ArevaEPRDCPEm Resource

From: WELLS Russell (AREVA) [Russell.Wells@areva.com]
Sent: Thursday, March 17, 2011 9:10 AM
To: Tesfaye, Getachew
Cc: BUDZIK Dennis (AREVA); HUDSON Greg (AREVA); BENNETT Kathy (AREVA); DELANO Karen (AREVA); HALLINGER Pat (EXTERNAL AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); WILLIFORD Dennis (AREVA)
Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 452, FSAR Ch. 7, Question 07.03-35
Attachments: RAI 452 Question 07.03-35 Response US EPR DC - DRAFT .pdf

Getachew,

Attached is a draft response to RAI No. 452, Question 07.03-35. The response is provided in advance of the final response date of April 28, 2011 as shown below.

Please let me know if the staff has questions, or if this can be sent as a final response.

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
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Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Thursday, February 24, 2011 4:33 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); BRYAN Martin (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 452, FSAR Ch. 7, Supplement 1

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 452 on December 6, 2010.

Based upon the information presented to the NRC during the February 15, 2011, Public Meeting, the schedule for the remaining questions has been changed.

The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 452 07.03-35	April 28, 2011
RAI 452 07.03-36	April 28, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
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From: BRYAN Martin (External RS/NB)
Sent: Monday, December 06, 2010 4:50 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 452, FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 452 Response US EPR DC," provides a schedule since a technically correct and complete response to the question is not provided.

The following table indicates the respective pages in the response document, "RAI 452 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 452 07.03-35	2	2
RAI 452 07.03-36	3	3

A complete answer is not provided for 2 of the 2 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 452 07.03-35	March 30, 2011
RAI 452 07.03-36	March 30, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, November 05, 2010 8:33 AM
To: ZZ-DL-A-USEPR-DL
Cc: Morton, Wendell; Spaulding, Deirdre; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 452(5161), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 20, 2010, and discussed with your staff on November 4, 2010. No change is made to the draft RAI 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
Email Number: 2717

Mail Envelope Properties (1F1CC1BBDC66B842A46CAC03D6B1CD410419E4F7)

Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 452, FSAR Ch. 7, Question 07.03-35
Sent Date: 3/17/2011 9:10:23 AM
Received Date: 3/17/2011 9:10:27 AM
From: WELLS Russell (AREVA)

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Files	**Size**	**Date & Time**	
MESSAGE	4397	3/17/2011 9:10:27 AM	
RAI 452 Question 07.03-35 Response US EPR DC - DRAFT .pdf			291524

Options
Priority: Standard
Return Notification: No
Reply Requested: No
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Response to

Request for Additional Information No. 452 (5161), Revision 0

11/05/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.03 - Engineered Safety Features Systems
Application Section: 7.3

QUESTIONS for Instrumentation, Controls and Electrical Engineering 1 (AP1000/EPR Projects) (ICE1)

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Question 07.03-35:

Follow-up to RAI No. 60, Question 07.03-19

Provide additional information regarding how single failures identified in the Protection System (PS) system-level FMEA in Section 7.3 correlate to the pre-defined failure states of the PS. Also provide additional information on how the PS Inspection, Tests, Analysis, and Acceptance Criteria (ITAAC) address predefined failure states of the PS.

10 CFR 50.55a(h) incorporates by reference IEEE Std. 603-1991. Clause 5.5 of IEEE Std. 603-1991 requires, in part, that safety systems shall be designed to accomplish their safety functions under the full range of applicable conditions enumerated in the design basis. Initially, the staff requested in RAI No. 60, Question 07.03-19, that the applicant demonstrate how the U.S. EPR design addresses guidance from SRP Section 7.1-C (in particular, guidance for IEEE Std. 603-1991, Clause 5.5) which states, in part, that instruments should fail into a safe-state, a failure of hardware or software should not inhibit manual initiation of a protective function and upon system restoration from a loss of power condition, actuated components should not automatically transfer out of the predefined failure state.

The applicant responded to the staff's question by pointing out that IEEE Std. 603-1991, Clause 5.5, was addressed by U.S. EPR FSAR, Tier 1, Section 2.4.1, ITAAC Item 4.10. The staff found the applicant's response to RAI No. 60, Question 07.03-19, did not fully address the question. ITAAC Item 4.10 does not address the safe-states of the PS nor that operator intervention is required to move an actuated component out of a predefined failure state in the case of a loss of power, EMI/RFI, etc. Also, U.S. EPR FSAR, Tier 2, Section 7.3.2.2, does not address this issue. The staff is requesting the applicant to:

a. Provide information in Section 7.3.2.2 on the safe-states of the PS and how they correlate with the identified single failures in the system-level FMEA and how the above-referenced guidance is addressed.
b. Provide clarification on how ITAAC Item 4.10 in US EPR FSAR, Tier 1, Section 2.4 addresses the guidance referenced in SRP 7.1-C. Specifically, how does the ITAAC verify that PS components remain in a predefined failure state upon restoration of power, etc.?

Response to Question 07.03-35:

Multiple failures of safety-related components are required to realize conditions such as disconnection of the system, loss of energy, or adverse environments. The PS failure modes and effects analysis (FMEA) does not include, and is not required to include, analysis of multiple failures.

The condition “disconnection of the system” has no real meaning relative to the U.S. EPR protection system (PS). There are hundreds of “connections” related to the PS (such as individual connections to input sensors, data communication connections between divisions, individual output connections to priority modules, or reactor trip devices). There is no mechanism that introduces a complete “disconnection of the system”. Each sensor input connection is analyzed for failure, specifically disconnection, in the PS FMEA. The effects of these failures are demonstrated to be acceptable. Each network connection between divisions is analyzed for failure, specifically disconnection, in the PS FMEA. The effects of these failures

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are demonstrated to be acceptable. Each output connection is analyzed for failure, specifically disconnection, in the PS FMEA. The effects of these failures are demonstrated to be acceptable.

Each division of the PS is supplied power by a safety-related, battery-backed, diesel-backed, uninterruptible electrical bus. In case of loss of offsite power, each PS division is supplied by its own battery until the emergency diesel generators are started and connected to the bus. A single failure of a divisional battery could result in loss of power to a PS division. In this case, the processors in the division shutdown, no data communication is sent from the division, and all outputs go to a “zero” state. This results in the reactor trip (RT) devices for that division opening (tripped state), and no actuation of engineered safety feature actuation system (ESFAS) components controlled by that division. The other three PS divisions remain capable of performing their protective functions. When power is restored to a PS division, the processors go through a reset and startup self-test mode, during which the outputs remain in a “zero” state. Upon successful completion of the startup self-test, each processor enters its normal cyclic operation mode. The RT outputs will transition from the “zero” state (trip) to their normal “one” state (no-trip). This action alone does not return the affected RT breaker to its normal state. Manual action is also required locally (re-racking the breaker) to return to its closed position. Upon successful completion of the startup self-test, when each processor enters its normal cyclic operation mode, ESFAS outputs will remain in their normal “zero” state. If there is a design basis event during power restoration, a change of state of the ESFAS outputs, to the actuation state, occurs to respond to the event. This discussion will be added to U.S. EPR Digital Protection System Technical Report, ANP-10309P, Revision 1 in support of the PS FMEA.

Both “spurious” and “blocking” failures of the PS outputs are analyzed in the PS FMEA and demonstrated to be acceptable. In the case that, upon a restoration of power, a PS division does not function as designed, the impact to the plant is bounded by the FMEA results. Because the existing FMEA bounds the PS outputs from a division acting adversely upon restoration of power, and the results of this multiple failure scenario are acceptable to plant safety, no special ITAAC is required to address the “restoration of power” scenario. However, an initial plant startup test will be performed to verify that the PS outputs attain a predefined state upon loss and restoration of power. This test will be documented in U.S. EPR FSAR Tier 2, Section 14.2.

PS equipment is located in a mild environment. The mild environment is protected by safety-related building structures and safety-related heating, ventilation and air conditioning systems. No single failure results in adverse environmental conditions for the PS equipment. This information will be added to ANP-10309P in support of the PS FMEA.

The information regarding the PS FMEA will be removed from U.S. EPR FSAR Tier 2, Sections 7.2 and 7.3 and will be moved to ANP-10309P to provide more detail.

To support the submittal of complete and consistent information, considering the multiple RAI responses and design changes that have been communicated to NRC staff, comprehensive markups for each FSAR section and each technical report will be submitted in single RAI responses.

The markups to ANP-10309P described in this response will be submitted with the Response to RAI 442, Question 07.01-27.

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FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 14.2.12.11.22 will be revised as described in the response and indicated on the enclosed markup.

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U.S. EPR Final Safety Analysis Report Markups

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5.2 The low range HMS signal processing unit is located in Safeguard Building 1 and is powered from the Class 1E electrical power supply.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 The HMS functions as described in Section 6.2.5.

14.2.12.11.22 Protection System (Test #146)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the safety-related protection system (PS).

1.2 To verify the PS response times.

RAI 452, 07.03-35

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.4 Verify operation of PS interlocks.

1.5 Verify that upon loss and restoration of electrical power to each PS division, the PS outputs attain a predefined state.

2.0 PREREQUISITES

2.1 Construction activities on the reactor trip breakers, reactor trip contactors, and PS have been completed.

2.2 PS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test instrumentation is available and calibrated.

2.4 Factory acceptance testing has been completed.

2.5 Support systems required for PS operation are functional and the plant is configured so that equipment damage or personnel injury will not occur. For example, pump breakers racked to test to prevent inadvertent pump start, or pump motors uncoupled.:

2.5.1 Reactor trip breakers.

2.5.2 Reactor trip contactors.

2.5.3 Manual reactor trip (RT) controls on SICS.

2.5.4 Engineered Safety Features systems components are energized and positioned in a manner to respond to a PS actuation.

3.0 TEST METHOD

3.1 Energize power supplies and verify power supply output voltage.

3.2 Simulate combinations of the actuation voting trip logic for each of the actuation signals and observe actuation and associated alarms.

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3.3 Simulate PS inputs described in Section 7.2 that would generate a reactor trip signal and trip each reactor trip breaker. Observe reactor trip breaker operation.

3.4 Simulate PS inputs described in Section 7.2 that would generate a reactor trip signal and trip each reactor trip contactor. Observe reactor trip contactor operation.

3.5 Initiate a manual reactor trip from SICS and observe the following:

3.5.1 Reactor trip breaker operation.

3.5.2 Reactor trip contactor operation.

3.5.3 CRDM operating coil transistor discharge.

3.6 Simulate PS inputs described in Section 7.3 that would generate an ESF actuation output. Observe ESF actuators response.

3.7 Initiate each manual ESF actuation from SICS while observing ESF system response.

3.8 Check the operation of bypass features including, where applicable, observation that operating bypasses are cancelled automatically.

3.9 Inject signals into appropriate sensors or sensor terminals and measure the elapsed time to achieve actuation of the field device (e.g., breaker, contactor). Trip or actuation paths may be tested in several segments.

3.10 Observe protection system operation over the design range using actual or simulated input signals.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power condition) PS divisions and determining which functions are lost on the energized PS division and which overall PS functions are lost. Repeat test for all PS divisions.

RAI 452, 07.03-35

3.12 Verify operation of PS interlocks described in Section 7.6 using actual or simulated inputs and verify corresponding interlock function.

3.13 Test the PS response to loss of power and subsequent power restoration as follows:

3.13.1 Simulate normal steady state full power conditions for the PS and verify all PS RT outputs are "one" and all PS ESFAS outputs are "zero."

3.13.2 Remove electrical power to one PS division and verify all PS outputs in that division are "zero."

3.13.3 Re-energize the PS division and verify that all PS outputs in that division are "zero" during the time that the PS division computers perform their start up self test.

3.13.4 Upon completion of the startup self test, verify the PS RT outputs attain "one" and the PS ESFAS outputs attain "zero" for the division under test.

3.13.5 Repeat test for all PS divisions.

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4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operational data.

4.3 PS functional logic diagrams.

4.4 PS activation values.

4.5 Reset margin and rate of setpoint change of variable setpoints.

4.6 Maximum and minimum values of variable setpoints.

4.7 PS response times described in the safety analyses.

4.8 ESF system actuator operational data.

5.0 ACCEPTANCE CRITERIA

5.1 The PS generates automatic RT signals.

5.2 The PS generates automatically actuated engineered safety feature signals.

5.3 The PS provides the correct operating bypasses for reactor trip functions.

5.4 The PS provides the correct operating bypasses for the engineered safety features.

5.5 Operating bypasses are automatically removed when required.

5.6 Manual actuation of reactor trip and engineering safety features occurs when initiated.

5.7 The PS provides status information to the non-safety-related control systems.

5.8 The total response time of each PS trip or actuation path is verified to be conservative with respect to the times used in the safety analysis.

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5.9 Electrical independence and redundancy requirements are met.

5.10 The PS functions as described in Sections 7.1.1.4.1, 7.2, 7.3, and 7.6.

5.11 The PS outputs attain a predefined state upon loss and restoration of electrical power.

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14.2.12.11.23 Reactor Control, Surveillance and Limitation System (Test #147)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the non-safety-related reactor control, surveillance and limitation system (RCSL).

1.2 To demonstrate electrical independence and redundancy of power supplies.