**REQUEST FOR ADDITIONAL INFORMATION 760-5576 REVISION 0**

5/23/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
Application Section: 9.2.2

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

09.02.02-82

Follow-up to RAI 362-2278, question 09.02.02-34 and RAI 571-4365 question 09.02.02-58. This is also related to RAI 148-1700, question 19-273.
The staff is unable to perform an adequate review for several Standard Review Plan (SRP) sections related to the reactor cooling pump (RCP) seals which include:

- SRP 5.4 - Reactor Coolant System Component and Subsystem Design
- SRP 8.4 - Station Blackout (SBO)
- SRP 9.2.2 - Reactor Auxiliary Cooling Water Systems
- SRP 9.3.4 - Chemical and Volume Control System (PWR) (Including Boron Recovery System)

Information described in the US-APWR Design Control Document Revision 2 related to RCP seals states that:

- Tier 2, DCD 1.2.1.5.2.3, “Reactor Coolant Pumps,” Leakage along the RCP shaft is normally controlled by three shaft seals, arranged in series so that any reactor coolant leakage to the containment is essentially zero.
- Tier 2, DCD 5.4.1.3.1, “Design Description,” the seal section consists of three seals. The first is the hydrostatic seal; the second and third are mechanical seals. The No. 2 and No. 3 seals are assembled in a cartridge. These three seals prevent release of reactor coolant to the atmosphere.
- Tier 2, DCD 5.4.1.3.3, “Loss of Seal Injection,” loss of injection water flow may be detected with a flow meter at the seal injection line. This condition will normally lead to an increase in seal and bearing inlet temperature and an increase in the No. 1 seal leak rate because reactor coolant flow into the RCP seals. Under these conditions, however, the CCW continues to provide flow to the thermal barrier heat exchanger; which cools the reactor coolant. The pump is therefore able to maintain safe operating temperatures and operate safely long enough for safe shutdown of the pump.
- Tier 2, DCD 5.4.1.3.4, “Loss of Component Cooling Water,” if loss of CCW should occur, seal injection flow continues to be provided to the RCP. The pump is designed so that the seal injection flow is sufficient to prevent damage to the seals with a loss of thermal barrier cooling.
- Tier 2, DCD 5.4.1.4.1, “Pump Performance,” ….If LOOP occurs, injection flow to the pump seals and CCW to thermal barrier and motor stops. Standby power sources are automatically triggered by LOOP so that CCW flow and seal injection flow are automatically restored. The RCP seal integrity during station blackout (SBO) is discussed in Section 8.4.

- · Tier 2, DCD 8.4.2.1.2, “Station Blackout Coping Analysis,” …(2) RCP seal, RCP seal can keep its integrity for at least one hour without water cooling. There is no LOCA considered in this condition.
- · Tier 2, DCD 9.2.2.3.5, RCP Seal Protection,” even in the event that the CCW to RCP is isolated by a containment spray actuation signal and the seal water injection from the CVCS is also lost, the containment isolation valves on the CCW supply and return lines can be manually reopened from the MCR to restore RCP seal cooling. As shown in Table 9.2.2-3, the CCWS is designed to restore CCW supply to the RCP thermal barrier HX, assuming any single failure. To re-supply water to the thermal barrier after the isolation of the containment vessel during an accident, the cooling water for the thermal barrier is ensured by opening NCS-MOV-445A/B, NCS-MOV-447A/B, and NCS-MOV-448A/B.
- · Tier 2, DCD 9.3.4.1.2.4, “Reactor Coolant Pump Seal Water Injection,” the CVCS continuously supplies seal water to the reactor coolant pump seals, as required by the reactor coolant pump design. The seal water flow requirement is specified in Table 9.3.4-2. During a SBO, the reactor coolant pumps seal integrity is maintained until the charging pumps are powered from an alternate power source and seal water injection restarts.

Specifically, MHI should address the following items:

1. The guidance of SRP 9.2.2, Section II. “Acceptance Criteria”, Item 4. D which states:
   “Remote manual isolation of the RCP seal coolant water by the main control room operator for continued long-term pump operation in an actual event”. In addition, SRP 9.2.2. Section III, “Review Procedure,” Item 4.F. states: “Design provisions are made for isolation of component cooling water supply and return lines to the RCP by remote manual means only”. Since the MHI CCWS design does not follow the guidance of this SRP, justification is needed in the DCD. This justification will need to be expanded to include other DCD sections as stated above.
2. Based on the November 29, 2010, Advisory Committee on Reactor Safeguards US-APWR Subcommittee Meeting, it was stated by MHI that testing has not occurred related the RCP seals during station blackout. MHI stated the since the #1 seal leak-off is stopped and the #2 seal becomes the reactor coolant boundary and the leakage is 0.2 gpm for the SBO case. Based on ACRS and MHI discussions, the assumed seal leakage based on NUMARK 87-00, “Guidance and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors,” of 25 gpm is not exceeded; however, this leakage of 0.2 gpm is not described in the DCD. This information should be added to the DCD.
3. The details of the seal design are not described in the DCD and should be included in the DCD (various sections).
4. Operating experience has not been provided to the staff related to the proposed RCP seal design. If available, provide a summary of operating experience in the RAI response.

5. A Topical Report for the RCP seal design has not been provided to the staff regarding seal testing to support the three seal design and to support the 0.2 gpm seal flow rate during SBO. This information should be provided to the staff.

6. The applicant's response to RAI 148-1700, question 19-273 needs to be modified, as discussed below:

a. The portion of the response that states that each RCP seals leaks 0.17 gpm between 0 and 60 minutes during the SBO should be added to the DCD.

b. The portion of the response that states that each RCP seal will leak at 480 gpm post SBO should be added to the DCD.
c. RCP seal testing should be described in the topical report (in item 5 above) to confirm the heatup calculations described in this RAI response.
d. DCD Tier 1 should be revised to add a new ITAAC to verify the seal design and leakage requirements with no cooling water described in this RAI response.