ArevaEPRDCPEm Resource

From: WELLS Russell D (AREVA US) [Russell.Wells@areva.com]
Sent: Thursday, December 11, 2008 11:34 AM
To: Getachew Tesfaye
Cc: John Rycyna; Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 129, FSAR Ch 5
Attachments: RAI 129 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 129 Response US EPR DC.pdf" provides technically correct and complete responses to all 4 questions.

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 129 Question 05.04.07-8.

The following table indicates the respective pages in the response document, "RAI 129 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 129 — 05.04.07-5	2	3
RAI 129 — 05.04.07-6	4	4
RAI 129 — 05.04.07-7	5	5
RAI 129 — 05.04.07-8	6	6

This concludes the formal AREVA NP response to RAI 129, and there are no questions from this RAI for which AREVA NP has not provided responses.
Sincerely,

(Russ Wells on behalf of)
Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
AREVA NP, Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, November 18, 2008 5:04 PM
To: ZZ-DL-A-USEPR-DL
Cc: John Budzynski; Shanlai Lu; Joseph Donoghue; Tarun Roy; Joseph Colaccino; John Rycyna
Subject: U.S. EPR Design Certification Application RAI No. 129 (1282), FSARCh. 5

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 27, 2008, and discussed with your staff on November 18, 2008. Draft RAI Question 05.04.07-6 was 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
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
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Created By: Russell.Wells@areva.com

Recipients:
"John Rycyna" <John.Rycyna@nrc.gov>
Tracking Status: None
"Pederson Ronda M (AREVA NP INC)" <Ronda.Pederson@areva.com>
Tracking Status: None
"BENNETT Kathy A (OFR) (AREVA NP INC)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen V (AREVA NP INC)" <Karen.Delano@areva.com>
Tracking Status: None
"Getachew Tesfaye" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

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Response to

Request for Additional Information No. 129 (1282), Revision 0

11/18/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 05.04.07 - Residual Heat Removal (RHR) System
Application Section: 5.4.7

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

Question 05.04.07-5:

FSAR Tier 2 Section 5.4.7 describes the functional, isolation, pressure relief, pump protection, and test requirements applicable to the RHRS. In order for the staff to complete its review of the RHRS and confirm conformity with the requirements of GDC 34 and the acceptance criteria of Branch Technical Position BTP 5-4, additional information is required.

a. BTP 5-4 requires that the RHRS be protected against accidental pressurization when in operation and connected to the RCS. FSAR Section 5.4.7.2 states that the RHRS safety-relief valve setpoints and capacities limit the piping to 110 percent of its design pressure. In FSAR Section 5.4.7.2.2, it is stated that the RHRS beyond the second isolation valve is designed so that the ultimate rupture strength exceeds that of the full RCS operating pressure. FSAR Tier 2 Figure 6.3-2 shows RHRS design pressure to be 2540 psig up to the second isolation valve and 930 psig immediately downstream of the second isolation valve. Clarify the FSAR statement that the RHRS beyond the second isolation valve is designed so that the ultimate rupture strength exceeds that of the full RCS operating pressure, and describe how the over-pressurization protection requirements of BTP 5-4 are met.

b. Inspection and testing requirements are addressed in FSAR Section 5.4.7.4. Describe the testing that will be performed to confirm adequate mixing of borated water that may be added before or during cooldown under natural circulation conditions.

Response to Question 05.04.07-5:

a. To verify conformance with the guidance of SRP 5.4.7 and BTP 5-4, the ultimate pipe rupture strength of the safety injection system/residual heat removal system (SIS/RHRS) was analyzed for piping outside of the containment. The minimum ultimate pipe rupture strength was determined to be 2568 psig, which exceeds the reactor coolant system (RCS) operating pressure of 2250 psig. The SIS/RHRS piping inside containment is similar in size and schedule to that of the piping outside of containment. Therefore, the ultimate pipe rupture strength of the SIS/RHRS exceeds that of the full RCS operating pressure.

   The RHRS safety relief valve is designed to provide overpressure protection for the SIS/RHRS, in the limiting event of a spurious actuation of the medium head safety injection (MHSI) pump with its miniflow line closed (i.e., full injection pressure) as the RHRS is aligned to the RCS. The RHRS safety relief valve is designed in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (see BTP 5-4, Pressure Relief Requirements 3-A). Fluid discharge from the RHRS safety relief valve is directed to the in-containment refueling water storage tank (IRWST), thus preventing flooding of safety-related equipment, avoiding reduction in the safety injection capability, and preventing discharge outside of the containment (see BTP 5-4, Pressure Relief Requirements 3-B).

b. To confirm the adequate mixing of borated water that may be added before or during cooldown under natural circulation, sampling of the reactor coolant will be performed either via the RCS (at sampling lines located at the crossover leg loop #3 or the hot leg loop #1) or via the sampling line located at the chemical and volume control system (CVCS) letdown line. Sampling can also be performed via the sampling line located downstream of each low head safety injection (LHSI) heat exchanger, when the RHRS is aligned to the RCS. Refer to U.S. EPR FSAR Tier 2, Section 6.3, Figure 6.3-2 (Sheet 1 of 2), Section 9.3.2, and Section 9.3.4, Figure 9.3.4-1 (Sheet 3 of 19).

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 05.04.07-6:

FSAR Tier 2 Section 5.4.7.2 describes a mini-flow and test line. The staff requires the following additional information be provided relative to the mini-flow and test line in order to ensure compliance with the in-service inspection requirements of 10 CFR 55 a (g) pertaining to RHRS pump testing and the guidelines of Generic Letters BL 88-04 and GL 89-04:

a. Confirm that the mini-flow and test line is shown in FSAR Tier 2 Figure 6.3-2 as the 8-inch line connected from downstream of the LHSI heat exchanger and upstream of the outboard isolation valve to the hot leg RHRS letdown line.
b. Confirm adequate sizing of the line and presence of an installed flow measurement device; and describe the design function of the installed flow restrictor to preclude pump damage during testing.
c. Address whether a single failure can result in conditions causing a "dead-head" no flow condition of the LHSI pumps during mini-flow operation.

This information is needed in order to ensure that potential generic deficiency associated with in-service testing of pumps utilizing minimum flow lines as described in Generic Letter 89-04 has been adequately addressed.

Response to Question 05.04.07-6:

a. The low head safety injection (LHSI) miniflow line (30JNG40 BR006) is shown in U.S. EPR FSAR Tier 2, Figure 6.3-2 (Sheet 2 of 2) as the 4-inch line connected downstream of the inside containment isolation valve (30JNG40 AA009) and upstream of the second reactor coolant pressure boundary (RCPB) isolation valve (30JNG40 AA006).

b. The LHSI miniflow line is sized such that a sufficient minimum flow (more than 15% of the estimated maximum run-out of the pump at shutoff head conditions) will be recirculated to the IRWST when the LHSI pump is taking suction from the in-containment refueling water storage tank (IRWST) (e.g., during testing and safety injection), thus preventing the pump from dead-heading in the event the downstream pressure is higher than the maximum LHSI injection pressure. Flow rate sensors, located downstream of the LHSI heat exchanger and upstream of the miniflow line, provide flow indication during operation of the LHSI pump.

   The flow restrictor installed along the LHSI miniflow line is designed to maintain minimum flow to the IRWST for LHSI pump protection during both testing and safety injection, while permitting sufficient flow to the reactor coolant system (RCS), when required for emergency core cooling.

c. A single failure, if occurring upstream of the LHSI miniflow line (e.g., spurious closing of the LHSI heat exchanger main control valve), could result in a dead-head no flow condition of the LHSI pump. However, as noted in U.S. EPR FSAR Tier 2, Table 6.3-7, failure of the control valve would cause unavailability of only one RHRS train, leaving three RHRS trains to provide sufficient residual heat removal.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 05.04.07-7:

FSAR Tier 2 Section 5.4.7.2.1 describes the design features pertaining to mid-loop operation. The following additional information is requested by the staff in order to ensure that the RHRS design meets the system design requirements of GDC 34 and GDC 19:

a. Confirm the availability of the redundant hot leg temperature indications in the main control room and describe the use of the core exit thermocouples for monitoring temperature during mid-loop operation.

b. Provide additional detail about the level sensor that is used to monitor reactor vessel level during an outage, including sensor design and RCS connection location, redundancy, availability of level indication and alarms in the main control room, and procedures for ensuring reliable level indication at the junction of the RHRS line and reactor vessel, for example under conditions of low flow.

c. Describe the communications equipment available to the main control room operator and field personnel during mid-loop operations.

This information is needed in order for the staff to complete its evaluation of the RHRS design features pertaining to mid-loop operation as per the recommendations contained in NRC Generic letter GL 88-17.

Response to Question 05.04.07-7:

a. The redundant hot leg temperature indications are available to the operators in the main control room via the process information and control system (PICS) and the safety information and control system (SICS).

   The core exit thermocouples provide an indication of the radial temperature distribution in the core and the saturation margin (ΔT_{sat}) at the core exit. Temperature measurement inside the reactor pressure vessel (RPV) will be unavailable when instrumentation is disconnected from the top of the RPV in preparation for head removal. See the response to RAI 26, Question 19-184 for availability of RCS instrumentation during mid-loop operations.

b. See the response to RAI 26, Question 19-184.

c. RG 1.206, SRP 5.4.7, and BTP 5-4 do not request that U.S. EPR FSAR Tier 2, Section 5.4.7 address communications equipment available to the main control room operator and field personnel during mid-loop operations. Additionally, the NRC question states: "This information is needed in order for the staff to complete its evaluation of the RHRS design features pertaining to mid-loop operation as per the recommendations contained in NRC Generic letter GL 88-17." In accordance with the guidance of SRP 5.4.7, Section III.19, which addresses conformance with GL 88-17, the RHR system has visible and audible indications of abnormal conditions in temperature, level, and RHR system performance parameters. Additionally, information on the U.S. EPR communication system is described in U.S. EPR FSAR Tier 2, Section 9.5.2.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 05.04.07-8:

Section 5.4.7.3.2 addresses RCS cooldown for a two train SIS/RHR operation with offsite power available. The FSAR states that “In Figure 5.4.4, two RHR trains (with full flow through the LHSI HXs) are able to cool the plant down from approximately 250°F to 200°F in around 10 hours.”

Based on Figure 5.4-4, the temperature of 250°F is reached approximately in 7.3 hours and the temperature of 200°F is reached at approximately 10 hours. Therefore, the cooldown from 250°F to 200°F occurs in approximately 2.7 hours. Please explain the difference between the FSAR statement and Figure 5.4-4.

Response to Question 05.04.07-8:

U.S. EPR FSAR Tier 2, Section 5.4.7.3.2 will be revised to state that the cooldown from 250°F to 200°F occurs in approximately 2.7 hours.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 5.4.7.3.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

letdown line, while the steam generators levels are controlled by the startup and shutdown system.

In the analysis performed, two RCPs are tripped when the RCS temperature decreases to 250°F, another RCP is tripped when the RCS temperature decreases to 158°F, and the last RCP is tripped when the RCS temperature decreases to 122°F.

Two trains of the SIS/RHRS are normally placed in service for residual heat removal when the RCS pressure and temperature decreases below approximately 390 psia and 250°F. The remaining two trains are placed in service after the RCS temperature has been further reduced to approximately 212°F.

Performance curve showing the calculated cooldown rates for four trains operation is shown in Figure 5.4-3—RCS Cooldown for Four Train SIS/RHRS Shutdown Cooling Operation From Figure 5.4-3, the time required to cool the plant down to approximately 250°F is around 7.3 hours after reactor trip, while the time required to cool the RCS temperature down to approximately 131°F (using all four LHSI heat exchangers in the sequence explained) is another 7.7 hours. The total time to cool the plant down to 131°F (for refueling) is approximately 15 hours after reactor trip. This total time attained is much shorter than the required time of 40 hours, as specified in Section 5.4.7.1.

5.4.7.3.2 Performance Evaluation Assuming the Most Limiting Single Failure and Offsite Power Available

For the most limiting single failure scenario, two SIS/RHRS trains are available to remove residual heat, assuming one train is unavailable due to system maintenance and a second train is lost due to the single failure. Offsite power is available; therefore, all auxiliary functions described in Section 5.4.7.3.1 to bring the reactor down to SIS/RHRS connection conditions are available.

05.04.07-8

Performance curve showing the most limiting single failure and offsite power available is shown in Figure 5.4-4—RCS Cooldown for Two Train SIS/RHRS Shutdown Cooling Operation (with Offsite Power Available). In Figure 5.4-4, two RHR trains (with full flow through the LHSI HXs) are able to cool the plant down from approximately 250°F to 200°F in around ~~10~~2.7 hours. This cooldown time is achieved with the normal RCP shutdown sequence explained in Section 5.4.7.3.1.

5.4.7.3.3 Performance Evaluation Assuming the Most Limiting Single Failure and Only Onsite Power Available

For the most limiting single failure scenario, with only onsite power available, the cooldown to cold shutdown condition is achieved with use of only safety-related equipment. The LOOP results in immediate RCP coastdown and termination of the main feedwater supply.