REQUEST FOR ADDITIONAL INFORMATION 695-4934 REVISION 2

2/18/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 06.03 - Emergency Core Cooling System
Application Section: SRP 6.3

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

06.03-88

RAI 0.6.03-4-1 (DCD Section 6.3.2.2.5-1)
The pH of the ESF fluids is controlled during a DBA using NaTB baskets as a buffering agent. NaTB baskets are placed in the containment to maintain the desired post-accident pH conditions in the recirculation water. MHI's response to this RAI indicated that "DCD Section 6.3, Figure 6.3-10 shows the containment spray pattern on the floor where the NaTB baskets are installed. One spray pattern indicated in circle, regardless of its size, means that inside the circle is covered by the designed spray flow from one spray nozzle. The maximum spray flow rate that flows into the NaTB basket container was calculated by using conservatively larger number of these spray pattern circles which cover the container. Even if this conservatively estimated spray water flows into the container, the pressure loss in the transfer piping is lower than the difference of elevation between the container and RWSP, that is, the driving force to gravity injection. Therefore, the NaTB solution in the container does not overflow from the container to the outside of RWSP."
In response to RAI 6.3.2.2.5-1, MHI stated that if the driving head of the flow is greater than the corresponding pressure drop in the piping leading to the RWSP, then the basket will not overflow. The related questions are:

a. As stated in DCD Section 6.3.2.2.5 in the fourth paragraph that "The upper lips of the NaTB Basket Containers are approximately 1 ft. - 7 in. above the top of the NaTB baskets. This allows for the full immersion of the baskets and the optimum NaTB transfer to the RWSP." This indicates that the water level surrounding the NaTB must be maintained above the NaTB but below the top of the NaTB basket container. DCD Figure 6.3-12 appears to indicate that the fluid flow from the container is transferred through 6" piping that is submerged in the holding basket container and the pipe goes up from the lower part of the holding basket container to some point above the NaTB basket and through the basket container wall and down to the RWSP.
    1) Please provide a detailed description including elevations of this flow path and where it combines with the flow path from the other basket container (See DCD Figure 6.3-12). Provide a comparison of driving head and piping pressure loss and any relevant assumptions.
    2) Since the piping inlet for fluid removal from the basket container appears close to the bottom of the basket container, justify that debris cannot accumulate in the lower part of the basket container and block the flow to the RWSP.
b. Under maximum flow conditions for the containment spray ring D can the flow into the NaTB basket container be great enough to overflow the container and spill into the

containment deck? If so, discuss the potential for the flow to be diverted to a hold-up area and discuss the impact on RWSP pH.

c. What are the conservative flows into the NaTB container and what is the expected pressure drop through the piping to the RWSP? Provide the pressure drop and head comparison.

d. In Figure 6.3-12 Note 2 states "Raise the outlet piping to a level 4'-3" higher than the bottom of the NaTB basket container and layout piping with a down slope from the outlet piping to RWSP." Figure 6.3-11 indicates that the height of the NaTB basket is 4'-11". How do you know that you are getting enough water coverage on the NaTB baskets to satisfy the design basis of maintaining the correct pH of the RWSP? Provide a calculation or discussion that supports the claim that the NaTB baskets would be fully immersed during minimum flow conditions for the containment spray ring D.

06.03-89

RAI 06.03-54-1 (6.3.3.1-1):
In its response to RAI 06.03-54, MHI provided the limiting conditions for operation (LCOs) for the Accumulators in TS 3.5.1. The staff asked, as a follow-up to MHI's response, to:

(a) Describe how the accumulator volume TS value (specified in gallons) is confirmed since only the accumulator pressure and level are know but not the temperature.

(b) Describe how the RWSP volume TS value (specified in gallons) is confirmed since only the RWSP pressure and level are know but not the temperature.

06.03-90

RAI 06.03-28-1 (6.3.2.2-2):
In UAP-HF-09408 the following RAI response given was,
"From the mechanism as shown in Figure 6.3.28-2, the following two conditions must be met for
steam hammer generation:
Condition 1: Two-phase environment where vapor and liquid exist together
Condition 2: Steam void is surrounded by cold water
For the SI piping of the US-APWR, even if the condition 1 is realized, the condition 2 is not realized since the inner diameter of SI piping is as small as 3.44 inch and flow velocity is too high to form the separated flow of vapor and liquid as shown in Figure 6.3.28-2(2). Consequently, steam void is not entrained into liquid phase, and is pushed out without the steam hammer as shown in Figure 6.3.28-1 (2)."
Please augment the discussion, and provide a reference, that includes details based on flow regime mapping (expected flow, pressure temperature ranges) to support this conclusion.

06.03-91

<u>RAI 06.03-29-1 (6.3.2.2-3)</u>:
In UAP-HF-09408, RAI response 06.03-29 did not indicate that the DCD Tier 2 Section 6.3 would be modified to provide the description of the CCWS for SI pump cooling during an accident. The text of the RAI response should be added to DCD Tier 2 Section 6 to support a conclusion that the US-APWR design meets the GDC 35.

06.03-92

<u>RAI 06.03-30-1 (6.3.2.2-4)</u>:
In UAP-HF-09408, RAI response 06.03-30 did not indicate that the DCD Tier 2 Section 6.3 would be modified to provide the description of the HVAC for SI pump cooling during an accident. The text of the response should be added to DCD Tier 2 Section 6 to support a conclusion that the US-APWR design meets the GDC 35.

06.03-93

RAI 06.03-37-1 (6.3.2.2-13)
Gas accumulation can cause water hammer, gas binding in pumps, and inadvertent relief valve actuation that may damage pumps, valves, piping, and supports and may lead to loss of system operability. Recently, GL 2008-01 (ML080110126) provided past instances of gas accumulation in operating plants and discussed the regulatory requirements related to gas accumulation prevention.
(1) Have potential pathways for gas intrusion into the safety injection system (SIS) and containment spray/residual heat removal system (CS/RHRS) been evaluated? If so, identify the pathways. What features are present in the US-APWR design to prevent gas accumulation to ensure SIS and CS/RHRS operability? Which design features (e.g., number and location of high point vents, piping slopes) are present for controlling gas accumulation?
(2) Describe the ITAAC test conditions for the SIS test (Tier 1 Table 2.4.4-5 Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria, Item 7.d Tests to measure the as built safety injection pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each safety injection pump will be performed.). Explain why these test conditions are conservative especially with regard to gas entrainment and its effect on NPSH.
(3) Describe the ITAAC test conditions for the CS/RHRS test (Tier 1 Table 2.4.5-5 Residual Heat Removal System Inspections, Tests, Analyses, and Acceptance Criteria, and Acceptance Criteria, Item 8.f Tests to measure the as built CS/RHR pump suction pressure will be performed. Inspections and analysis to determine NPSH available to each CS/RHR pump will be performed.). Explain why these test conditions are conservative especially with regard to gas entrainment and its effect on NPSH.
Also, IN 2010-11 (ML100640465) discusses operating experience in which there was a potential for the RHR system to be inoperable due to steam voiding.
(4) How does the design of the US-APWR address this issue? Is it sufficient to use forced cooling through the RHR minimum-flow recirculation method of cooling for the US-APWR to prevent steam voiding or are additional procedures required to preclude the potential for steam voiding?

06.03-94

<u>RAI 06.03-55-1 (6.3.3.1-2)</u>:
Justify why the LBLOCA analysis range only covers RWSP temperature down to 45 ^{o}F while T.S. SR 3.5.4.1 states a minimum RWSP temperature of 32 ^{o}F. Should the T.S. SR be revised to reflect the safety analysis value of 45 ^{o}F? Include the effects of temperature on the boron precipitation in the RWSP.

06.03-95

<u>RAI 06.03-13-1 (6.3.1.4-9)</u>:
In UAP-HF-09408 the RAI response indicated that Generic Letters and Bulletins BL 01-01 and BL 02-01 will be addressed in DCD Section 5.2.4.
Revise DCD Table 6.3-4 referring to BL 01-01 and BL 02-01 such that it points to the ISI plan.

06.03-96

<u>RAI 06.03-87 (6.3.4.1-10)</u>:
(1) Provide a description of how the temperature is controlled in the RWSP? Is there a high temperature alarm for the RWSP? Provide a description of the RWSP system components controls, including temperature controls.
(2) Section 6.3.5.4 states that there is a low temperature alarm for the RWSP, but does not state that there is high temperature alarm. Provide a justification of why a high temperature alarm is not necessary for the RWSP.
(2) Where does the DCD discuss how the RWSP level instrumentation and alarms are tested?

06.03-97

<u>RAI 06.03-88 (6.3.4.1-8)</u>:
For test 14.2.12.1.57, how does a "partially pressurized" accumulator satisfy the test Acceptance Criteria to demonstrate the discharge performance in the design specifications since the RCS is open and at atmospheric pressure?