REQUEST FOR ADDITIONAL INFORMATION 384-2862 REVISION 0

6/8/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.03.04 - Chemical and Volume Control System (PWR) (Including Boron Recovery System)
Application Section: 9

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

09.03.04-9

Table 9.3.4-3 of Section 9.3.4 of the DCD indicates that boric acid containing components of the CVCS are maintained at 200°F. However, in the response to RAI No. 280-2060 Revision 1, in the answer to Question 9.3.4-1, subpart e) states that, "The boric acid solution in the tanks is heated to a temperature above the low temperature alarm setpoint and maintained within the temperature ranges of approximately 70°F to 105°F." This statement is regarding the boric acid storage tanks and is conflicting with temperature information in Table 9.3.4-3 of Section 9.3.4 of the DCD for the corresponding tanks. Please provide clarification of the actual temperature range for all boric acid containing components.

09.03.04-10

1. How is the use of the boron recycle system and the potential recycling of depleted boron (depleted in ^{10}B atom percent) back into the accumulator and refueling water storage pit addressed?
2. What measures are taken to ensure that the product of boron concentration (in ppm) and ^{10}B atom percentage yield the expected negative reactivity assumed by the Chapter 15 accidents?
3. Provide the methodology for the determination of the ^{10}B concentration (atom %) in the recycled boric acid and provide the frequency of that determination.

09.03.04-11

In Sections 9.3.4.2.3.2 and 9.3.4.2.7.2, it is stated that the pH will be maintained at 7.3 ± 0.1.

1. Please provide justification as to why such a large pH range of 4.2-10.5 is given in Table 9.3.4-1. Why is such a precise range given in the text, but such a large range given in the table?
2. Under what conditions is the coolant allowed to have a pH in the range of 4.2-6.8? How long is the reactor coolant in an acidic state for these conditions?
3. What is the maximum lithium concentration (ppm) allowed? Is this consistent with the EPRI guidelines?

4. What is the maximum integrated Li-days (ppm-days) the fuel is allowed? How does this compare with MHI's operating experience base?

09.03.04-12

In Section 9.3.4.3, the sixth paragraph states the following:

"The CVCS does not provide an ECCS function. Therefore, the provision for a leakage detection and control program in accordance with 10 CFR 50.34 (f) (xxvi) does not apply."

Although the CVCS does not provide an ECCS function, that does not imply that 10 CFR 50.34(f)(2)(xxvi) is not applicable to the CVCS. Compliance with 10 CFR 50.34(f)(2)(xxvi) is required.

What kind of containment leakage control program is implemented that address leaks in the CVCS? Both inside and outside containment leaks should be addressed. Please explain how leaks are to be identified and what action will be taken to mitigate the leaks.

09.03.04-13

In Section 9.3.4.1.2.4 it is stated that during a SBO, "reactor coolant pump seal integrity is maintained until the charging pumps are powered from an alternate power source and seal water injection restarts." Section 8.4.2.1.2 explains how seal integrity can be maintained for up to 60 minutes after a SBO without damage and that after this amount of time, an alternate alternating current power gas turbine generator re-establishes power to the charging pumps so that seal injection and RCS makeup can be resumed by the CVCS.

Please address the following items:

1. Provide justification showing that seal integrity can be maintained for a 60 minute period after a SBO.
2. What system provides RCS makeup and volume control during a SBO before the charging pumps become powered again?
3. How is seal leakage during a SBO mitigated?

09.03.04-14

Please make corrections as appropriate to the following items:

1. The Section 9.3.4.5.4.1 title is entitled "Volume Co Volume." Please provide correction to this title.
2. Section 9.3.4.5.2.10, "Seal Water Exchanger Inlet Temperature," states the following:

   "Instrumentation is provided to indicate the seal water heat exchanger outlet temperature, and provide the indication in the MCR."

The word *outlet* should be changed to *inlet* to be consistent with the section title.

09.03.04-15

Table 9.3.4-2 states that the temperature of charging water at full power is 464°F. Table 9.3.4-3 has the charging pump design temperature at 200°F. Please provide clarification to why these numbers differ.

09.03.04-16

During plant shutdown, Section 9.3.4.2.7.3 states that “When the purification flow is increased, two charging pumps can be in operation.” An increase in flow seems to imply that only one charging pump might be needed. Do you mean to say that an increased purification flow is needed, therefore two charging pumps are used? If not, when does *increased* flow occur such that two pumps are needed? Or, do you mean to say that the second charging pump is always running for plant shutdown situations?

09.03.04-17

Please give more detail regarding the containment isolation system signal types. In DCD Tier 1 Section 2.4.6.1 under the subsection titled “Logic”, the following is stated:

“The containment isolation valves in the CVCS letdown line and charging line close on a containment isolation signal; where as the seal water return line close on a containment isolation signal with the under voltage signal present.”

Three containment isolation valves (CIVs) are mentioned, however, in DCD Tier 2 Section 9.3.4.2.6.27, there are four CIVs listed.

1. Please explicitly discuss when the *seal water injection line CIV* is closed and add this discussion to the appropriate section of the DCD.
2. Explain what is meant by the “under voltage signal” and what causes it.
3. Is the seal water injection line CIV supposed to be closed in conjunction with the seal water return line CIV?

09.03.04-18

How does US-APWR handle the processing of the gaseous fission products? Where are the storage tanks that hold these fission products kept? How does the GWMS design provide suitable radiation shielding in order to maintain low exposure for areas where personnel might come in contact with any associated fission gas storage tanks or associated piping? Are periodic inspections and maintenance possible based on the design layout?

09.03.04-19

With regard to Section 9.3.4.5.3.3, "Demineralizer and Filter Differential Pressure," what measures are taken once a high differential pressure alarm is received for each of the listed components in the section?

09.03.04-20

The latest edition of the EPRI PWR Primary Water Chemistry Guidelines is an acceptable standard for determining whether a primary water chemistry control program is adequate to comply with GDC 14 with respect to minimizing corrosion-induced degradation of the reactor coolant pressure boundary. DCD Tier 2 Section 5.2.3.2.1 reference 1 identifies the EPRI PWR Water Chemistry Guidelines Revision 4 (2003).The guidelines have been updated since that time and have significant changes.

1. Confirm that the reference will be updated to the latest edition, Revision 6 (2007), of the EPRI Guidelines.
2. Alternatively, provide a detailed explanation of meeting and presenting the changes to the guidelines.
3. The EPRI Primary Water Chemistry Guidelines provide specific Action Level 1, 2 and 3 limits for many primary water chemistry control parameters. Specific actions including reduced power and/or shutdown are required if these limits are exceeded. Describe the implementation of these action levels.

09.03.04-21

It is stated in Section 9.3.4.2.4 that hydrazine is injected into the RCS at plant startup via the chemical mixing tank. It is stated in Section 9.3.4.2.3.2 that LiOH is also added to the RCS via the chemical mixing tank and is continuously fed to the RCS throughout the cycle. Furthermore, it is stated that hydrazine is only used at startup from cold shutdown. At what point is the LiOH introduced into the RCS if hydrazine is initially used in the chemical mixing tank during startup?

09.03.04-22

In Section 9.3.4.2.6.14, "Mixed Bed Demineralizers," the following is stated in the first paragraph:

"Each demineralizer is sized to accept the full purification flow during normal plant operation and to have a minimum design life of one core cycle."

1. What is the maximum design life of each mixed bed demineralizer?
2. What is the maximum design life of all of the other demineralizers, including the cation bed, deborating, and boric acid evaporator feed demineralizers?
3. Are all of the demineralizer resins refilled at end of cycle? If so, please update the DCD to state this in each demineralizer sub-section.

09.03.04-23

Section 9.3.4.2.5 discusses the boron recycle subsystem. Typical boron recycle systems use evaporative techniques to separate pure water from concentrated boric acid solution. The evaporator feed is purified through a demineralizer and then sent to an evaporator where the water is distilled through a series of trays to purify the distillate removing additional boric acid. Concentration of contaminants in the boric acid phase, such as chlorides, silica, sulfate and sodium, and difficulty in maintaining flow continuity at higher boron concentrations and temperatures due to boric acid insolubility at high concentrations, have caused some plants to abandon operations of these systems for recycle purposes.

1. Provide additional details regarding the trays in the boron evaporator and their physical functionality (e.g., percent boron removed for each tray).
2. Provide the mechanism for removing anionic contaminants from the boric acid concentrate so that it may be reused and still meet the EPRI PWR Primary Water Chemistry Guideline requirements for boric acid solution.

09.03.04-24

In DCD Tier 1 Section 2.4.6 Figure 2.4.6-1 (Sheet 2 of 2), there are two CVS seal water return lines shown. The one that is connected to the purification loop should be shown as the letdown line and not the CVS seal water return line. Please make the necessary change to the figure.