KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Wednesday, February 10, 2016 8:43 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Erin Wisler
Cc: Yeshnik, Andrew; Mitchell, Matthew; Umana, Jessica; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 403-8454 (06.01.01 - Engineered Safety Features Materials)
Attachments: APR1400 DC RAI 403 MCB 8454.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, the following RAI question response times. We may adjust the schedule accordingly.

06.01.01-1: 45 days
06.01.01-2: 60 days
06.01.01-3: 60 days
06.01.01-4: 60 days
06.01.01-5: 45 days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 403-8454

Issue Date: 02/10/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 06.01.01 - Engineered Safety Features Materials
Application Section: 6.1.1

QUESTIONS

06.01.01-1

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 1 and 30; and 10 CFR Part 50.55a contain provisions regarding quality standards for material specifications that are met by compliance with the applicable provisions of the ASME Boiler and Pressure Vessel Code (ASME Code) and by acceptable application of materials Code Cases as described in Regulatory Guide (RG) 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III." Specifications for permitted materials are identified in the ASME Code, Section III, Appendix I, or described in detail in the ASME Code, Section II.

On November 13, 2015, the applicant provided supplemental information (ML15321A271) which clarified information in the original application and responded to issues identified by the staff. Table 6.1-2 on page 6.1-18 was supplemented with material specifications for the In-Containment Water Storage System.

In this table the IRWST and the HVT are specified to use ASTM A-240 Type 304 stainless steel.

In FSAR Table 3.2-1, the applicant states that the code of construction for these components is ASME Section III, Division 2. This information is consistent with FSAR Section 6.8 which states:

> "The IRWST and HVT are reinforced concrete structures with a stainless steel liner on surfaces expected to be in direct contact with borated water."

The liner material requirements for an ASME Section III, Division 2 component are specified in CC-2511. CC-2511 references Appendix I, Table I-2.2 which does not include the ASTM specification but does allow the ASME specification.

ASME Section III, Subsubarticle NCA-1220 permits the use of ASTM material with conditions. However, the applicant does not invoke NCA-1220 for this material in the FSAR.

As such the staff has two requests:

1) Does the ASTM A-140, Type 304 material specification apply to the IRWST and HVT liners only? If so, update Table 6.1-2 to specify "IRWST Liner" and "HVT Liner."
2) Provide an explanation how the ASTM A-240, Type 304 material complies with ASME Section III, Division 2, paragraph CC-2511.

06.01.01-2

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.

On November 13, 2015, the applicant provided supplemental information (ML15321A271) which clarified information in the original application and responded to issues identified by the staff. Issue #9 (AI 6-14.9) had the following response from KHNP:

> "Valves and Piping in the CS, ECC, and IW systems and all components which come into contact with the reactor coolant are fabricated with austenitic stainless steel. There is no allowance for wall thinning considered in the design of these systems and components. "

If the staff were to certify the APR-1400 design and a plant was built the Combined Operating Licenses would have a term of 40 years.

Provide the staff with a justification on how erosion/corrosion/abrasion/other environmental effects for 40 operating years of the ESF system would not reduce the thickness of the ESF components thereby challenging the operability of the ESF system.

06.01.01-3

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.

On July 29th, 2015 the staff and KHNP had a public meeting to discuss areas of the APR-1400 FSAR which could be supplemented with more information to improve the quality of the initial staff SER. One FSAR section that was discussed was Section 5.2.3.

Staff Issue #14 requested information on a 0.065% carbon limit for austenitic stainless steels; this carbon limit is greater than the staff recommendations in Regulatory Guide 1.44 "Control of the Processing and Use of Stainless Steel."

The applicant responded that the 0.065% carbon limit was sufficient because reactor coolant system has a dissolved oxygen limit of 0.10 ppm. This control is an acceptable method for preventing intergranular failure as it is described in RG 1.44.

On November 13, 2015, the applicant provided supplemental information (ML15321A271) which clarified information in the original application and responded to issues identified by the staff. The sensitization controls in FSAR Section 6.1.1 were removed and a reference to FSAR Section 5.2.3 was added. The result of this change was that the sensitization controls for ESF components would be the same as reactor coolant system components.

The water source for the ESF system is the IRWST. This water source is not isolated from the containment atmosphere which allows the dissolved oxygen content to be higher than the 0.10 ppm limit in the RCS. Additionally, the IRWST water is not monitored during operation.

Provide the staff with a justification of how the sensitization controls for ESF components are sufficient considering the dissolved oxygen content of the ESF system is not controlled in the same manner as the reactor coolant system.

06.01.01-4

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.

FSAR Section 6.1.1 states that cold-worked stainless steel will be subjected to an augmented in-service inspection (ISI) program. FSAR Section 6.6 discusses the general in-service inspection program for Class 2 and 3 systems including the augmented ISI:

> "An augmented in-service inspection is conducted to provide reasonable assurance of the structural integrity of cold-worked austenitic stainless steel components (refer to Subsection 6.1.1.1). The COL applicant is to identify the implementation milestone for the augmented in-service inspection program (COL 6.6(2))."

The Combined License item for augmented ISI is:

> COL 6.6(2) The COL applicant is to identify the implementation milestone for the augmented in-service inspection program.

The FSAR does not provide a description of the augmented ISI that will be conducted on the cold-worked austenitic stainless steel. Add information to the FSAR on the inspections to be conducted or add a COL item to instruct a COL applicant to provide a description on the augmented ISI program for cold-worked austenitic stainless steel.

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.

REQUEST FOR ADDITIONAL INFORMATION 403-8454

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, cold-worked 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 is 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).


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