KHNPDCDRAIsPEm Resource

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Sent: Tuesday, November 10, 2015 2:13 PM
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Subject: APR1400 Design Certification Application RAI 303-8391 (04.05.01 - Control Rod Drive Structural Materials)
Attachments: APR1400 DC RAI 303 MEB 8391.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.

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

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 303-8391

Issue Date: 11/10/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 04.05.01 - Control Rod Drive Structural Materials
Application Section: 4.5.1

QUESTIONS

04.05.01-1

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criterion (GDC) 14 states that, "[t]he reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, or of gross rupture." 10 CFR Part 50, Appendix A, GDC 26 states that, "[t]wo independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded."

In order for the staff to determine whether the APR1400 design meets these criteria with regard to pressure-retaining and internal components of its control rod drive (CRD) system, the staff is requesting the following information.

Review APR1400 Final Safety Analysis Report (FSAR) Sections 4.5.1.1(a) and 4.5.1.2(b) to determine if there are components of the APR1400 design that would be considered reactor coolant pressure boundary (RCPB) components, or components in contact with reactor coolant, which have been omitted, but which should be included in these sections along with their American Society of Mechanical Engineers (ASME) Code material specifications. The staff notes, for example, that APR1400 FSAR Figure 3.9-7 identifies the housing nut and vent stem, which are reactor coolant pressure retaining components, but which have been omitted from FSAR Section 4.5.1.1(a).

Revise FSAR Sections 4.5.1.1(a) and 4.5.1.1(b) to include any omitted components and their ASME Code material specifications based on your review.

04.05.01-2

Type 304 and 316 stainless steel (SS), which have higher carbon content than Type 304L and 316L SS, and their associated Type 308 and 316 SS weld filler metals which are designated for use in the APR1400 CRD system are less resistant to sensitization due to heat treatment or welding than low carbon Types 304L and 316L SS. NRC Information Notice 2006-27, "Circumferential Cracking in Stainless Steel Pressurizer Heater Sleeves of Pressurized Water Reactors," and operating experience with leaking CRD canopy seal welds document the potential of stress corrosion cracking (SCC) in Type 304 and 316 SS. These instances of SCC are occurring in stagnant or dead end pressurized water reactor coolant environments prone to increased levels of oxygen.

Since Type 304 and 316 SS materials are more susceptible to SCC than low carbon Type 304L, 304LN, 316L, and 316LN SS, the use of Type 304 and 316 materials may affect the integrity of the CRD system components, including portions of the RCPB. Specifically, the use of these materials can affect the

structural integrity of CRD components that are subjected to stagnant water, dead legs, or areas prone to increased levels of oxygen.

Revise Section 4.5.1.1 of APR1400 FSAR to specify the use of Types 304L and 316L SS and their applicable filler metals (Types 308L and 316L SS) or provide further justification (e.g., discussing how design features of the APR1400 ensure these areas are not prone to increased levels of oxygen to minimize the likelihood of SCC of in 304 and/or 316 SS grades) addressing the acceptability of the use of normal carbon Type 304 and 316 SS materials and their applicable filler metals (Types 308 and 316 SS).

04.05.01-3

APR1400 FSAR Section 4.5.1.1(a)(1) specifies austenitic stainless steel, martensitic stainless steel and Alloy 690 as materials of construction for the CRD motor housing assembly which is a component of the RCPB.

Revise FSAR Section 4.5.1.1(a)(1) to clearly identify the different parts of the CRD motor housing assembly and specify the applicable ASME Code material specification for each part, noting also the staff's concern raised in Question 4.5.1-2.

04.05.01-4

APR1400 FSAR Sections 4.5.1.1(b)(9), 4.5.1.1(b)(13) and 4.5.1.1(c)(4) specify Type 300 Series SS as the material of construction for the CRD system dowel pin, locking cap and screws, and extension shaft pins. The specification of "Type 300 Series SS" is too generic for the staff to make a clear determination regarding the acceptability of the material to be selected for each of these applications.

Revise FSAR Sections 4.5.1.1(b)(9), 4.5.1.1(b)(13) and 4.5.1.1(c)(4) to give a specific ASME Code material specification for each part, noting also the staff's concern raised in Question 4.5.1-2.

04.05.01-5

APR1400 FSAR Section 4.5.1.3 specifies cobalt-based Alloy (Stellite No. 6B) for the pins and cobalt-alloy (Haynes No. 36) for the latch and links. The staff understands that these materials will be used as structural materials for the fabrication of these components (not hardfacing material). As such, the staff requires additional information to ensure that the material properties of these components (e.g., toughness, etc.) will be appropriate for these applications.

Revise APR1400 FSAR Section 4.5.1.3 to specify the applicable material specifications, including heat treatment to be applied, etc., which will ensure appropriate component material properties when utilizing Haynes No.36 or Stellite No. 6B material.

Also provide operating experience which supports the use of Haynes No. 36 and Stellite No. 6B material of the given specifications for these applications.

04.05.01-6

FSAR Section 4.5.1.1(d) specifies the use of Types 308 and 316 SS, and Alloys 52, 52M, and 152 welding filler metal. This statement is ambiguous and unclear for which components and applicable base material each weld filler metal is to be used.

In order for the staff to understand what components and materials are to be welded with which filler metals, delete APR1400 FSAR Section 4.5.1.1(d) and specify the applicable weld metal, including the filler metal specification and type of weld, for each component in APR1400 FSAR Sections 4.5.1.1(a), (b) and (c), so that the NRC staff can make its determination that the material is compatible with its environment and that each component will perform its design function, noting also the staff's concern raised in Question 4.5.1-2.

04.05.01-7

APR1400 FSAR Section 4.5.1.3 states that "The material used in CEDM that are not included in ASME Section III, Appendix I, Division 1 are identified in Subsections 4.5.1.1 b and c." It is not clear to the staff what materials this statement refers to since the austenitic stainless steels and nickel based alloys identified in APR1400 FSAR Subsections 4.5.1.1(b) and 4.5.1.1(c) are included in Appendix I of the American Society of Mechanical Engineers (ASME) Code, Division 1.

Explain which specific materials the statement above from FSAR Section 4.5.1.3 applies to or revise FSAR Section 4.5.1.3 to delete the statement above.

04.05.01-8

Verify the NRC staff's understanding of the following information and, as appropriate, revise the FSAR as stated below.

FSAR Subsection 4.5.1.2 states, "[f]abrication and processing of austenitic stainless steel are applicable to the CEDM stainless steel as addressed in Subsection 5.2.3.4." Confirm that this means "the fabrication and processing requirements in Subsection 5.2.3.4 are applicable to the austenitic stainless steel materials for the CEDMs." If the staff's understanding is correct, revise the FSAR accordingly.

FSAR Subsection 4.5.1.4 states, "[d]iscussions of the fabrication and processing of austenitic stainless steel provided in Subsection 5.2.3.4.2 are applicable to the cleaning and cleanliness control of the CEDMs." Confirm that this means "the cleaning and contamination protection requirements in Subsection 5.2.3.4.2 are applicable to the CEDMs." If the staff's understanding is correct, revise the FSAR accordingly.

04.05.01-9

FSAR Sections 4.5.1.1(b) identifies that portions of the latch magnet and center spacer assembly, lift magnet and latch spacer assembly, and the lower lift stop assembly are fabricated from Type 410 martensitic stainless. Typically, martensitic stainless steels are annealed where strength is not an issue. However, for the Type 410 components that are quenched and tempered, the applicant does not specify the tempering temperature. SRP Section 4.5.1, Paragraph II.4 states that the tempering temperature of martensitic stainless steels should be

specified for assurance that these materials will not deteriorate from stress corrosion cracking in service. Acceptable heat treatment temperature for Type 410 stainless steel is over 565°C (1050°F). Therefore, provide the tempering temperature for Type 410, martensitic stainless steel, and confirm that other Type 410 martensitic stainless steel is provided in the annealed condition, since this is not specifically stated.

04.05.01-10

FSAR Section 4.5.1.1(b)(1) specifies Chrome Oxide (plasma spray treatment) as a material of construction (surface treatment) for the latch guide tubes. This material is understood by the staff to be intended to promote the reliable functioning of the CRD system and the design's ability to meet the requirements of GDC 26.

Revise FSAR Section 4.5.1.1(b)(1) to document a material specification for this material.


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