REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**403-8454**
SRP Section:	**06.01.01 – Engineered Safety Features Materials**
Application Section:	**6.1.1**
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Question No. 06.01.01-5

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 4 requires SSCs to be designed and fabricated to accommodate the effects of environmental conditions during normal, off normal, and accident conditions.

In Section 6.1.1.2.2, the FSAR states the following:

> "6.1.1.2.2 Controls for Ferritic Steel and Stainless Steel
>
> Subsection 6.1.1.1 describes the control of sensitized stainless steel, cleaning and contamination protection, coldworked stainless steel, non-metallic insulation, welder qualification, and weld fabrication. The manufacture and construction of ESF components and structures conform with the provisions of NRC RGs 1.31, 1.36, 1.44 (Reference 11), 1.50, and 1.71."

RG 1.44 provides licensees and applicants with staff approved guidance regarding stainless steel controls. The guidance has two equally important components: 1) water chemistry and 2) sensitization controls.

Regulatory Guide 1.44 states the following:

> "Controls should be maintained on the chemistry of the reactor coolant and auxiliary systems fluids to which the material is exposed. Chloride and fluoride ion concentrations should be specified to be less than 0.15 parts per million at all times. Dissolved oxygen concentrations should be maintained below the limiting value of 0.10 parts per million during periods when the material is at elevated temperatures. If the oxygen content exceeds this level, such as in boiling water reactor coolants during normal operation, sensitization of material that is welded without subsequent solution heat treatment should be further controlled by limiting the carbon level in the material to 0.03 percent"

In FSAR Section 6.1.1.2 the applicant states the following:

> 6.1.1.2 Composition and Compatibility of Core Cooling Coolants and Containment Sprays
>
> "Controlled water chemistry is maintained within the RCS. RCS water chemistry is specified to minimize corrosion. RCS water chemistry specification is shown in Table 5.2-5. Water chemistry limits are determined at a level comparable to the guidelines in the Electric Power Research Institute (EPRI), "PWR primary water chemistry guidelines" (Reference 10). …
>
> Water from the in-containment refueling water storage tank (IRWST), which serves as the long-term water source for containment spray system, is controlled to maintain a pH range during a loss-of-coolant accident (LOCA)."

The staff cannot determine if the EPRI water chemistry guidelines will also apply to the water in the IRWST; this is significant because the water in the IRWST is the source of water in the ESF components (such as safety injection pumps, connected piping, etc.).

FSAR Table 9.3.2-1, "Normal Primary Sampling System (NPSS) Sample Points," shows the following information:

Sample Origin	Pressurized Sample Capability	Continuous Online Analysis	Sample Removal Method	Off-line Analysis
Boric acid storage tank and in-containment refueling water storage tank	No	None	Local	pH, boron, chloride, sulfate, fluoride, gamma isotopes, aluminum, calcium, magnesium, turbidity

The staff believes that the chloride and fluoride content of the IRWST will be measured but the "sampling removal method" indicates that it can only be done while the reactor is shut down; this could be frequency up to every 18 months (refueling frequency).

In summary the staff has three questions:

1) Will the IRWST in the APR-1400 use the EPRI PWR primary water chemistry guidelines?

2) If not, address how will the ESF system meet the requirements of RG 1.44. The discussion should consider the water chemistry in all ESF components especially during normal plant operation when the ESF systems are not in use.

3) Provide the staff with the basis of how the sampling frequency is adequate to preclude the deterioration of ESF components during normal operation (assumed to be one sample every refueling outage).

Response – (Rev.1)

1) Water chemistry in the IRWST is controlled to adhere to the EPRI primary water chemistry guidelines to ensure the water is suitable for use as the source of water in the ESF components.

2) Please refer to the response to item #1 above.

3) The sampling removal method of the boric acid storage tank (BAST) and the in-containment refueling water storage tank (IRWST) is to be conducted in a valve handling area at the 68'-0" elevation inside the auxiliary building. Samples are to be taken once weekly for analysis of chloride, fluoride, boron, sulfate, and pH. The analysis and frequency for other constituents are to be analyzed once monthly (silica, gamma isotopes, calcium, magnesium, and turbidity (IRWST only)), or as required (iron). KHNP believes this frequency is adequate for chemistry controls for these tanks due to being consistent with industry practice.

   Based on the above discussion, a note is added to DCD Tier 2, Table 9.3.2-1 to clarify the sample removal method for the IRWST.

Impact on DCD

DCD Tier 2, Subsection 6.1.1.2 will be revised to add the control of water chemistry in the IRWST.

DCD Tier 2, Table 9.3.2-1 will be revised to clarify the sample removal method for the IRWST, as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environment Report.

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Moisture control on low hydrogen welding materials conforms to the requirements of ASME Section III.

Welder performance qualification for areas with limited accessibility conforms with the recommendations of NRC RG 1.71 (Reference 9).

6.1.1.2 Composition and Compatibility of Core Cooling Coolants and Containment Sprays

Controlled water chemistry is maintained within the RCS. RCS water chemistry is specified to minimize corrosion. RCS water chemistry specification is shown in Table 5.2-5. Water chemistry limits are determined at a level comparable to the guidelines in the Electric Power Research Institute (EPRI), "PWR primary water chemistry guidelines" (Reference 10). Control of the reactor coolant chemistry is the function of the chemical and volume control system (CVCS), which is described in Subsection 9.3.4.

Water from the in-containment refueling water storage tank (IRWST), which serves as the long-term water source for containment spray system, is controlled to maintain a pH range during a loss-of-coolant accident (LOCA).

6.1.1.2.1 Compatibility of Construction Materials with Core Cooling Coolants and Containment Sprays

Water chemistry in the IRWST is controlled to adhere to the EPRI primary water chemistry guidelines (Reference 10).

To minimize the corrosion of the stainless steel in the containment during a LOCA, long-term post-LOCA pH control of IRWST water is provided by granular TSP, which is stored in baskets in the holdup volume tank (HVT). The stainless steel baskets have a solid top and bottom with mesh sides to provide reasonable assurance of dissolution when submerged in water. The pH control is described in Subsection 6.5.2.3.2. Surfaces in the IRWST that are in direct contact with borated water are lined with stainless steel.

The materials used in the fabrication of mechanical and structural components inside the containment are selected to minimize corrosion and hydrogen generation resulting from contact with spray solutions. The use of aluminum and zinc is minimized in the containment to minimize the yield of hydrogen gas through the chemical reaction with the emergency core cooling or containment spray solutions used in the containment.

Table 9.3.2-1 (4 of 5)

Sample Origin	Pressurized Sample Capability	Continuous Online Analysis Provided	Method of Sample Removal	Off-line Analysis
Primary Sampling (Liquid Only)				
Reactor makeup water to volume control tank	No	None	Local	pH, conductivity, chloride, fluoride, suspended solids, silica, sulfate
Volume control tank drain outlet	No	None	Local	Boron, chloride, sulfate, fluoride, dissolved oxygen, dissolved hydrogen, dissolved nitrogen
Safety injection tanks	No	None	Remote	pH, dissolved hydrogen, dissolved nitrogen, hydrazine, ammonia, chloride, lithium, fluoride, sulfate, boron, suspended solids
Spent fuel pool	No	None	Local	pH, boron, chloride, sulfate, fluoride, ammonia, lithium, turbidity
Boric acid storage tank and in-containment refueling water storage tank	No	None	Local (1)	pH, boron, chloride, sulfate, fluoride, gamma isotopes, aluminum, calcium, magnesium, turbidity

(1) The sampling point of the IRWST is off of the discharge side of the SFP cleanup pumps. The sampling connection is located in a shielded valve handling area at 68'-0" elevation inside the AB.