an alarm is transmitted to the MCR. If the in-leakage is radioactive, the radiation monitors of the CCWS also indicate in the MCR the increased radiation level and transmit an alarm when the radiation level reaches its set point. After the leak source is identified, the leak is isolated from the CCWS.

In the event that the in-leakage is through the RCP thermal barrier HX, the isolation valves on the RCP thermal barrier HX CCW return line are automatically closed by the high flow rate signal, thereby preventing further CCWS contamination.

9.2.2.3.2 Leakage from the CCWS

A decrease to the setpoint in the CCW surge tank water level initiates automatic makeup water to the surge tank and an alarm is transmitted to the main control room indicating a system leak. After the leak source is identified by visual inspection or by a change in individual CCW flow rate, the leak is isolated.

If the water level of the surge tank further decreases, the surge tank low-low water level signal is transmitted to the MCR and the ~~header tie line isolation valves automatically close. Since~~operator may close the header tie line isolation valves from the MCR. Because the subsystem consists of two ~~individual~~ trains, the train with the leak can be isolated and the other train ~~can be operated~~remains operational. DCD_09.02.02-58

In the event of a loss of system integrity in the non-seismic portion of the system, the CCWS is designed to maintain functionality by closing ~~both header tie line isolation valves and~~ the isolation valves in the supply and return lines to the non-seismic category I buildings. Automatic closure is activated upon the surge tank low-low water level signal. DCD_09.02.02-58 DCD_09.02.02-49