ArevaEPRDCPEm Resource

From: DUNCAN Leslie E (AREVA NP INC) [Leslie.Duncan@areva.com]
Sent: Thursday, February 25, 2010 8:22 AM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); BRYAN Martin (EXT); NOXON David B (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 304, FSARCh. 5
Attachments: RAI 304 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 304 Response US EPR DC.pdf" provides a technically correct and complete response to the one question.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 304 Question 05.03.01-12.

The following table indicates the respective pages in the response document, "RAI 304 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 304 — 05.03.01-12	2	4

This concludes the formal AREVA NP response to RAI 304, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Les Duncan
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AREVA NP Inc.
An AREVA and Siemens Company
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, October 09, 2009 2:10 PM
To: ZZ-DL-A-USEPR-DL
Cc: Jenkins, Joel; Terao, David; Roy, Tarun; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 304 (3812), FSARCh. 5

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 2, 2009, and on October 9, 2009, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The question in this RAI is considered a potential open item for Phases 2 and 3 reviews. As such, the schedule we have established for your application assumes technically correct and complete responses prior to the start of Phase 4 review. If the RAI cannot be answered prior to the start of Phase 4 review, it is expected that a date for receipt of this information will be provided so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye

Sr. Project Manager
NRO/DNRL/NARP
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Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1168

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Subject: Response to U.S. EPR Design Certification Application RAI No. 304, FSARCh. 5
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Response to

Request for Additional Information No. 304 (3812), Revision 1

10/9/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.03.01 - Reactor Vessel Materials
Application Section: 5.3.1

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

Question 05.03.01-12:

POTENTIAL OPEN ITEM

In response to RAI 2761 Questions 05.03.01-10, the applicant stated that 309L/308L stainless steel and Alloy 52/52M/152 cladding is deposited for the full clad thickness, and that the nominal cladding thickness of 0.295 inches applies to the total cladding thickness regardless of cladding material. The applicant also stated that this thickness applies only to cladding. As an option, the cladding may be qualified as weld buttering and additional thickness requirements may apply, as addressed in the response to Question 05.03.01-11b. However, the NRC staff notes that AREVA's response to Question 05.03.01-11b did not state the additional thickness requirement for the U.S. EPR design, but only used a specific fabrication sequence for a particular reactor vessel with a weld buttering thickness of 0.39 inches minimum, and, as such, might not reflect the fabrication sequence to be used for the U. S. EPR design. In addition, AREVA stated that in accordance with QW-283 of the ASME Code, Section IX, the minimum qualified buttering thickness is specified in the qualified weld procedure, and that qualification of the welding procedures and processes in accordance with ASME Sections III and IX provides acceptable controls to ensure integrity of the RPV low alloy steel base metal is not adversely affected by welding of the radial keys.

The NRC staff notes that the minimum weld buttering thickness specified in a welding procedure is based on the thickness used during the procedure qualification test. But, the design buttering thickness is also based on the design of the reactor vessel and the core support structures in accordance with ASME Code, Section III to account for stresses, including thermal stresses, bearing loads, etc., and should not be solely dependent on the fabrication methods (welding procedures or processes). Therefore, AREVA is requested to provide additional design thickness requirements for the weld buttering option, and include these requirements in the EPR FSAR. This is to ensure that the design of the reactor vessel accounts for the weld buttering, and that the low alloy steel reactor vessel is not adversely affected by heat input after welding of the radial key structural attachment weld is completed without post weld heat treatment of the low alloy steel reactor vessel.

Response to Question 05.03.01-12:

The design requirement for the weld between the radial keys and the internal surface of the reactor pressure vessel (RPV) requires the weld to be a full penetration weld. As stated in the Response to RAI 232, Question 05.03.01-11a (and referenced by Question 05.03.01-11b), the weld-deposited cladding directly below the radial key is considered part of the structural weld and qualified in accordance with ASME Code Sections III and IX. U.S. EPR FSAR Tier 2, Section 5.3.1.2 was revised to add this statement.

The requirements of QW-283 in ASME Code Section IX are applicable when the essential variables for the buttering process are different than the essential variables for the process for subsequent completion of the joint. QW-283.1(a) uses the performance of buttering with heat treatment and completion of the weld without heat treatment as a specific example.

The required thickness of the weld buttering cannot be qualified based on a specified thickness of the buttering layer(s) only. In accordance with QW-283.2, the procedure will be qualified by buttering the test coupon (including heat treatment when done in production welding), and then making the subsequent weld joining the members. Mechanical testing of the completed weld

test coupon will then be completed in accordance with QW-202.2(a), which includes tension and guide bend specimens. ASME Code Section III, NB-4300 and NB-2300 subjects the coupons to testing, which includes impact (notch toughness) testing. This testing will verify that the low alloy steel base material is not adversely affected by the welding process when considering both the weld buttering with heat treatment and the subsequent welding without heat treatment.

There is no design thickness for the weld buttering by itself, only a qualified thickness. The only design thickness is for the completed weld between the radial key and the RPV internal surface, which is specified to be a full penetration weld. A clarification will be added to U.S. EPR FSAR Tier 2, Section 5.3.1.2, which will revise the RAI 232, Question 05.03.01-11a added text, to indicate that the weld between the RPV and the radial key is a full penetration weld.

The final profile of the weld between the radial key and the RPV internal surface/adjacent cladding will be obtained with a radius transition (see Figure 05.03.01-12-1). When providing this transition, the majority of the deposited buttering material that is not within the volume of the structural weld will be removed.

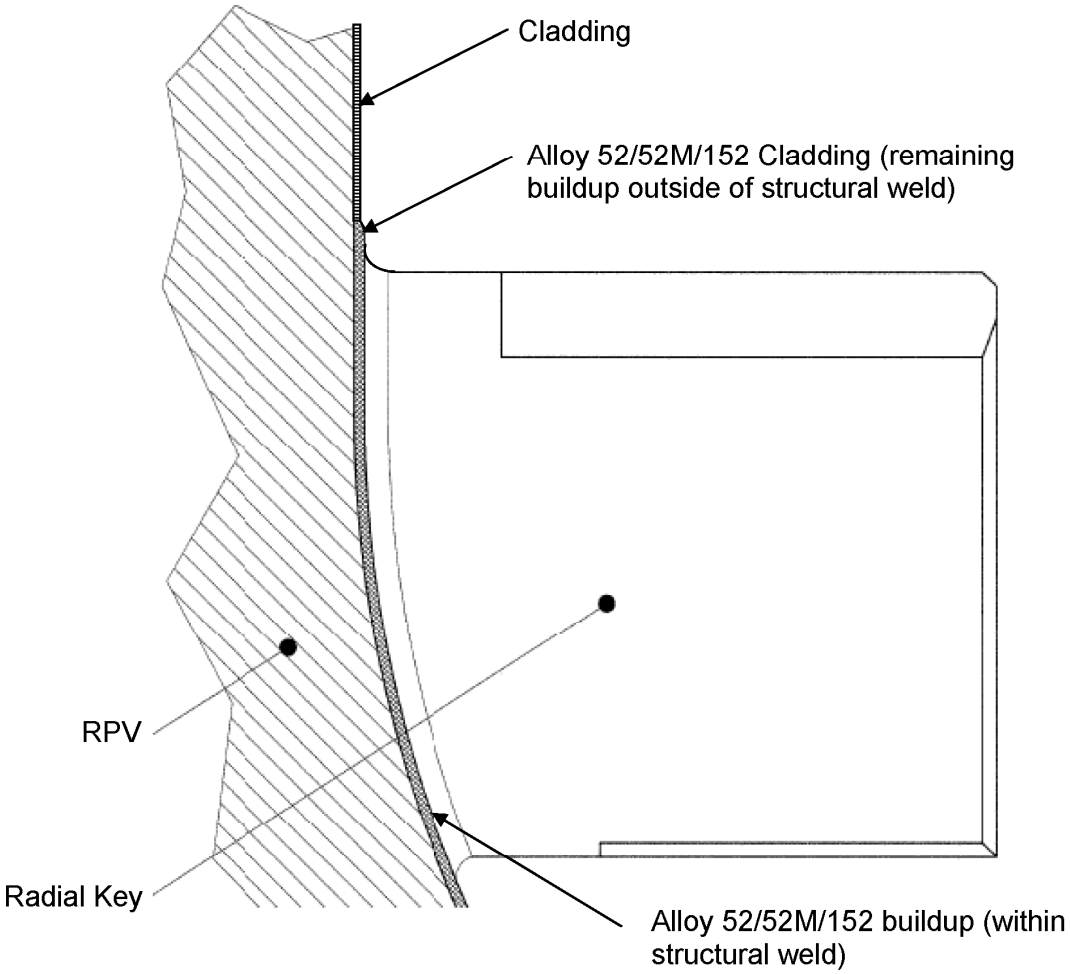
In the event that additional thickness of deposited Alloy 52/52M/152 weld material (beyond that required for cladding) remains outside the area of the structural weld (see Figure 05.03.01-12-1), the presence of this material will not have a significant adverse impact. The additional thickness is expected to be minimal (nominally less than 0.1 inch increase based on the vessels under fabrication for European plants). As the thermal expansion of the Alloy 52/52M/152 weld material is closer to that of the low alloy steel pressure boundary material than the adjacent stainless steel cladding, no significant increase in thermal stress is anticipated.

The total thickness of the weld buttering (nominally 0.39 inch for vessels under fabrication for European plants) represents less than four percent of the total component thickness (nominally 9.84 inches at the thinnest part of the transition ring at the location where the radial keys are attached). Although this specific provision is not utilized in the evaluation of the U.S. EPR RPV, ASME Code Section III, NB-3122.3 states that when the cladding is integrally bonded and the nominal thickness of the cladding is 10 percent or less of the total thickness of the component, the presence of cladding may be neglected altogether.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.3.1.2 will be revised as described in the response and indicated on the enclosed markup.

Figure 05.03.01-12-1—Weld Between the RPV and the Radial key



U.S. EPR Final Safety Analysis Report Markups

attachment configuration. The cladding at all interfaces between the stainless steel and Ni-Cr-Fe cladding is deposited with Ni-Cr-Fe weld filler material.

As the radial keys perform a structural function in support of the reactor vessel internals, the Ni-Cr-Fe cladding directly below the radial key attachment is qualified as part of the radial key full penetration structural weld in accordance with ASME Sections III and IX. Where the radial keys are welded to the cladding without subsequent post-weld heat treatment, the cladding is qualified as weld buttering in accordance with ASME Sections III and IX. 05.03.01-12

5.3.1.3 Special Methods for Nondestructive Examination

The non-destructive examination (NDE) of the RPV and its appurtenances is conducted in accordance with ASME Section III requirements. Full penetration weld preparations for pressure retaining materials are examined in accordance with ASME Section III, NB-5130, prior to welding.

The cladding on the sealing surfaces and load-bearing surfaces of the RPV flange and the closure head flange are ultrasonically examined for the complete volume for both bond and defects. All cladding is ultrasonically examined for bond. Surfaces to be clad are examined using magnetic particle or liquid penetrant techniques in accordance with ASME Section III NB-2545 or NB-2546, respectively, prior to cladding.

5.3.1.4 Special Controls for Ferritic and Austenitic Stainless Steels

Welding of ferritic and austenitic stainless steels is addressed in Section 5.2.3, which addresses conformance to the guidance of RG 1.31, RG 1.34, RG 1.37, RG 1.43, RG 1.44, RG 1.50, and RG 1.71 regarding welding, composition, heat treatments, and similar processes. In addition, RG 1.99 is addressed in Section 5.3.1.5 and RG 1.190 is addressed in Section 5.3.1.6.

5.3.1.5 Fracture Toughness

RCPB ferritic materials provide adequate fracture toughness in accordance with ASME Section III, NB-2300 and 10 CFR Part 50, Appendix G.

The initial Charpy V-notch minimum upper-shelf fracture energy levels for the RPV beltline materials (in the transverse direction for base materials), including welds (along the weld), is 75 ft-lbs, as required by 10 CFR Part 50, Appendix G. The maximum initial nil-ductility reference temperature, $RT_{NDT,}$ of the RPV is -4°F. Materials are evaluated with regard to the effects of chemistry (copper content), initial upper shelf energy, and neutron fluence to assure that 50 ft-lbs upper-shelf energy, as required by 10 CFR Part 50, Appendix G, is maintained throughout the life of the vessel. The vessel fracture toughness data is calculated in accordance with RG 1.99,