ArevaEPRDCPEm Resource

From: Getachew Tesfaye
Sent: Tuesday, March 24, 2009 3:07 PM
To: 'usepr@areva.com'
Cc: Robert Davis; Jeffrey Poehler; David Terao; Tarun Roy; Joseph Colaccino; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 199 (794, 2243, 2309), FSAR Ch. 5
Attachments: RAI_199_CIB1_749_2243_2309.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on March 6, 2009, and discussed with your staff on March 19, 2009. RAI Questions 05.02.01.02-2, 05.02.03-16, 05.02.03-18, and 05.02.03-19 were modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
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Hearing Identifier: AREVA_EPR_DC_RAIs
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U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.02.01.02 - Applicable Code Cases
SRP Section: 05.02.03 - Reactor Coolant Pressure Boundary Materials
Application Section: 5.2

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

05.02.01.02-2

FSAR Table 5.2-1, ASME Section III Code Cases, list Code Case N-71-18 as being used in the EPR design. The staff notes that N-71-18 lists a wide range of material specifications and grades. In order for the staff to evaluate the materials that will be used to fabricate supports for components in the EPR design, the staff requests that the applicant provide a list of all component supports that will be fabricated using N-71-18 and the materials specifications and grades that will be used to fabricate each component support.

05.02.03-15

Previously, the staff requested, in RAI 05.02.03-4, that the applicant modify FSAR Section 5.2.3.3.2 to state that the minimum preheat requirements for all carbon steel and low-alloy steel components in the RCPB will meet the recommendations provided in ASME Code, Section III, Appendix D. The applicant responded on November 10, 2008 and stated that U.S. EPR FSAR, Tier 2, Section 5.2.3.3.2 will be revised to state that welding of carbon- and low-alloy-steel, reactor-coolant-pressure-boundary materials meet minimum preheat requirements of ASME Code, Section III, Appendix D ("Nonmandatory Preheat Procedures"). While the response is acceptable to the staff, the staff notes that the applicant's revision of FSAR Section 5.2.3.3.2, included in its November 10, 2008 response, does not mention carbon steels. In addition, FSAR Section 5.2.3.3.2 states that the typical preheat temperature for low-alloy steels in the RCPB is 200ºF. The staff notes that Appendix D recommends a minimum preheat of 250ºF for P3 (low alloy steel) materials over 5/8 in. thick. The staff requests that the applicant address the above discrepancies.

05.02.03-16

FSAR Section 3.6.3.4.2 and Table 5.2-2 indicate that the main coolant loop (MCL) and pressurizer surge line (SL) piping will be fabricated from SA-336 F304LN or SA-182 F304LN forged austenitic stainless steel material. These specifications do not contain limitations on grain size. Given that grain size can affect the material properties of a material and the ability to perform ultrasonic examination, the staff requested, in RAI 05.02.03-8, that the applicant modify FSAR Section 5.2.3 to include the maximum grain size for forged stainless steel components within the entire RCPB and a basis for the grain size specified. The applicant responded on November 10, 2008 and stated that it would modify FSAR Section 5.2.3 to state that forged stainless steel components within the RCPB that are subject to ASME Code,Section XI volumetric examinations are specified to have a sufficiently large grain size to allow for inspection through ultrasonic methods, while continuing to meet the specified mechanical properties of the ASME Code. The staff considers the applicant's response insufficient for the following reasons:

a) The applicant did not specify the actual grain size number and provide a basis for its selection. The grain size number specified should be based on testing performed by the applicant that verifies that the grain size selected facilitates the performance of PDI-qualified UT exams.

b) The applicant's reference to "a sufficiently large grain size" is ambiguous because it implies that larger grains are more advantageous when performing ultrasonic examinations which is incorrect.

The staff requests that the applicant address the staff's comments above and modify the FSAR accordingly.

05.02.03-17

In RAI 05.02.03-6, the staff requested that the applicant modify FSAR Section 5.2.3.4.1 to include the stabilizing heat-treatment temperature for stabilized grades of stainless steels, and the basis for its selection including a discussion on verification testing that AREVA has performed to determine that its stabilizing heat treatment is adequate for material in the RCS environment to prevent stress-corrosion cracking. In addition, the staff requested that the applicant modify FSAR Section 5.2.3.4.1 to include corrosion-testing requirements for stabilized grades of stainless steels and a basis for the adequacy of the testing requirements selected.

The applicant responded on November 10, 2008 and provided the following response:

1. The material specifications for the U.S. EPR state that the designer must minimize the sensitization of austenitic stainless steels. The designer meets this specification by selecting the time and temperature for a stabilization heat treatment that reduces sensitization susceptibility for stabilized steels.

2. U.S. EPR FSAR, Tier 2, Section 5.2.3.4.1 will be modified to include the following sentences: Stabilized austenitic stainless steel is solution annealed and rapidly cooled so that the material is cooled through the sensitization temperature range rapidly to prevent sensitization. If means other than rapid cooling are used, the material is tested in accordance with Practice E of ASTM A262 to demonstrate the material is in the unsensitized condition.

The applicant's response does not fully address the staff's question. The staff understands that stabilized austenitic stainless steel used in the RCPB will be solution annealed and rapidly cooled but the staff's RAI sought information related to the applicant's stabilizing heat-treatment temperature, including the adequacy of the stabilizing heat treatment. The only stabilized stainless steel material (Grade 347) identified by the staff that is part of the RCS pressure boundary is used to fabricate the

CRDM pressure housing. The staff notes that some of the welding performed on Grade 347 material will involve dissimilar-metal welds-to-F6NM material as shown in the applicant's response to RAI 05.02.03-12, in which the applicant provided additional information to the staff on November 10, 2008. The staff also notes that the applicant has stated, in RAI responses, that the EPR CRDM is based on a proven German design with several years of operating experience. The staff requests that the applicant provide the following information:

1. Identify the stabilizing heat treatment temperature, for stabilized grades of stainless steels, and a basis for its selection including a discussion on verification testing that has been or will be performed to determine that the stabilizing heat treatment is adequate for material in the RCS environment to prevent stress corrosion cracking.

2. If the dissimilar-metal welds between F6NM and Grade 347 material will not be performed by first applying a buttering layer to the F6NM followed by PWHT before joining F6NM to Grade 347 material, provide a basis for performing a PWHT on the Grade 347 austenitic stainless steel. The staff notes that PWHT of Grade 347 after the stabilizing heat treatment is performed may degrade the material's resistance to degradation mechanisms such as stress-corrosion cracking. In addition, please include corrosion-testing requirements for weld-procedure qualifications involving stabilized grades of stainless steels that receive a subsequent PWHT.

3. Given that the applicant has stated that the EPR CRDM is based on a proven German design, the staff requests that the applicant describe any differences between the German and EPR design of the dissimilar-metal weld, including materials processing requirements and PWHT. Identify any service-related degradation issues that have occurred that were associated with the pressure housing in German plants. If degradation has occurred in German plants, describe what steps have been taken to address these issues in the EPR CRDM pressure housing design.

05.02.03-18

In RAI 05.02.03-3 the staff requested, in part, that the applicant list the material specifications for pressurizer safety-relief valves. The applicant responded by letter dated December 17, 2008 and stated that this information is not available because a vendor has not been selected for these components. In addition, the applicant's proposed revision to Table 5.2-2 does not list weld filler metal specifications and classifications used to weld various material types and combinations in the RCPB. The staff also notes that other valves, piping and components that are part of the reactor coolant pressure boundary such as, but not limited to, valves, piping and components in the safety injection system and residual heat removal system are also not listed.

In order for the staff to verify the applicant's compliance with GDC 1, GDC 30 and 10 CFR 50.55a, the staff requests that the applicant modify Table 5.2-2 to include material specifications and grades for ALL valves, piping and fittings or other components that form part of the reactor coolant pressure boundary, or provide a reference in Table 5.2-2 to the location of this information in the FSAR. Material specifications for valves should include valve bodies, valve bonnets, closure bolting and valve disks. In addition, the staff requests that the applicant modify Table 5.2-2 to list weld filler metal specifications and classifications used to weld various material types and combinations in the RCPB.

05.02.03-19

Background

The applicant is proposing to use SA-479 (UNS S41500) or SA 182 Grade F6NM (UNS S41500), in the quenched and tempered condition, for a portion of the control-rod-drive-mechanism pressure housing. UNS S41500 is a martensitic stainless steel. In operating reactors, there has been a history of environmentally induced cracking (stress-corrosion cracking or service-induced hydrogen embrittlement) in martensitic stainless steels (References 1-3), although not in control-rod-drive-mechanism applications. Many of these incidents have been attributed to improper heat treatment, specifically tempering at a lower-than-optimal temperature resulting in excessive strength and hardness, thereby rendering the material susceptible to environmentally induced cracking. In Reference 1, it was concluded based on several cracking incidents that the susceptibility of martensitic stainless steels to stress-corrosion cracking increased if the Rockwell hardness exceeded 26 HRC. For Grade F6NM, SA-182 imposes a maximum Brinell hardness of 295 HB, and SA-479 imposes a maximum hardness of 293 HB for UNS S41500 - both of which equate to a Rockwell hardness of approximately 31 HRC. Martensitic stainless steels with higher nickel content (> 2%) can also be susceptible to thermal aging embrittlement in the operating temperature range of PWR reactor coolant systems. (S41500 has a nickel content of 3.5-5.5 weight %)

Requested Information

1. Describe measures to be taken during manufacture of the UNS S41500 material and fabrication of the CRDM pressure housing to minimize the material susceptibility to environmentally induced cracking.

2. Describe the operating experience or other information used as the basis for concluding UNS S41500 stainless steel will be compatible with the reactor coolant system environment, particularly with regard to its resistance to environmentally induced cracking (either stress-corrosion cracking or service-induced hydrogen embrittlement) and its resistance to thermal aging embrittlement.

References

1. NRC Bulletin No. 89-02: Stress Corrosion Cracking of High-Hardness Type 410 Stainless steel Internal Preloaded Bolting in Anchor-Darling Model 350W Swing Check Valves or Valves of Similar Design, July 19, 1989
2. NRC Information Notice 94-055: Problems With Copes-Vulcan Pressurizer Power-Operated Relief Valves, August 4, 1994
3. NRC Information Notice 95-26: Defect in Safety-Related Pump Parts Due to Inadequate Heat Treatment, May 31, 1995