

REQUEST FOR ADDITIONAL INFORMATION 224-2067 REVISION 1

2/26/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 05.02.03 - Reactor Coolant Pressure Boundary Materials
Application Section: 5.2.3

QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects)
(CIB1)

05.02.03-1

- a. What recommendation(s) can the applicant make to the combined operating license (COL) applicant(s) referencing the US-APWR standard design with respect to maintaining the primary water chemistry control program current with industry standards? Such recommendations should be captured via a COL information item.
- b. Clarify which year edition and revision of the EPRI Primary Water Chemistry Guidelines is consistent with the standard and limiting values for RCS chemical parameters in the US-APWR.

Background

To ensure compatibility of reactor coolant pressure boundary materials with the environment in accordance with GDC 4, and to ensure compliance with GDC 14 by minimizing the probability of gross rupture of the RCPB due to corrosion induced failure, SRP Section 5.2.3 indicates that the chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion is reviewed using the guidance of SRP Section 9.3.4. SRP Section 9.3.4 recommends that the reviewer evaluates the proposed chemistry program with respect to that described in the latest version in the Electric Power Research Institute (EPRI) report series, "PWR Primary Water Guidelines."

The US-APWR DCD Section 5.2.3.2.1 stated that the standard and limiting values for RCS chemical additive and impurities are consistent with the EPRI Primary Water Chemistry Guidelines, and referenced the 2003 edition (Rev. 4) of these guidelines. However, the guidelines are periodically updated by EPRI to reflect the latest best practices in water chemistry control. Also, the 2003 edition of the guidelines was actually Revision 5.

05.02.03-2

How is pH (at operating temperature) determined from Li and B inventories, and how does the plant ensure the pH remains within a range that ensures materials integrity? Explain any algorithms to be used and how they would involve online measurements and additions of either quantity. What is the limiting value for pH which would provoke

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major corrective action? Are there conditions (e.g. shutdown) in which pH would be permitted to deviate significantly from standard conditions?

Background

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The DCD (Table 5.2.3-2) states that the standard value for pH at 25°C is between 4.2 and 10.5. However, DCD Section 9.3.4.2.3.2 says pH will be maintained in the range 7.2-7.4, which is inconsistent with Table 5.2.3-2. The EPRI Guidelines⁴ mention that pH at nominal operating temperature (usually around 300°C) should be above 6.9 and not exceed 7.4, with a target of operating in the range 7.1-7.3 (see Ref. 4, p. 3-4). Table 5.2.3-2 does not give a limiting value for pH and the value in Section 9.3.4.2.3.2 suggests that normal operation might reach the upper limit of EPRI recommendations. However, neither section of the DCD mentions a maximum value which would provoke significant corrective action to ensure materials integrity, as recommended by the EPRI Guidelines.

As stated in the DCD, pH is determined from concentrations of boric acid and LiOH, although no details are given. The staff requests that the applicant clarify the acceptable pH values and how they are determined.

05.02.03-3

How is sulfate controlled in the reactor coolant? What limiting values are tolerated and what corrective action would be taken if these limits were violated? What strict limits are placed on Li inventory to ensure materials integrity?

Background

To ensure compatibility of reactor coolant pressure boundary materials with the environment in accordance with GDC 4, and to ensure compliance with GDC 14 by minimizing the probability of gross rupture of the RCPB due to corrosion induced failure, SRP Section 5.2.3 indicates that the chemistry of the reactor coolant and the additives (such as inhibitors) whose function is to control corrosion is reviewed using the guidance of SRP Section 9.3.4. SRP Section 9.3.4 recommends that the reviewer evaluates the proposed chemistry program with respect to that described in the latest version in the Electric Power Research Institute (EPRI) report series, "PWR Primary Water Guidelines."

EPRI Guidelines specify certain inventories as control parameters, which require strict adherence to limits in order to achieve material protection. Control parameters include

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the concentrations of SO₄, and Li, but the DCD does not list any limits for these quantities.