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August 12, 2011

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-11263

Subject: MHI's Response to US-APWR DCD RAI No. 774-5859 (SRP 09.02.02)

Reference: 1) "REQUEST FOR ADDITIONAL INFORMATION 774-5859 REVISION 0, SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems, Application Section: 9.2.2 and Chapter 16 (TS 3.7.7)" dated 6/27/2011.

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. 774-5859, Revision 0."

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

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.

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NRO

Enclosure:

1. Response to Request for Additional Information No. 774-5859, Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-11263
Docket No. 52-021

Response to Request for Additional Information No. 774-5859,
Revision 0

August, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/12/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 774-5859 REVISION 0**
SRP SECTION:	**09.02.02 – Reactor Auxiliary Cooling Water Systems**
APPLICATION SECTION:	**09.02.02 AND CHAPTER 16(TS3.7.7)**
DATE OF RAI ISSUE:	**6/27/2011**

QUESTION NO.: 09.02.02-84

This RAI is a follow-up to RAI 571-4365, Question 09.02.02-56, related to the component cooling water system (CCWS) cross-tie alignment.

US-APWR DCD Tier 2 Section 5.4.1.3.4 states that if a loss of CCWS occurs, seal injection flow would continue to be provided to the reactor coolant pumps (RCPs) from the chemical volume & control system (CVCS). In addition, the DCD states that the RCPs are designed so that the seal injection flow is sufficient to prevent damage to the seals if cooling to the thermal barrier heat exchanger from CCWS is lost. The DCD states that the RCP motor bearing coolers are designed such that the RCP can last up to 10 minutes without CCWS cooling to its motor bearings. The DCD further states that if CCWS cooling to RCPs cannot be restored within 10 minutes, the RCPs will be tripped.

US-APWR DCD Tier 2 Section 9.2.2.2.1.5 states that the CCWS cooling for the RCP thermal barrier heat exchanger is ensured by opening NCS-MOV-232A and B and NCSMOV-233A and B and closing NCS-MOV-234A (or 234B). The US-APWR DCD Technical Specification (TS) Bases do not describe these design features of the CCWS with respect to its cooling functions for RCP components.
In a postulated scenario that involves one division of CCWS out for maintenance (Note: no TS Action statement is entered since the limiting condition of operation (LCO) for CCWS is only specified for 3 trains, not 4) and a single failure occurring on the CCWS division that shares the common surge tank with the division that is out for maintenance (e.g., "A" and "C" are in operation with "D" out for maintenance and the single failure occurs on "C"), the plant would then be in a condition that would require operator actions within10 minutes to restore CCWS to the RCPs. The TS 3.7.7 LCO required action that would be entered has a 72-hour completion time which requires restoring three divisions of CCWS to operable status. Given this scenario, the applicant should address the following items in DCD Tier 2 Section 9.2.2 and/or TS 3.7.7:

- The DCD should clearly state the basis for opening of the RCP cross-tie between divisional pairs A/B to C/D (or vice versa), pertaining to RCPs thermal barrier heat exchangers and RCP motors. This basis should also take into consideration the contribution of RCP seal injection from the charging pumps which are described in DCD Section 9.3.4.
- The DCD should clearly describe when the cross-tie valves should be opened or be prohibited from opening depending on the operating status or the accident condition of the

plant.

- The applicant should consider and address in the RAI response the use of whether an automatic opening of the RCP cross-tie is necessary due to the limited time for which the main control room operators have to manually restore cooling to the RCP motors and RCP seals. (For dealing with loss of cooling to the RCP thermal barrier heat exchangers, operator actions should also consider the availability of seal injection from CVCS charging function).
- The applicant should address in the RAI response whether TS 3.7.7 LCO should include RCP thermal barrier protection in its scope, and whether TS 3.7.7 Required Actions should address RCP cooling flow. Specifically, the valves relied on to provide cross-tie capability between A/B and C/D division pairs should be addressed.
- The applicant should address whether CCWS flow to the RCP thermal barriers heat exchangers (including when RCP cross-tie is needed to established flow to these heat exchangers) should be discussed in Tier 2 DCD Section 9.2.2.1.1, "Safety Design Basis," DCD Section 9.2.2.3, "Safety Evaluation" and Tier 1 of the DCD.
- Based on the applicant's responses for the above, consider necessary changes to Tier 1 DCD ITAAC and Tier 2 DCD Chapter 14 testing.

Reference: MHI's Responses to US-APWR DCD RAI No. 571-4365; MHI Ref: UAP-HF-10160; dated June 8, 2010; ML101650268.

ANSWER:

As discussed in the amended response to RAI 571-4365, Question 09.02.02-56 (provided in the transmittal UAF-HF-11237 from MHI to the NRC, dated 07/29/11), the RCP cross-tie valves are required to be opened within 10 minutes only when one of the four trains of CCW are isolated for maintenance and there is a failure in the operating train of that subsystem. If CCW flow is lost and cannot be restored within 10 minutes, the RCPs will be tripped following a reactor trip. The response to Question 09.02.02-56 addresses some of the issues discussed in this RAI. The amended response to RAI 571-4365, Question 09.02.02-54 (also provided in UAF-HF-11237) provides additional information relevant to this response.

Item 1
The response to Question 09.02.02-56 modifies DCD Revision 3, Subsection 9.2.2.2.2.1 to discuss the basis for opening the RCP cross-tie valves. The discussion addresses the use of this flow path to provide motor cooling and protection of the RCP seals if CVCS seal injection were lost. The discussion also addresses the intended circumstances for opening the cross-tie valves.

Item 2
Please see response to Item 1.

Item 3
As discussed in the response to Question 09.02.02-56, operator action to open the RCP cross-tie valves within 10 minutes is not required to protect RCP seal integrity from a safety-related perspective. The 10-minute time frame is for an operator action to provide RCP motor cooling to compensate for a loss of a CCWS subsystem due to a single failure and unavailability of a train in the same subsystem due to on-line maintenance. Seal integrity would not be affected in such a scenario because CVCS remains available to provide seal injection.

Automatic opening of the cross-tie valves to protect RCP seal integrity is not appropriate because of the multiplicity of failures required to lose RCP seal cooling, i.e., CVCS must be unavailable for seal injection as well as both trains of a CCWS subsystem are unavailable for thermal barrier cooling. By contrast, automatic opening of the RCP valves could introduce the potential of a control system fault compromising separation among multiple trains.

Item 4
As discussed in the previous items, use of the RCP cross-tie valves provides operational flexibility to compensate for a loss of CCWS to the RCP motors and thermal barriers. Opening the RCP cross-ties implies that fewer than three CCWS trains are available, and thus, the Limiting Condition for Operation (LCO) of Technical Specification 3.7.7 becomes applicable. The RCP cross-tie valves were not modeled in the PRA, so are not credited as contributors to risk reduction. Therefore, the RCP cross-tie function does not meet the criteria for a Technical Specification LCO, as defined in 10CFR50.36(c)(2) and no change to LCO 3.7.7 is necessary to explicitly include the RCP cross-tie isolation valve function. However, to provide additional information on the use of the RCP cross-ties, Technical Specification Basis B 3.7.7 will be modified to summarize the use of cross-ties based on operator action.

Item 5
DCD Subsection 9.2.2.1.1, "Safety Design Basis" (first bullet) provides a summary statement regarding the cooling capacity of each CCWS subsystem, but does not address specific user loads. The amended response to Question 09.02.02-54 provides a detailed listing of user loads, including RCP thermal barriers and motors for each "operating mode". For clarity, Subsection 9.2.2.1.1 will be revised to reference the design basis to provide cooling for all operating modes. The current Tier 1 Subsection 2.7.3.3.1 discussion regarding adequate CCWS cooling capacity required for safety function, and reference to Figure 2.7.3.3-1, addresses all safety loads.

Item 6
Tier 1 currently requires that the functional arrangement of the CCW system, including RCP cooling lines, be verified. The cross-tie valves are listed in Tier 1 Tables 2.7.3.3-2 and 2.7.3.3-4 and the operation of these valves is verified under Tier 1 Table 2.7.3.3-5, ITAAC 8.a, 9.a. No additional ITAAC are necessary.

Chapter 14 testing of RCP seal flow is accomplished under 14.2.12.1.13, "CVCS Preoperational Test - Charging and Seal Water" and RCP seal cooling is tested under Subsection 14.2.12.1.87, "Component Cooling Water System Preoperational Test", and 14.2.12.1.3, "RCP Initial Operation Preoperational Test". Item C.3 in Subsection 14.2.1.2.1.87 verifies each CCW mode of operation including verification of coolant flow to the thermal barrier via cross-tie. No additional pre-operational or startup testing is necessary.

Impact on DCD

DCD Tier 2 Subsection 9.2.2.1.1 will be revised as follows (See Attachment-1):

- Add reference to CCWS capability to support all operating modes, including accident conditions.

DCD Tier 2 Chapter 16 will be revised as follows (See Attachment-1):

- Add summary description on cross-tie use in Technical Specification Bases B 3.7.7.

Impact on R-COLA

There is no impact on the COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

and status indication are provided in the MCR. The ESWS is interlocked with the CCWS such that at either a low ESW supply header pressure or at low CCW header pressure, alternate standby pumps are being automatically activated as described in 9.2.1.2.3.1. The CCWS is used for supplying the cooling water to the components which are essential for normal power operation. The interlock between the ESWS and CCWS for inadvertent stoppage of one train of ESWS or CCWS is necessary for maintaining the water supplement to the components that require rapid water re-supplement such as charging pump, letdown heat exchanger, instrument air compressor, seal water heat exchanger or RCP thermal barrier. There are no interlocks between the ESWS and the essential chilled water system because the ECWS is not required to restart rapidly at inadvertent stoppage of the components. DCD_09.02.01-40

9.2.2 Component Cooling Water System

9.2.2.1 Design Bases

The component cooling water system (CCWS) provides cooling water required for various components during all plant operating conditions, including normal plant operating, abnormal and accident conditions. It is an intermediate, closed loop cooling system that transfers heat from the various components to the ESWS. The CCWS is designed to meet the relevant requirements of GDC 2, GDC 4, GDC 44, GDC 45, and GDC 46 (Ref. 9.2.11-1). Its design bases are further described below.

9.2.2.1.1 Safety Design Basis

The CCWS design bases to meet the safety-related functional requirements are :

- The CCWS consists of two independent subsystems, with each subsystem providing 100% of the cooling capacity required for safe function during all operating modes, including accident conditions. Each of the subsystems contains two fifty percent (2 x 50%) trains, for a total of four 50% trains. DCD_09.02.02-84
- The CCWS is designed to have the capability to provide cooling water using either offsite power supply or onsite Class 1E power supply. Each train is powered by Class 1E power supplies respectively.
- The CCWS is designed to perform its safety function of accident mitigation assuming that one 50% train is out of service for maintenance coincident with the loss of offsite power and a single failure in another train.
- The CCWS is designed to seismic category I requirements so as to remain functional during and following a SSE.
- The CCWS is designed to have the capability to isolate the non-safety portions of the system during accident mitigation.
- The CCWS is designed against natural phenomena and internal missiles.
- The CCWS safety components are designed to withstand design loadings.

B 3.7 PLANT SYSTEMS

B 3.7.7 Component Cooling Water (CCW) System

BASES

BACKGROUND

The CCW System provides a heat sink for the removal of process and operating heat from safety related components during a Design Basis Accident (DBA) or transient. During normal operation, the CCW System also provides this function for various nonessential components, as well as the spent fuel storage pool. The CCW System serves as a barrier to the release of radioactive byproducts between potentially radioactive systems and the Essential Service Water System, and thus to the environment.

A typical CCW System is arranged as four independent, 50% capacity cooling loops, and has isolatable nonsafety related components. Each safety related train includes one 50% capacity pump, connection to one of the two surge tanks, a 50% capacity heat exchanger, piping, valves, and instrumentation. Each safety related train is powered from a separate bus. The surge tanks in the system provide pump trip protective functions to ensure that sufficient net positive suction head is available. The pump in each train is automatically started on receipt of a safety injection signal, and all nonessential components are isolated.

Additional information on the design and operation of the system, along with a list of the components served, is presented in Chapter 9 (Ref. 1). The principal safety related function of the CCW System is the removal of decay heat from the reactor via the Containment Spray/Residual Heat Removal (CS/RHR) System. This may be during a normal or post accident cooldown and shutdown. CCWS cooling to the four RCP seal thermal barriers is used for all operating modes (including accident and safe shutdown) to preclude a RCP seal LOCA in the event that CVCS is unavailable to provide required flow to the RCP seal via seal injection. Manual alignment of RCP thermal barrier cooling is achieved via the CCWS RCP cross-tie valves from the MCR in the event two CCWS trains are unavailable to supply CCWS to a pair of RCP thermal barriers. DCD_09.02.02-84

APPLICABLE SAFETY ANALYSES

The design basis of the CCW System is for two CCW trains to remove the post loss of coolant accident (LOCA) heat load from the refueling water storage pit and other components, such as Safety Injection Pumps and CS/RHR Pumps. The Emergency Core Cooling System (ECCS) LOCA and containment OPERABILITY LOCA each model the maximum and minimum performance of the CCW System, respectively. The normal temperature of the CCW is 100°F, and, during unit cooldown to MODE 5 (T_{cold} < 200°F), a maximum temperature of 110°F is assumed. This prevents the refueling water storage pit fluid from increasing in temperature following a LOCA, and provides a gradual reduction in the temperature of this fluid as it is supplied to the Reactor Coolant System (RCS).