ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Saturday, February 27, 2010 10:33 AM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 341, FSARCh. 5 OPEN ITEM
Attachments: RAI 341 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 341 Response US EPR DC.pdf" provides technically correct and complete responses to the three questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 341 Question 05.04.01.01-2, 05.04.01.01-3 and 05.04.01.01-4.

The following table indicates the respective pages in the response document, "RAI 341 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 341 — 05.04.01.01-2	2	2
RAI 341 — 05.04.01.01-3	3	3
RAI 341 — 05.04.01.01-4	4	4

This concludes the formal AREVA NP response to RAI 341, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Martin (Marty) C. Bryan
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, December 15, 2009 7:35 AM
To: ZZ-DL-A-USEPR-DL
Cc: Honcharik, John; Terao, David; Roy, Tarun; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 341 (4042), FSARCh. 5 OPEN ITEM

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 6, 2009, and on December 14, 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 questions in this RAI are OPEN ITEMS in the safety evaluation report for Chapter 5 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. For any RAI that 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,

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1189

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RAI 341 Response US EPR DC.pdf	125622	

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Reply Requested: No
Sensitivity: Normal
Expiration Date:
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Response to

Request for Additional Information No. 341(4042), Revision 1

12/15/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.04.01.01 - Pump Flywheel Integrity (PWR)
Application Section: 5.4.1.6

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

Question 05.04.01.01-2:

OPEN ITEM

RG 1.14, Paragraph C.4.a, states that following the spin test, each finished flywheel receives a check of critical dimensions and a non-destructive examination. The non-destructive examination specified in RG 1.14 include surface examination of areas of high stress concentrations using procedures in accordance with NB-2540 and acceptance criteria in NB-2545 or NB-2546 of Section III to the ASME Code, and a 100 percent volumetric examination using procedures and acceptance criteria specified in accordance with NB-2530 or NB-2540 of Section III to the ASME Code. Therefore, the NRC staff requests that FSAR Tier 2, Section 5.4.1.6.5, "Preservice Inspection," specify that the surface and volumetric examinations, with the acceptance criteria, will be performed after the spin test so that any flaws that have initiated or grown during the spin test can be detected. Also, the FSAR should specify that the flywheel will be inspected for critical dimensions after the spin test so that any dimensional changes can be detected.

Response to Question 05.04.01.01-2:

U.S. EPR FSAR Tier 2, Section 5.4.1.6.5 will be revised to specify that the surface and volumetric examinations, using applicable acceptance criteria, will be performed after the 125 percent spin test so that flaws that could have been initiated or grown during the spin test can be detected. U.S. EPR FSAR Tier 2, Section 5.4.1.6.5 will also be revised to indicate that the flywheel will be inspected for critical dimensions after the spin test so that dimensional changes can be detected.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.4.1.6.5 will be revised as described in the response and indicated on the enclosed markup.

Question 05.04.01.01-3:

OPEN ITEM

The staff notes that the AREVA Report No. ANP-10294P, Revision 1 uses material properties of the thrust runner in the excessive deformation analysis. However, the material specification for the thrust runner was not provided in the report or the U.S. EPR FSAR Tier 2, Section 5.4.1.6. The thrust runner material specification should be included in the FSAR Tier 2, Section 5.4.1.6 to ensure that the analysis in the AREVA Report No. ANP-10294P, Revision 1, bounds the material that will be used for the thrust runner.

Response to Question 05.04.01.01-3:

U.S. EPR FSAR Tier 2, Section 5.4.1.6.2 and Section 5.4.1.6.3 will be revised to include the thrust bearing runner material specification.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.4.1.6.2 and Section 5.4.1.6.3 will be revised as described in the response and indicated on the enclosed markup.

Question 05.04.01.01-4:

OPEN ITEM

To ensure the flywheel will maintain its structural integrity during an overspeed event in accordance with the guidelines in Paragraph C.3 of RG 1.14, an ITAAC should be included in Table 2.2.1-5 of Chapter 2 to the U.S. EPR FSAR, Tier 1. This test ensures that the flywheel assembly can withstand a design overspeed (125 percent of normal operating speed) condition and preclude the generation of missiles, as required by GDC 1 and 4 of 10 CFR Part 50, Appendix A. The ITAAC should also provide the necessary information for the flywheel spin test to be performed, including the acceptance criteria.

Response to Question 05.04.01.01-4:

In accordance with RG 1.14, Paragraph C.3, U.S. EPR FSAR Tier 1, Section 2.2.1 and Table 2.2.1-5—Reactor Coolant System ITAAC will be revised to provide ITAAC to confirm that the reactor coolant pump (RCP) flywheel maintains its structural integrity during an overspeed event.

FSAR Impact:

U.S. EPR FSAR Tier 1, Section 2.2.1 and Table 2.2.1-5 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

3.16 RPV internals listed in Table 2.2.1-1 are designed in accordance with ASME Code Section III, Subsection NG.

3.17 Core support structure welds meet ASME Code Section III, Subsection NG requirements.

3.18 The RPV internals are provided with irradiation specimen guide baskets to hold capsules containing RPV material surveillance specimens.

3.19 Each RCP contains an oil collection system.

3.20 Portions of the RCS piping shown as ASME Code Section III in Figure 2.2.1-1 are designed in accordance with ASME Code Section III requirements.

3.21 Portions of the RCS piping shown as ASME Code Section III in Figure 2.2.1-1 are installed in accordance with an ASME Code Section III Design Report.

3.22 Pressure boundary welds in portions of the RCS piping shown as ASME Code Section III in Figure 2.2.1-1 are in accordance with ASME Code Section III.

3.23 Portions of the RCS piping shown as ASME Code Section III in Figure 2.2.1-1 retain their pressure boundary integrity at their design pressure.

3.24 Portions of the RCS piping shown as ASME Code Section III in Figure 2.2.1-1 are installed and inspected in accordance with ASME Code Section III requirements.

3.25 Components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, are designed in accordance with ASME Code Section III requirements.

3.26 Components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, are fabricated in accordance with ASME Code Section III requirements.

3.27 Pressure boundary welds on components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, are in accordance with ASME Code Section III requirements.

3.28 Components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, retain their pressure boundary integrity at their design pressure.

3.29 The RCP flywheel maintains its structural integrity during an overspeed event.

05.04.01.01-4

4.0 Instrumentation and Controls (I&C) Design Features, Displays, and Controls

4.1 Displays listed in Tables 2.2.1-2—Equipment and Valve Actuator Power Supplies and Controls and 2.2.1-3—Instrumentation Power Supplies, Classification, and Displays are retrievable in the main control room (MCR) and remote shutdown station (RSS) as listed in Tables 2.2.1-2 and 2.2.1-3.

4.2 The RCS system equipment controls are provided in the MCR and RSS as listed in Table 2.2.1-2.

Table 2.2.1-5—~~RCS~~ Reactor Coolant System ITAAC (9 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
3.26	Components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, are fabricated in accordance with ASME Code Section III requirements.	Inspections will be performed to verify that the design report has been revised to reflect as-built deviations from the design if applicable.	For components listed as ASME Code Section III in Table 2.2.1-1, other than RPV internals, the as-built component satisfies design requirements of ASME Code Section III as demonstrated in the Design Report (NCA-3550).
3.27	Pressure boundary welds on components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, are in accordance with ASME Code Section III requirements.	Inspections of pressure boundary welds will be performed to verify that welding is performed in accordance with ASME Code Section III requirements.	For components listed as ASME Code Section III in Table 2.2.1-1, other than RPV internals, ASME Code Section III Data Reports (NCA-8000) exist and conclude that pressure boundary welding has been performed in accordance with ASME Code Section III.
3.28	Components listed in Table 2.2.1-1 as ASME Code Section III, other than RPV internals, retain their pressure boundary integrity at their design pressure.	Hydrostatic tests will be performed on the components.	For components listed as ASME Code Section III in Table 2.2.1-1, other than RPV internals, ASME Code Section III Data Reports exist and conclude that hydrostatic test results comply with ASME Code Section III requirements.
3.29	The RCP flywheel maintains its structural integrity during an overspeed event.	An overspeed test will be performed.	Test results verify that there is no loss of structural integrity at 125 percent of the maximum synchronous speed of the motor.

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The largest break size remaining after application of the leak before break analysis, described in Section 3.6.3, will not result in a significant RCP overspeed. On that basis, the RCP rotor is precluded from an overspeed due to LOCA that could exceed the structural limits of the pump assembly and cause collateral damage. An increase in turbine generator speed, such as that occurring during a loss of external load event as described in Section 15.2.1, would result in an increase in RCP speed to less than the design speed of 125 percent of normal operating speed. The RCP rotating assembly and flywheel have been designed to sustain these speeds without exceeding the structural limits of the pump assembly or causing collateral damage.

5.4.1.5 Inspection and Testing Requirements

Refer to Section 14.2 (Test #003, Test #012, Test #031, Test #170, and Test #183) for initial plant startup testing.

Non-destructive examinations, as required by ASME Section III for Class 1 components, are performed on all reactor coolant pump pressure retaining parts, qualified supports, and other parts, including the flywheel. The RCP pressure boundary is hydrostatically tested at the manufacture facility and as part of the RCS hydrotest after installation.

The RCP is performance tested by the manufacturer in accordance with ASME PTC 8.2, "Centrifugal Pumps," (Reference 2). The RCP motors are tested in accordance with NEMA MG-1, "Motors and Generators," (Reference 3). The RCP motor is also monitored to verify compliance with vibration criteria and is tested up to at least 125 percent of synchronous speed.

5.4.1.6 Pump Flywheel Integrity

5.4.1.6.1 Design Basis

The RCP flywheel is designed with suitable materials with adequate fracture toughness and conservative design procedures. There is a preservice testing and inservice inspection program for RCP flywheels so that the structural integrity of the RCP flywheel will be maintained in the event of design overspeed transients or postulated accidents (GDC 4).

The data on selection of materials, fracture toughness tests, design procedures, preservice overspeed spin testing program and inservice inspection program for the RCP flywheels meet the requirements for GDC 1 and 10 CFR Part 50, 50.55a(a)(1).

05.04.01.01-3

5.4.1.6.2 Design Description

A flywheel consists~~ing~~ of a sandwich of two circular steel discs mounted on the end of the motor shaft of each RCP, as shown in Figure 5.4-1~~,~~. The bottom of the flywheel contacts the top of the thrust bearing runner, which is also mounted on the RCP motor

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shaft. The flywheel provides sufficient inertia in addition with the inertia of the RCP rotating assembly for the RCPs to maintain DNB margin during the gradual loss of forced RCS flow that occurs during RCP coast down. The flywheels are designed, fabricated, examined and tested in accordance with RG 1.14, "Reactor Coolant Pump Flywheel Integrity."

5.4.1.6.3 Material Selection and Fabrication

05.04.01.01-3

The flywheel material is produced by a process that minimizes flaws in the material and improves its fracture toughness properties, in accordance with the relevant portions of RG 1.14. Each forging is fabricated from SA-508, Grade 4N, Class 1 steel, a quenched and tempered, vacuum treated material. Certified material test reports are required for all forgings and demonstrate the acceptability of the flywheel material. No welding is performed on the flywheel. All flame-cut surfaces of the flywheel are removed by machining to a depth of at least 1/2 inch below the flame-cut surface. The RCP motor thrust bearing runner located on the RCP motor shaft below the flywheel is fabricated from ASTM A 372 Grade E Class 65 material.

5.4.1.6.4 Fracture Toughness

The reference nil-ductility transition temperature (RT_{NDT}) of the flywheel material is no greater than -50°F, which is 90°F below the reactor minimum operating service temperature of 40°F.

The fracture toughness of each forging is verified using direct method fracture mechanics testing in accordance with ASTM E 1820-05a, "Standard Test Method for Measurement of Fracture Toughness," (Reference 4).

The minimum static fracture toughness of the material at the normal operating temperature of the flywheel is determined to be equivalent to a reference stress intensity factor (K_{Ic}) of at least 150 ksi√in.

05.04.01.01-2

5.4.1.6.5 Preservice Inspection

Following final machining and overspeed testing, ~~E~~each flywheel undergoes a preservice inspection to detect flaws that could have been initiated or grown during the spin test. This inspection consists of:

- A check of all critical dimensions so that dimensional changes can be detected.
- A 100 percent volumetric examination ~~by ultrasonic methods~~ using ~~the~~ procedures and acceptance criteria specified in ~~of ASME Section III,~~ NB-2540 of Section III of the ASME Code.
- ~~Non-destructive~~Surface examination of areas of high stress concentration (e.g., bores, keyways, splines and drilled holes) and surfaces adjacent to these areas using

05.04.01.01-2

procedures in accordance with NB-2540 and acceptance criteria in NB-2545 or NB-2546 of Section III of the ASME Code.~~via liquid penetrant or magnetic particle examination~~.

The results of the preservice inspection are documented to establish initial flywheel conditions, accessibility and practicality of the program to be used as baseline information for future ISIs.

5.4.1.6.6 Flywheel Design

The flywheel design and selection of material is evaluated based on similar flywheel material used for other RCP designs. Fracture toughness and tensile testing is performed on each flywheel forging to verify that the material conforms to the properties used in this fracture analysis performed in accordance with RG 1.14, Section C.2–Design as described in ANP-10294P, "U.S. EPR Reactor Coolant Pump Motor Flywheel Structural Analysis Technical Report" (Reference 19).

The RCP motor shaft and bearings support the flywheel. The RCP motor shaft and bearings are evaluated to verify that they withstand the loads associated with design conditions, the design basis loss of coolant accident (LOCA), the SSE and the quadratic combination of the design basis LOCA and the SSE.

5.4.1.6.7 Overspeed Testing

Each flywheel assembly is spin tested at the design speed of the flywheel i.e., 125 percent of the maximum synchronous speed of the motor.

5.4.1.6.8 Inservice Inspection

Holes machined into the flywheel permit access, without removing the flywheel, for ultrasonic examination of areas of high stress concentration.

Inservice inspection consists of periodic volumetric examination by ultrasonic methods of the areas of higher stress concentration at the bore and keyway extending to half of the flywheel radius, or a surface examination by liquid penetrant or magnetic particle methods of all exposed surfaces, at nominal 10 year intervals coinciding with the ASME Section XI Inservice Inspection Schedule.

5.4.2 Steam Generators (PWR)

The SG transfer heat from the reactor core to the secondary system to produce the steam required for turbine operation.

5.4.2.1 Design Bases

The SGs are designed, fabricated, examined and tested to the requirements of Section III of the ASME Code, as required by 10 CFR 50.55a (GDC 1, GDC, 30). The RCPB