AREVAEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Friday, July 20, 2012 1:13 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7, Supplement 4
Attachments: RAI 512 Supplement 4 Response US EPR DC.pdf

Getachew,

AREVA NP provided a schedule on October 13, 2011 for a technically correct and complete response to the one question in RAI 512. On January 10, 2012, AREVA NP provided Supplement 1 to revise the schedule for the one question. On February 17, 2012, AREVA NP provided Supplement 2 to revise the schedule for the one question. On May 30, 2012, AREVA NP provided Supplement 3 to provide a complete and final response for the one question.

The attached file, "RAI 512 Supplement 4 Response US EPR DC.pdf" provides additional mark-ups to ANP-10304, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," in redline-strikeout as discussed with NRC. This response and associated mark-ups in conjunction with the markups in the RAI 512 Supplement 3 response transmitted May 30, 2012 provide the complete and final response to this Question 07.08-50.

The following table indicates the respective pages in the response that contain AREVA NP's final response to the subject question.

Question #	Start Page	End Page
RAI 512 — 07.08-50	2	4

This concludes the formal AREVA NP response to RAI 512, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, May 30, 2012 8:50 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7, Supplement 3

Getachew,

AREVA NP provided a schedule on October 13, 2011 for a technically correct and complete response to the one question in RAI 512. On January 10, 2012, AREVA NP provided Supplement 1 to revise the schedule for the one question. On February 17, 2012, AREVA NP provided Supplement 2 to revise the schedule for the one question.

The attached file, "RAI 512 Supplement 3 Response US EPR DC.pdf" provides a technically correct and complete final response to the remaining question as promised. 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 this question. Also appended to this file as a part of the response are affected pages of ANP-10304, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," and ANP-10309P, "U.S. EPR Protection System Technical Report," in redline-strikeout format which support the response to RAI 512. A complete revision to these technical reports will be submitted by separate letter.

The following table indicates the respective pages in the response that contain AREVA NP's final response to the subject question.

Question #	Start Page	End Page
RAI 512 — 07.08-50	2	4

This concludes the formal AREVA NP response to RAI 512, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, February 17, 2012 4:17 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7, Supplement 2

Getachew,

AREVA NP provided a schedule on October 13, 2011 for a technically correct and complete response to the one question in RAI 512. On January 10, 2012, AREVA NP provided Supplement 1 to revise the schedule for the one question.

The schedule for providing a technically correct and complete response to Question 07.08-50 has been changed as shown below in bold.

Question #	Response Date
RAI 512 — 07.08-50	**May 30, 2012**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (CORP/QP)
Sent: Tuesday, January 10, 2012 4:57 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7, Supplement 1

Getachew,

AREVA NP provided a schedule on October 13, 2011 for a technically correct and complete response to the one question in RAI 512.

The schedule for providing a technically correct and complete response to Question 07.08-50 has been changed as shown below in bold.

Question #	Response Date
RAI 512 — 07.08-50	**April 5, 2012**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Thursday, October 13, 2011 5:24 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 512 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the one question cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 512 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 512 — 07.08-50	2	3

A complete answer is not provided for the one question. The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI 512 — 07.08-50	January 10, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, September 14, 2011 3:35 PM
To: ZZ-DL-A-USEPR-DL
Cc: Mott, Kenneth; Zhang, Deanna; Morton, Wendell; Spaulding, Deirdre; Truong, Tung; Zhao, Jack; Mills, Daniel; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 13, 2011, and discussed with your staff on September 14, 2011. 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: 3974

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D4D41D56)

Subject: Response to U.S. EPR Design Certification Application RAI No. 512 (6048), FSAR Ch. 7, Supplement 4
Sent Date: 7/20/2012 1:13:06 PM
Received Date: 7/20/2012 1:13:13 PM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

Recipients:
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: auscharmx02.adom.ad.corp

Files	Size	Date & Time
MESSAGE	8404	7/20/2012 1:13:13 PM
RAI 512 Supplement 4 Response US EPR DC.pdf		636658

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 512,
Supplement 4

9/14/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.08 - Diverse Instrumentation and Control Systems
Application Section: ANP-10304 Revision 4

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

Question 07.08-50:

OPEN ITEM

Follow-up to RAI 303, Question 07.03-28

Clarify the role of the safety automation system (SAS) regarding defense-in-depth and diversity (D3) and the plant response if it were to fail due to a postulated common-cause failure (CCF). Identify automatic or manual actions that would compensate for such failure.

10 CFR Part 50, Appendix A, General Design Criteria 22, states, in part, that design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function. One of the purposes of the diversity analysis method described in NUREG/CR-6303 is to postulate common-cause failures and to determine what portions of a design are uncompensated with regards to D3. NUREG/CR-6303 also states that manual operator action is permissible as a diverse means of response to postulated CCF if, among other things, sufficient information and time is available for the operator to detect, analyze, make decisions, take action, and correct reasonably probable errors of operator function.

In Table A.2-1 of Technical Report ANP-10304, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," Revision 4 (ML11188A198), the applicant classifies “Decrease in feedwater temperature, "Increase in feedwater flow,” “Increase in steam flow,” “Inadvertent opening of SG relief or safety valve,” and “Loss of normal feedwater flow” events as anticipated operational occurrences (AOOs). In the event of a postulated software CCF of the protection system, if necessary, the diverse actuation system (DAS) would actuate the emergency feedwater (EFW) system upon the low steam generator (SG) level actuation setpoint being reached. Once EFW is initiated by DAS, the operator is credited for controlling the EFW system manually to maintain SG level and to remove decay heat. Technical Report ANP-10304 states that, after DAS initiation of EFW on low SG level, the operator action credited is:

- For loss of normal feedwater flow event, manual operation of the EFW flows is required for the operators to prevent SG overfill, during long-term control. It takes approximately one hour to fill the SG with EFW from the low level EFW actuation setpoint to the protection system EFW isolation setpoint. Therefore, there is sufficient time for the operator to manually control SG level with the EFW system.
- For decrease in feedwater temperature event, main feedwater may be isolated on high SG level (a DAS function). If main feedwater is isolated, EFW actuates once SG level decreases to the low level DAS setpoint. The operator then controls SG level to remove decay heat using the EFW system. It takes more than 60 minutes for the level to recover from the EFW actuation setpoint, giving the operator sufficient time to manually control SG level.
- For increase in feedwater flow event, the operator controls the EFW system manually to maintain SG level and remove decay heat. It takes approximately 60 minutes for the SG level to recover to its nominal value from the EFW actuation setpoint. This provides the operator adequate time to manually control SG level.
- For inadvertent opening of an MRST or MSSV event, after 30 minutes, the operator terminates EFW flow to the affected SG.

In Technical Report ANP-10304, the staff found that SAS is only credited to *limit EFW flow* to a depressurized SG. It appears the stated times for SG fill up after EFW actuation by the DAS include the EFW flow limitation by SAS. Furthermore, if operator action is used for limiting EFW flow in other events, why is the SAS credited to limit flow for a depressurized SG? For example, is the limit flow function of SAS to prevent SG overfill, to prevent pump runout, or to prevent a rapid cooldown of the RCS and therefore mitigate a pressurized thermal shock event or reactor restart? From the staff's observation, SAS is the only system that can provide this limit flow function. Given a common-cause failure of SAS, an AOO or postulated accident, and other systems functioning properly, what type of automatic or manual actions would address the loss of EFW limit flow function provided by SAS? If operator actions are used, discuss the basis for why use of operator actions is acceptable.

Response to Question 07.08-50:

This response and associated mark-ups, in addition to RAI 512 Supplement 3 response transmitted May 30, 2012, provides the complete and final response to this question 07.08-50.

The sections referring to the process automation system (PAS) signal diversity will be removed from ANP-10304, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," due to the fact that PAS and the Protection System (PS) share a number of common sensors.

The SAS is not credited with the actions for Diversity and Defense-in-Depth due to the fact that SAS shares a number of common sensors with PS and is designed on the same TXS platform. Therefore, Technical Report ANP-10304 will be revised to say that SAS is not credited for being diverse from the PS.

The SAS EFW flow control function limits EFW pump flow to a depressurized SG to prevent pump runout and provides closed-loop control of the EFW flow to a desired setpoint. This function is performed by the EFW flow control valves. The valves include two adjustable mechanical stops. One mechanical stop limits the maximum flow to approximately 490 gpm. The second mechanical stop provides a minimum flow of approximately 270 gpm. The valve is positioned on the "minimum flow" mechanical stop during normal plant operation. During EFW pump operation, the valve is automatically positioned by a flow controller (SAS) based on the difference between the setpoint value of 400 gpm and the EFW Pump flow as measured by a flow sensor.

During events requiring EFW actuation, the SAS EFW flow control function is assumed to be operational. Flow from each EFW pump is maintained at 400 gpm. Based on this flow, it takes approximately 53 minutes for the SG level to recover to the high level isolation setpoint (89 percent wide range) from the EFW actuation setpoint. SG level control is performed by the EFW SG level control valves. The operator is credited with manual control of the level control valves after 30 minutes.

In the event of a CCF of the SAS concurrent with an AOO or PA requiring actuation of EFW, the flow control function would be lost. Two scenarios are examined, maximum flow and minimum flow.

If the flow control valve fails open, then maximum flow to the SG would occur. Because of the mechanical stop on the valve, the flow would be limited to approximately 490 gpm. Based on this higher flow rate, it would take approximately 43 minutes for the SG level to recover to the high level isolation setpoint (89 percent wide range) from the EFW actuation setpoint. There is adequate time for the operator to control SG Level with the level control valve. The EFW pump would be protected from runout at this flow rate. This higher flow also remains within the bounds assumed in the Main Steam Line Break safety analysis for the maximum EFW flow to a depressurized SG.

If the flow control valve failed closed or if the SAS CCF occurred before EFW actuation, then a minimum flow to the SG would occur. Because of the mechanical stop, approximately 270 gpm would still be allowed to flow through the valve. This is sufficient flow following a loss of normal feedwater or feedwater line break to remove decay heat and recover SG levels. The operator would be able to modulate the valve position after 30 minutes if necessary for long term control.

In summary, there are no automatic or manual actions credited to address the loss of EFW flow control in the event of a SAS CCF. The mechanical stops on the flow control valves will protect the pump from runout and provide sufficient flow to an affected SG, even in the absence of a control signal from SAS.

ANP-10304, “U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report,” will be modified as described in the response. A complete revision to the technical report will be submitted by separate letter. Changes to U.S. EPR FSAR sections that reference the Technical Report will be modified to reference the updated technical report. ANP-10309, “U.S. EPR Protection System Technical Report” will also be changed to reflect the revision to ANP-10304, and the changes will be included in the markups to this response.

FSAR Impact:

The U.S. EPR FSAR Tier 2, Sections 4.6.6, 7.1, 7.2, 7.3, 7.8, 18.7, and 19.1, and Table 1.6-1 were revised as described in the response to RAI 512 Supplement 3, which was transmitted on May 30, 2012.

Technical Report Impact:

Technical Report ANP-10304 will be revised to as described in the response and indicated on the enclosed markups, which supplements the mark-ups provided in the response to RAI 512, Supplement 3, which was transmitted on May 30, 2012.

Technical Report ANP-10309 was revised as described in the response to RAI 512, Supplement 3, which was transmitted on May 30, 2012.

ANP-10304—U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report Markups

- Manual control room heating, ventilation, air conditioning (HVAC) reconfiguration on high intake activity signal (radiological events).
- Manual chemical and volume control system (CVCS) isolation on boron dilution indication for loss of shutdown margin.
- Manual main steam relief train (MSRT) (for long-term heat removal).

The U.S. EPR design, including DAS functions, available plant control systems, and manual operator actions, are determined to be sufficient in maintaining the acceptance criteria of BTP 7-19 for an AOO or PA concurrent with an SWCCF.

A.2 D3 PLANT RESPONSE ANALYSIS APPROACH

A.2.1 Method

The method used in this analysis is to review the U.S. EPR AOOs or PAs analyzed in the U.S. EPR FSAR safety analysis, assuming an SWCCF in the PS and SAS that renders the PS and SAS ineffective. The events considered are identified in Section A.2.3. The D3 plant response analysis considers the I&C functionality as described in Section A.2.2.

The D3 plant response analysis consists of both engineering analysis and engineering arguments to demonstrate that the acceptance criteria of BTP 7-19 are met (see Section A.2.4). The engineering analysis, where applied, utilizes best estimate models and methods based on the NRC-approved S-RELAP5 code (References A-2 and A-3). These models and methods are described in Section A.2.5. The engineering arguments utilize results from the U.S. EPR FSAR safety analysis to establish the plant response, with an SWCCF. The engineering arguments draw on the fact that the DAS and other available plant systems have functions that provide a similar level of protection as the PS.

The analysis assumes the plant is operating under full power nominal conditions (no uncertainties) with all equipment available (i.e., no preventative maintenance and no single failures). RCCAs are maintained in their normal full power position (i.e., all RCCAs are out, with the lead control bank slightly inserted). The analysis employs best estimate core neutronic parameters and power distributions expected at full power conditions (hot channel factors accounting for engineering uncertainties, RCCA bow, or assembly bow are excluded). The best estimate parameters assumed in the D3 assessments are compared to design parameters

For long-term heat removal, manual operation of the MSRTs is available. These features were not credited in the analysis of this event to evaluate the proximity to fuel design limits.

Actual reactor power reaches a higher value than in the U.S. EPR FSAR analysis, as a result of the decalibration of the excore neutron flux signal used by DAS for RT. However, no fuel failure is ~~predicted~~calculated. Any degradation in safety system functionality, due to the SWCCF in the PS, is more than offset by the best estimate initial conditions analyzed within the core, as illustrated in Figure A.3.2-11—Increase in Steam Flow Event:
Normalized DNBR and LHGR, Normalized performance of DNBR and LHGR.

These results were based on an evaluation of BOC and EOC cases. It is possible that between EOC and BOC, reactivity kinetic conditions could lead to a slightly higher actual core power with the indicated neutron flux signal just under the DAS RT setpoint. An additional analysis was performed with reactivity conditions that lead to an indicated power just below the DAS RT setpoint. Figure A.3.2-12 shows the indicated power and reactor power response for this case. Figure A.3.2-13 presents the DNBR and LHGR response.

Consequently, the acceptance criteria for D3 are met and the U.S. EPR design is assessed as adequate to meet an SWCCF in the PS, for the Increase in Steam Flow event.

In the event of an SWCCF in the SAS the EFW flow control function would not be available. However, the EFW flow to a depressurized SG would be limited by the high flow mechanical stop on the EFW flow control valve. These conditions are bounded by the analysis of steam sytem piping failures.

A.3.2.4 Inadvertent Opening of an MSRT or MSSV

Opening an MSRT or MSSV valve increases the steam removed from the SGs. This increases heat removal from the RCS, lowering the temperatures of the RCS. The decreased RCS temperatures, coupled with a negative MTC, increases reactor power. The U.S. EPR FSAR safety analysis addresses cases for both MSRT and main steam safety valve (MSSV) opening. An MSRT has a greater flow capacity than an MSSV, but the MSRT can be isolated by the PS, so both scenarios are analyzed. The Inadvertent Opening of an MRST or MSSV event is an AOO.