ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Wednesday, July 13, 2011 1:48 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); Canova, Michael
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 16
Attachments: RAI 442 Supplement 16 Response US EPR DC.pdf

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions. Supplement 11 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 5 remaining questions. Supplement 12 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 4 remaining questions. Supplement 13 response was sent on June 3, 2011 to provide a technically correct and complete response to one question. Supplement 14 response was sent on June 9, 2011 to provide a revised technically correct and complete response to Question 07.03-32. Supplement 15 response was sent on June 22, 2011 to provide a revised technically correct and complete response to Questions 07.01-26 and Question 07.01-31.

Based on additional NRC feedback, some minor changes have been made to the response to Question 07.01-30 (originally submitted with the Supplement 13 response on June 9, 2011).

The attached file, “RAI 442 Supplement 16 Response US EPR DC.pdf” provides a revised technically correct and complete response to the Question 07.01-30. 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 442 Question 07.01-30.

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

Question #	Start Page	End Page
RAI 442 — 7.1-30	2	3

This concludes the formal AREVA NP response to RAI 442, 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, June 22, 2011 3:57 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 15

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions. Supplement 11 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 5 remaining questions. Supplement 12 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 4 remaining questions. Supplement 13 response was sent on June 3, 2011 to provide a technically correct and complete response to one question. Supplement 14 response was sent on June 9, 2011 to provide a revised technically correct and complete response to Question 07.03-32.

The attached file, “RAI 442 Supplement 15 Response US EPR DC.pdf” provides a technically correct and complete response to the remaining two 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 442 Question 07.01-26 and Question 07.01-31.

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

Question #	Start Page	End Page
RAI 442 — 7.1-26	2	4
RAI 442 — 7.1-31	5	6

This concludes the formal AREVA NP response to RAI 442, 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: Thursday, June 09, 2011 2:50 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 14

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions. Supplement 11 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 5 remaining questions. Supplement 12 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 4 remaining questions. Supplement 13 response was sent on June 3, 2011 to provide a technically correct and complete response to one question.

Based on discussions with the NRC staff, the U.S. EPR FSAR Section 7.3 mark-ups that accompanied the response to Question 07.03-32 have been revised. The response to this question was submitted as a final response in Supplement 12 that was sent to the NRC on May 25, 2011. Although no change has been made to the text of the Question 07.03-32 response itself, the response is being revised in this supplement to include the revised FSAR markups.

The attached file, “RAI 442 Supplement 14 Response US EPR DC.pdf” provides a revised technically correct and complete response to Question 07.03-32. 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 442, Question 07.03-32.

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

Question #	Start Page	End Page
RAI 442 07.03-32	2	3

AREVA NP's schedule for providing a technically correct and complete response to the remaining 2 questions in RAI 442 is unchanged and is provided below.

Question #	Response Date

RAI 442 — 7.1-26	June 22, 2011
RAI 442 — 7.1-31	June 22, 2011

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: RYAN Tom (RS/NB)
Sent: Friday, June 03, 2011 6:30 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); WILLIFORD Dennis (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 13

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions. Supplement 11 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 5 remaining questions. Supplement 12 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 4 remaining questions.

The attached file, “RAI 442 Supplement 13 Response US EPR DC.pdf” provides a technically correct and complete response to Question 07.01-30, as committed. 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 442, Question 07.01-30.

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

Question #	Start Page	End Page
RAI 442 07.01-30	2	3

AREVA NP's schedule for providing a technically correct and complete response to the remaining 2 questions in RAI 442 is unchanged and is provided below.

Question #	Response Date
RAI 442 — 7.1-26	June 22, 2011
RAI 442 — 7.1-31	June 22, 2011

Sincerely,

Tom Ryan for
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 25, 2011 3:03 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 12

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions. Supplement 11 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 5 remaining questions.

The attached file, "RAI 442 Supplement 12 Response US EPR DC.pdf" provides a technically correct and complete response to Question 07.03-32, as committed. 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 442, Question 07.03-32.

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

Question #	Start Page	End Page
RAI 442 07.03-32	2	3

AREVA NP's schedule for providing a technically correct and complete response to the remaining 3 questions in RAI 442 has been changed and is provided below.

Question #	Response Date

RAI 442 — 7.1-26	June 22, 2011
RAI 442 — 7.1-30	June 3, 2011
RAI 442 — 7.1-31	June 22, 2011

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 25, 2011 12:11 PM
To: 'Tesfaye, Getachew'
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. 442, FSAR Ch. 7, Supplement 11

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions. Supplement 10 response was sent on May 25, 2011 to provide a technically correct and complete response to one of the 6 remaining questions.

The attached file, “RAI 442 Supplement 11 Response US EPR DC.pdf” provides a technically correct and complete response to Question 07.01-28, as committed. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format to support the response to RAI 442, Question 07.01-28.

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

Question #	Start Page	End Page
RAI 442 07.01-28	2	3

AREVA NP's schedule for providing a technically correct and complete response to the remaining 4 questions in RAI 442 is unchanged and is provided below.

Question #	Response Date

RAI 442 — 7.1-26	May 27, 2011
RAI 442 — 7.1-30	May 27, 2011
RAI 442 — 7.1-31	May 27, 2011
RAI 442 — 7.3-32	May 27, 2011

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 25, 2011 7:42 AM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 10

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule. Supplement 9 response was sent on May 20, 2011 to provide a technically correct and complete response to one of the 7 remaining questions.

The attached file, "RAI 442 Supplement 10 Response US EPR DC.pdf" provides a technically correct and complete response to Question 07.01-27, as committed. 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 442, Question 07.01-27.

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

Question #	Start Page	End Page
RAI 442 07.01-27	2	2

AREVA NP's schedule for providing a technically correct and complete response to the remaining 5 questions in RAI 442 remains unchanged and is provided below.

Question #	Response Date
RAI 442 — 7.1-26	May 27, 2011
RAI 442 — 7.1-28	May 27, 2011
RAI 442 — 7.1-30	May 27, 2011
RAI 442 — 7.1-31	May 27, 2011
RAI 442 — 7.3-32	May 27, 2011

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, May 20, 2011 5:32 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 9

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule. Supplement 8 response was sent on April 25, 2011 to provide a revised schedule.

The attached file, "RAI 442 Supplement 9 Response US EPR DC.pdf" provides a technically correct and complete response to Question 07.09-64, as committed. 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 442, Question 07.09-64.

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

Question #	Start Page	End Page
RAI 442 07.09-64	2	3

AREVA NP's schedule for providing a technically correct and complete response to the remaining 6 questions in RAI 442 remains unchanged and is provided below.

Question #	Response Date
RAI 442 — 7.1-26	May 27, 2011
RAI 442 — 7.1-27	May 27, 2011
RAI 442 — 7.1-28	May 27, 2011
RAI 442 — 7.1-30	May 27, 2011
RAI 442 — 7.1-31	May 27, 2011
RAI 442 — 7.3-32	May 27, 2011

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: WELLS Russell (RS/NB)
Sent: Monday, April 25, 2011 4:43 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 8

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions. Supplement 7 response was sent on April 5, 2011 to provide a revised schedule.

To provide additional time to interact with the NRC, a revised schedule is provided in this e-mail.

AREVA NP's schedule for providing a technically correct and complete response to the remaining questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	May 27, 2011
RAI 442 — 7.1-27	May 27, 2011

RAI 442 — 7.1-28	May 27, 2011
RAI 442 — 7.1-30	May 27, 2011
RAI 442 — 7.1-31	May 27, 2011
RAI 442 — 7.3-32	May 27, 2011
RAI 442 — 7.9-64	May 27, 2011

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)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Tuesday, April 05, 2011 10:56 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. 442, FSAR Ch. 7, Supplement 7

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Supplement 6 response was sent on March 15, 2011 to provide technically correct and complete responses to two of the 9 remaining questions.

To provide additional time to interact with the NRC, a revised schedule is provided in this e-mail.

AREVA NP's schedule for providing a technically correct and complete response to the remaining questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	**April 28, 2011**
RAI 442 — 7.1-27	**April 28, 2011**
RAI 442 — 7.1-28	**April 28, 2011**
RAI 442 — 7.1-30	April 28, 2011
RAI 442 — 7.1-31	**April 28, 2011**
RAI 442 — 7.3-32	**April 28, 2011**
RAI 442 — 7.9-64	April 28, 2011

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)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Tuesday, March 15, 2011 12:51 PM
To: 'Tesfaye, Getachew'
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. 442, FSAR Ch. 7, Supplement 6

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Supplement 5 response was sent on March 2, 2011 to provide technically correct and complete responses to three of the 12 remaining questions. Based on discussions with NRC, the attached file, "RAI 442 Supplement 6 Response US EPR DC.pdf" provides technically correct and complete responses to two of the 9 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 442 Supplement 6 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 442 07.01-32	2	3
RAI 442 07.09-67	4	5

AREVA NP's schedule for providing a technically correct and complete response to the remaining questions in RAI 442 remains unchanged and is provided below.

Question #	Response Date
RAI 442 — 7.1-26	April 21, 2011
RAI 442 — 7.1-27	April 14, 2011
RAI 442 — 7.1-28	April 7, 2011
RAI 442 — 7.1-30	April 28, 2011
RAI 442 — 7.1-31	April 7, 2011

RAI 442 — 7.3-32	April 14, 2011
RAI 442 — 7.9-64	April 28, 2011

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)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Wednesday, March 02, 2011 4:52 PM
To: Tesfaye, Getachew
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. 442, FSAR Ch. 7, Supplement 5

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Supplement 4 response was sent on February 25, 2011 to provide technically correct and complete response to one question. Based on discussions with NRC, the attached file, "RAI 442 Supplement 5 Response US EPR DC.pdf" provides technically correct and complete responses to three of the 12 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 442 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 442 07.03-33	2	2
RAI 442 07.03-34	3	4
RAI 442 07.09-61	5	8

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 remains unchanged and is provided below.

Question #	Response Date
RAI 442 — 7.1-26	April 21, 2011
RAI 442 — 7.1-27	April 14, 2011
RAI 442 — 7.1-28	April 7, 2011

RAI 442 — 7.1-30	April 28, 2011
RAI 442 — 7.1-31	April 7, 2011
RAI 442 — 7.1-32	April 7, 2011
RAI 442 — 7.3-32	April 14, 2011
RAI 442 — 7.9-64	April 28, 2011
RAI 442 — 7.9-67	April 7, 2011

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)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Friday, February 25, 2011 8:07 AM
To: Tesfaye, Getachew
Cc: BRYAN Martin (External RS/NB); 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. 442, FSAR Ch. 7, Supplement 4

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Supplement 3 response was sent on February 18, 2011 to provide technically correct and complete responses to four questions. Based on discussions with NRC, the attached file, "RAI 442 Supplement 4 Response US EPR DC.pdf" provides technically correct and complete responses to one of the 13 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report and Technical Report ANP-10309P, in redline-strikeout format which support the response to RAI 442 Question 07.09-63.

The following table indicates the respective pages in the response document, "RAI 442 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 442 07.09-63	2	2

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

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	April 21, 2011
RAI 442 — 7.1-27	April 14, 2011
RAI 442 — 7.1-28	April 7, 2011
RAI 442 — 7.1-30	April 28, 2011
RAI 442 — 7.1-31	April 7, 2011
RAI 442 — 7.1-32	April 7, 2011
RAI 442 — 7.3-32	April 14, 2011
RAI 442 — 7.3-33	April 7, 2011
RAI 442 — 7.3-34	April 7, 2011
RAI 442 — 7.9-61	April 7, 2011
RAI 442 — 7.9-64	April 28, 2011
RAI 442 — 7.9-67	April 7, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
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Mail Stop OF-57
Lynchburg, VA 24506-0935
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434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, February 18, 2011 12:21 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 3

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. Supplement 2 response was sent on February 9, 2011 to provide a revised schedule. Based on discussions with NRC, the attached file, "RAI 442 Supplement 3 Response US EPR DC.pdf" provides technically correct and complete responses to four of the 17 questions, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report and Technical Report ANP-10281P, in redline-strikeout format which support the response to RAI 442 Question 07.01-29.

The following table indicates the respective pages in the response document, "RAI 442 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 442 07.01-29	2	2
RAI 413 07.09-62	3	4
RAI 413 07.09-65	5	5
RAI 413 07.09-66	6	6

The schedule for technically correct and complete responses to the remaining 13 questions is unchanged and provided below:

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-30	March 15, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	March 15, 2011
RAI 442 — 7.3-32	March 15, 2011
RAI 442 — 7.3-33	March 15, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	March 15, 2011
RAI 442 — 7.9-63	March 15, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-67	March 15, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Wednesday, February 09, 2011 5:07 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 2

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. Supplement 1 response was sent on January 7, 2011 to provide a revised schedule for four of the questions. To allow additional time to interact with the staff and to process the responses a revised schedule is provided below. It should be noted that the dates below may need to be adjusted following the February 15, 2011 public meeting between AREVA and the NRC on digital instrumentation and controls.

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	March 15, 2011
RAI 442 — 7.1-30	March 15, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	March 15, 2011
RAI 442 — 7.3-32	March 15, 2011
RAI 442 — 7.3-33	March 15, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	March 15, 2011
RAI 442 — 7.9-62	March 15, 2011
RAI 442 — 7.9-63	March 15, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	March 15, 2011
RAI 442 — 7.9-66	March 15, 2011
RAI 442 — 7.9-67	March 15, 2011

Sincerely,

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AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, January 07, 2011 11:15 AM
To: Tesfaye, Getachew
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 1

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. To allow additional time to interact with the staff a revised

schedule is provided below for questions 7.1.29, 7.1.32, 7.9-65 and 7.9-67. The schedule for the other questions remains unchanged.

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	**February 9, 2011**
RAI 442 — 7.1-30	February 9, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	**February 9, 2011**
RAI 442 — 7.3-32	February 9, 2011
RAI 442 — 7.3-33	February 9, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	February 9, 2011
RAI 442 — 7.9-62	February 9, 2011
RAI 442 — 7.9-63	February 9, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	**March 15, 2011**
RAI 442 — 7.9-66	February 9, 2011
RAI 442 — 7.9-67	**February 9, 2011**

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
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Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, November 19, 2010 5:12 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. 442, FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 442 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 17 question (s) is not provided.

The following table indicates the respective pages in the response document, "RAI 442 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page

RAI 442 — 7.1-26	2	2
RAI 442 — 7.1-27	3	3
RAI 442 — 7.1-28	4	4
RAI 442 — 7.1-29	5	5
RAI 442 — 7.1-30	6	6
RAI 442 — 7.1-31	7	8
RAI 442 — 7.1-32	9	9
RAI 442 — 7.3-32	10	10
RAI 442 — 7.3-33	11	11
RAI 442 — 7.3-34	12	12
RAI 442 — 7.9-61	13	13
RAI 442 — 7.9-62	14	14
RAI 442 — 7.9-63	15	15
RAI 442 — 7.9-64	16	16
RAI 442 — 7.9-65	17	17
RAI 442 — 7.9-66	18	18
RAI 442 — 7.9-67	19	19

A complete answer is not provided for the 17 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 442 — 7.1-26	March 15, 2011
RAI 442 — 7.1-27	March 15, 2011
RAI 442 — 7.1-28	March 15, 2011
RAI 442 — 7.1-29	January 7, 2011
RAI 442 — 7.1-30	February 9, 2011
RAI 442 — 7.1-31	March 15, 2011
RAI 442 — 7.1-32	January 7, 2011
RAI 442 — 7.3-32	February 9, 2011
RAI 442 — 7.3-33	February 9, 2011
RAI 442 — 7.3-34	March 15, 2011
RAI 442 — 7.9-61	February 9, 2011
RAI 442 — 7.9-62	February 9, 2011
RAI 442 — 7.9-63	February 9, 2011
RAI 442 — 7.9-64	March 15, 2011
RAI 442 — 7.9-65	January 7, 2011
RAI 442 — 7.9-66	February 9, 2011
RAI 442 — 7.9-67	January 7, 2011

Sincerely,

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Martin.Bryan.ext@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, October 20, 2010 8:09 AM

To: ZZ-DL-A-USEPR-DL
Cc: Zhao, Jack; Morton, Wendell; Mott, Kenneth; Spaulding, Deirdre; Truong, Tung; Zhang, Deanna; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 442(4295,5076,5068,5067), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 10, 2010, and discussed with your staff on October 13, 2010. Drat RAI Questions 07.01-26 and 07.03-33 were 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
Email Number: 3240

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D47EBDB9)

Subject: Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 16
Sent Date: 7/13/2011 1:48:01 PM
Received Date: 7/13/2011 1:49:06 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
"Canova, Michael" <Michael.Canova@nrc.gov>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: auscharmx02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	45872	7/13/2011 1:49:06 PM
RAI 442 Supplement 16 Response US EPR DC.pdf	212638	

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

Response to

Request for Additional Information No. 442(4295, 5076, 5068, 5067), Revision 1, Supplement 16

9/10/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 07.01 - Instrumentation and Controls - Introduction
SRP Section: 07.03 - Engineered Safety Features Systems
SRP Section: 07.09 - Data Communication Systems

Application Section: FSAR Ch 7

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

Question 07.01-30:

Provide details on how the U.S. EPR design will verify functionality of the self testing features based on guidance from BTP 7-17.

For the U.S. EPR design, the applicant has committed to meeting BTP 7-17, "Guidance on Self-Test and Surveillance Test Provisions." BTP 7-17 (which cites GDC 21 and 10 CFR 50.55a(h) as a regulatory bases) states that: "(a) Self-test functions should be verified during periodic functional tests, and (b) If automatic test features are credited with performing surveillance test functions, provisions should be made to confirm the execution of the automatic test during plant operation. The capability to periodically test and calibrate the automatic test equipment should also be provided. The balance of surveillance and test functions that are not performed by the automatic test feature should be performed manually to meet the intent of Regulatory Guide 1.118. In addition, the automatic test feature function should conform to the same requirements and considerations (e.g., test interval) as the manual function."

a) The staff requests that the applicant provide details on the method by which the U.S. EPR Protection System self testing features will be periodically verified and how the operation will be confirmed during plant operation.

b) How does the applicant propose to meet item (b), as quoted above?

Response to Question 07.01-30:

Item a:

Technical Report ANP-10315P, Revision 1, "U.S. EPR Protection System Surveillance Testing and TELEPERM XS Self-Monitoring" describes the U.S. EPR protection system (PS) self-test features.

Technical Report ANP-10315P, Revision 1, Section 3.6 addresses compliance with BTP 7-17 and Section 3.5 addresses compliance with RG 1.118.

Item b:

Technical Report ANP-10315P, Revision 1, Section 3.6 states that there are no automatic test features that use the automatic test equipment credited to perform surveillance testing in the U.S. EPR PS design.

Technical Report ANP-10315P, "U.S. EPR Protection System Surveillance Testing and TELEPERM XS Self-Monitoring" was submitted by separate letter.

Proposed changes to the instrumentation and controls (I&C) architecture were communicated to the NRC staff in the public meeting on February 15, 2011. The affected sections of U.S. EPR FSAR Tier 2, Sections 1.1, 1.2, 1.6, 1.7, 1.9, 3.2, 3.9, 3.10, 3.11, 4.4, 4.6, 5.4, 7.1, 7.2, 9.2,14.2, 14.3, 15.0, 15.1, 15.4, 15.6, 16, 18.7, 19.1 were revised to incorporate modifications to I&C architecture and were included in the Response to RAI 442, Supplement 13 on June 3, 2011.

Additional conforming changes to U.S. EPR FSAR Tier 2 are provided with this response to address feedback from NRC staff.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 1.6, 4.6, 7.1, 7.2, 7.3, 7.4, 7.7, 7.8, 14.2, 18.7 and 19.1 will be revised as described in the response and indicated on the enclosed markup.

These changes are in addition to markups provided in Supplement 13 of this RAI.

U.S. EPR Final Safety Analysis Report Markups

Table 1.6-1—Reports Referenced
Sheet 2 of 4

Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
ANP-10286P ANP-10286NP	U.S. EPR Rod Ejection Accident Methodology Topical Report	11/20/07	4.3 and 15
ANP-10287P ANP-10287NP	Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report	11/27/07	4.3, 4.4, 7.1, 7.2, 15.0, 15.1, 15.2,15.3,15.4,15.6, 16~~4, 6, 7, and 15~~
ANP-10288P ANP-10288NP Revision 1	U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report	01/10	15
ANP-10290 Revision 1	AREVA NP Environmental Report Standard Design Certification	9/11/09	19.2
ANP-10291P ANP-10291NP	Small Break LOCA and Non-LOCA Sensitivity Studies and Methodology Technical Report	5/09	15
ANP-10292 Revision 1	U.S. EPR Conformance with Standard Review Plan (NUREG-0800) Technical Report	5/09	1.9
ANP-10293, Revision 3	U.S. EPR Design Features to Address GSI-191 Technical Report	~~2/08~~3/11	6.3 and 15.6.5.4.3
ANP-10294 Revision 1	U.S. EPR Reactor Coolant Pump Motor Flywheel Structural Analysis Technical Report	3/09	5.4.1.6.6
ANP-10295 Revision 1	U.S. EPR Security Design Features	10/09	13.6
ANP-10296	U.S. EPR Design Features that Enhance Security	12/08	13.6
ANP-10299P Revision 2	Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis	12/09	6.2.1 and 6.2.2
ANP-10304 Revision ~~1~~4	U.S. EPR Diversity and Defense in Depth Assessment Technical Report	~~12/09~~6/11	1.9, 7.1, 7.2, 7.3, ~~7.7,~~ 7.8, 18.7, 19.1
ANP-10306P	Comprehensive Vibration Assessment Program for U.S. EPR Reactor Internals Technical Report	12/09	3.9.2.1.1, 3.9.2.3, 3.9.2.4, and 3.9.2.7
ANP-10309P ANP-10309NP Revision 3	U.S. EPR ~~Digital~~ Protection System Technical Report	~~11/24/09~~06/11	~~3.1.3,~~ 4.6, 7.1, 7.2, and 7.3~~7, 19.1, and 8.1~~

07.01-30

SIS and EBS systems reliably control reactivity changes to cool the core under postulated accidents in accordance with GDC 27.

4.6.6 References

07.01-30

1. ANP-10309P, Revision ~~0~~3, "U.S. EPR ~~Digital~~ Protection System Technical Report," ~~November 2009~~June 2011.

2. IEEE Standard 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., 1998.

3. IEEE 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," Institute of Electrical and Electronics Engineers, Inc., 1992.

7.1.3 References

1. IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations,"1998.

2. IEEE Std 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations,"1991.

3. EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System," Siemens Power Corporation, July 2000.

4. Deleted.~~ANP-10273P, Revision 0, "AV42 Priority Actuation and Control Module Topical Report," AREVA NP Inc., November 2006.~~

5. ANP-10272, Revision 3~~2~~, "Software Program Manual TELEPERM XS™ Safety Systems Topical Report," AREVA NP Inc., ~~May~~October 2010.

07.01-30

6. ANP-10309P, Revision ~~0~~3, "U.S. EPR ~~Digital~~ Protection System Technical Report," AREVA NP Inc., ~~November 2009~~June 2011.

7. ANP-10287P, Revision 0, "Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report," AREVA NP Inc., November 2007.

8. ANP-10304, Revision ~~1~~4, "U.S. EPR Diversity and Defense-In-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.

9. NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems," U.S. Nuclear Regulatory Commission, December 1994.

10. SRM to SECY 93-087 Issue II.Q, "Defense Against Common-Mode Failures in Digital Instrumentation and Control Systems," United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, 1993.

11. IEEE Std 379-2000, "IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems," 2000.

12. IEEE Std 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," 1992.

13. IEEE Std 497-2002, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," 2002.

14. ANP-10275P-A, Revision 0, "U.S. EPR Instrument Setpoint Methodology Topical Report," AREVA NP Inc.,~~ March 2007~~January 2008.

15. ANSI/ISA-67.04.01-2006, "Setpoints for Nuclear Safety Related Instrumentation," 2006.

16. IEEE Std 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems," 1987.

~~RT breakers~~RTBs and~~,~~ RTCs ~~contactors, and transistors of the CRDM operating coils~~.

~~Automatic RT functions that use SPND measurements as inputs utilize an additional level of computer function. This additional level consists of redundant remote acquisition units (RAU) in each division dedicated to the acquisition and distribution of the SPND measurements. The RAU in each division acquire one-fourth of the total SPND measurements and distribute those measurements to APU in all four divisions allowing for an accurate calculation over the whole reactor core in each division. Once the SPND measurements have been received by the APU, the RT function is carried out as described previously in this section for the typical RT function. Figure 7.2-2—Typical SPND-based RT Actuation illustrates the typical RT initiation sequence for SPND-based RT functions.~~

The capability for manual RT is available to the operator through the safety information and control system (SICS) in both the MCR and RSS. At each location, four manual RT buttons are provided to correspond to the four PS divisions. Manual RT initiation is illustrated in Figure 7.2-3—Manual RT and is also described in ~~ANP-10309P, "~~U.S. EPR ~~Digital~~ Protection System Technical Report~~"~~ (ANP-10309P) (Reference 1). The SICS is described in Section 7.1.1.3.

07.01-30

7.2.1.2 Reactor Trip Functional Description

The variables monitored by the PS are used either directly or as an input to a calculation, to detect the plant conditions which initiate reactor ~~shutdown~~trip:

- Low departure from nucleate boiling ratio.
- High linear power density.
- High neutron flux rate of change.
- High core power level.
- Low saturation margin.
- Low reactor coolant system ~~loop~~ flow rate (two loops).
- Low-low reactor coolant system ~~loop~~ flow rate (one loop).
- Low reactor coolant pump speed.
- High neutron flux.
- Low doubling time.
- Low pressurizer pressure.

The DNBR calculation performed by the PS is described in Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report (ANP-10287P) (Reference 3) and is based on:

- Power density distribution of the hot channel: This parameter is directly derived from the SPND measurements.
- Inlet temperature: This parameter is derived from the cold leg temperature sensors.
- Pressure: This parameter is ~~given~~derived ~~by~~from the pressurizer pressure sensors.
- Core Flow Rate: This parameter is derived from the reactor coolant pump (RCP) speed sensors.
- Three Loop Operating Signal: This signal is generated as part of the low RCS flow rate RT function (refer to Section 7.2.1.2.5). The signal is used to account for the change in RCS flow rate caused by the shutdown of an RCP.

The outputs of the DNBR calculation consist of twelve DNBR values (one per SPND finger), and twelve outlet quality values (one per SPND finger). The output values are used in various combinations to generate an RT:

- Second lowest DNBR value compared to a variable low setpoint.
- Lowest DNBR value compared to a variable low setpoint that is only valid when either a rod drop (1/4) signal or SPND imbalance signal is present.
- Lowest DNBR value compared to a variable low setpoint that is only valid when a rod drop (2/4) signal is present.
- Second highest quality value compared to a fixed high setpoint.
- Highest quality value compared to a fixed high setpoint that is only valid when either a rod drop (1/4) signal or SPND imbalance signal is present.

07.01-30

The values of the variable low DNBR setpoints depend on the number of invalidated SPND fingers. Each SPND input signal is monitored by the PS, using both inherent and engineered monitoring mechanisms, to determine the validity of the signal. A description of the inherent and engineered monitoring features utilized by TELEPERM XS is found in U.S. EPR Protection System Technical Report (ANP-10309P) (Reference 1) and in ~~EMF-2110(NP)(A)~~, ~~Revision 1, "~~TELEPERM XS: A Digital Reactor Protection System~~,"~~ (EMF-2110(NP)(A)) (Reference 2). If an SPND input signal is determined to be invalid, it is automatically assigned a faulty status. Additionally, if an SPND is determined to be faulty in the course of manual surveillance, the corresponding input signal is manually assigned a faulty status using the service unit (SU). Since the DNBR calculation produces its outputs on a per-finger basis (six SPND per finger), if one SPND carries a faulty status, then the entire finger is

7.2.2.3.5 Compliance ~~to~~with Requirements on System Testing and Inoperable Surveillance Requirements (Clause 5.7 of IEEE Std 603-1998)

The design of the PS allows for testing of the RT function while retaining the capability to perform the RT function. The majority of the components required for RT can be tested with the reactor at power. Surveillance of the PS consists of overlapping tests to verify performance of the complete RT function from sensor to RT devices.

The ~~computerized portions~~functional units of the PS are continuously monitored through self-testing during power operation. During outages, extended ~~computer~~ self-testing is performed to verify functionality that cannot be tested with the reactor at power.

Sensors and acquisition circuits are periodically tested. The input channel to be tested is placed in a lockout condition, and the downstream voting logic is automatically modified to disregard the input being tested. The RT function is still performed using the redundant input channels.

The connections between the PS output circuits and the RT devices and the RT devices themselves can be tested during power operation. One division of the PS and one redundancy of the RT devices are tested at a time to avoid spurious RT. If reactor trip orders are generated during the test, the RT is performed normally.

7.2.2.3.6 Conformance to Guidance Regarding the Use of Digital Systems (IEEE Std 7-4.3.2-2003)

07.01-30

The RT function is implemented using the TELEPERM XS ~~digital~~ platform (Reference 2) which is approved for use in safety-related systems of nuclear power generating stations in the United States. The RT function is implemented in an architecture designed to satisfy requirements applicable to all safety-related I&C systems~~, digital or otherwise~~.

07.01-30

Implementation of safety-related I&C systems is governed by the requirements of IEEE Std 603-1998 (Reference 6). Compliance with this requirement is described in Section 7.1. Guidance on the use of digital computers in safety-related systems is provided by IEEE Std 7-4.3.2-2003 (Reference 7). Conformance to ~~these standards~~this guidance is described in Section 7.1.

7.2.2.3.7 Compliance ~~to~~with Requirements for RT Setpoint Determination (Clause 6.8 of IEEE Std 603-1998)

Each setpoint used to initiate an RT function is selected based on the safety limits assumed in the plant accident analysis. The RT setpoint provides margin to the safety limit and takes into account measurement uncertainties. The methodology to determine setpoints used in SPND-based RT functions is documented in ANP-10287P

(Reference 3). The methodology to determine setpoints for all other RT functions is documented in U.S. EPR Instrument Setpoint Methodology Topical Report (ANP-10275P-A) (Reference 5). The single-sided measurement uncertainty reduction factor shall not be used in determining U.S. EPR setpoints.

7.2.3 References

07.01-30

1. ANP-10309P, Revision ~~0~~3, "U.S. EPR ~~Digital~~ Protection System Technical Report," AREVA NP Inc., ~~November 2009~~June 2011.

2. EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System," Siemens Power Corporation, July 2000.

3. ANP-10287P, Revision 0, "Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report," AREVA NP Inc., November 2007.

07.01-30

4. ANP-10304, Revision ~~1~~4, "U.S. EPR ~~Instrumentation and Controls~~ Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.

5. ANP-10275P-A, Revision 0, "U.S. EPR Instrument Setpoint Methodology Topical Report," AREVA NP Inc., ~~March 2007~~January 2008.

6. IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1998.

7. IEEE Std 7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 2003.

the Chapter 15 analyses. The actions of the execute features for an ESF actuation function are complete when, for example, a valve has reached its full open or full closed position, or required flow has been established by a pump.

The ESF actuation logic generally allows ESF actuation outputs generated by the PS to be reset after completion of the actions of the execute features. The reset of the ESF actuation signal does not result in change of state (return to normal) of the ESF actuator. Plant specific operating procedures govern the point in time when the ESF actuators can be returned to normal following their actuation.

7.3.2.2 Failure Modes and Effects Analysis

07.01-30

A system-level failure modes and effect analysis (FMEA) is performed on the PS to identify potential single point failures and their consequences. The architecture of the PS as defined in the U.S. EPR ~~Digital~~ Protection System Technical Report (ANP-10309P) (Reference 1) is used as the basis for the analysis. The FMEA considers each major part of the system, how it may fail, and the effect of the failure on the system.

Because the PS is an integrated RT and engineered safety features actuation system (ESFAS), a single failure in the system has the potential to affect both types of functions. Therefore, a single FMEA is performed on the PS and the effects on both RT and ESFAS functions are considered. The result of the FMEA with regard to ESF actuation functions is in ANP-10309P.~~summarized in this section. A summary of the effects of single failures on the RT functions is provided in Section 7.2.~~

~~To define the major parts of the system for which failures are assumed, a single division of the PS is divided into functional units as described in Reference 1. The PS consists of four identical divisions, so the definition of functional units is the same for each division. The following are defined as functional units that participate in the generation of automatic ESF actuation functions and are included in the analysis:~~

- ~~Acquisition and processing units (APU).~~
- ~~Actuation logic units (ALU).~~

~~In addition to the equipment defined as functional units of the system, the following equipment contribute to automatic ESF actuation functions and are analyzed as part of the system-level FMEA:~~

- ~~Sensors that provide input measurements to ESF actuation functions.~~
- ~~Hardwired output logic used in ESF actuation function.~~
- ~~PACS priority modules.~~

The overall EPR I&C approach to diversity and defense in depth is described in the ~~Instrumentation and Control~~U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report (ANP-10304) (Reference 3).

7.3.2.3.6 Compliance ~~to~~with System Testing and Inoperable Surveillance Requirements (Clause 5.7 of IEEE Std 603-1998)

The design of the PS allows for testing of automatic ESF actuation functions while retaining the capability to perform the functions in response to an event requiring protective action. The majority of the PS and PACS components required for ESF actuation can be tested with the reactor at power. Surveillance of the PS consists of overlapping tests to verify performance of the ESF actuation function from sensor to PACS priority module. Surveillance of the ESF system components consists of actuating the component through the PACS priority module in a manner that overlaps the PS surveillance of the PACS priority module.

The functional units ~~computerized portions~~ of the PS are continuously monitored through self-testing during power operation. During outages, extended ~~computer~~ self-testing is performed to verify functionality that cannot be tested with the reactor at power.

Sensors and acquisition circuits are periodically tested. The input channel to be tested is placed in a lockout condition, and the downstream voting logic is automatically modified to disregard the input being tested. The ESF actuation functions are still performed using the redundant input channels.

The connections between the PS output circuits and the PACS priority modules can be tested during power operation. One function of one division of the PS is tested at a time and the outputs of the PACS priority modules are disabled so that the actuators are not affected by the test. The PACS priority modules are disabled for five seconds and then they automatically exit the test mode and enable their outputs. If an ESF actuation order is generated during the time that a PACS priority module is in test mode, the outputs of the PACS priority module ~~are enabled and the ESF actuation is carried out~~remain disabled until the PACS priority module exits the test mode. The ESF actuation functions are still performed using the other PS divisions.

The testing of the PS is described in the U.S. EPR Protection System Surveillance Testing and TELEPERM XS Self-Monitoring Technical Report (ANP-10315P) (Reference 7).

7.3.2.3.7 ~~Compliance to Requirements~~Conformance to Guidance Regarding the Use of Digital Systems (IEEE- Std 7-4.3.2-2003)

07.01-30

The automatic ESF actuation functions are implemented using the TELEPERM XS ~~digital~~ platform (Reference 2) which is approved for use in safety-related systems of

nuclear power generating stations in the United States. The ESF actuation functions are implemented in an architecture designed to satisfy requirements applicable to all safety-related I&C systems~~, digital or otherwise~~.

Implementation of safety-related I&C systems is governed by the requirements of IEEE Std 603-1998 (Reference 5). Compliance with this requirement is described in Section 7.1. Guidance on the use of digital computers in safety-related systems is provided by IEEE Std 7-4.3.2-2003 (Reference 6). Conformance to ~~these standards~~ this guidance is described in Section 7.1.

7.3.2.3.8 ~~Conformance to~~Compliance with Requirements for ESF Actuation Setpoint Determination (Clause 6.8 of IEEE Std 603-1998)

Each setpoint used to actuate an ESF system is selected based on the safety limits assumed in the plant accident analysis. The ESF actuation setpoints provide margin to the safety limit and take into account measurement uncertainties. The methodology to determine setpoints for ESF actuation functions is documented in the U.S. EPR Instrument Setpoint Topical Report (ANP-10275P-A) (Reference 4). The single-sided measurement uncertainty reduction factor shall not be used in determining U.S. EPR setpoints.

7.3.3 References

07.01-30

1. ANP-10309P, Revision ~~0~~3, "U.S. EPR ~~Digital~~ Protection System Technical Report," AREVA NP Inc., ~~November 2009~~June 2011.

2. EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System," Siemens Power Corporation, July 2000.

3. ANP-10304, Revision ~~1~~4, "U.S. EPR Diversity and Defense-In-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.

4. ANP-10275P-A, Revision 0, "U.S. EPR Instrument Setpoint Methodology Topical Report," AREVA NP Inc., ~~March 26, 2007~~January 2008.

5. IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1998.

6. IEEE Std 7-~~.~~-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 2003.

7. ANP-10315P, Revision 1, "U.S. EPR Protection System Surveillance Testing and TELEPERM XS Self-Monitoring Technical Report, " AREVA NP Inc., June 2011.

accident conditions. The FPCPS is included as a post-~~-~~fire shutdown system because fires in the spent fuel areas must be considered. The I&C associated with the FPCPS are described in Section 9.1.3.

7.4.1.3.4 Remote Shutdown Station

The RSS provides an independent alternative shutdown capability that is physically and electrically independent of the MCR.

The RSS is a control center located in Safeguard Building ~~division~~ 3 near the MCR. It contains the equipment necessary to bring the plant to a safe shutdown state during an event requiring evacuation of the MCR, in conjunction with:

- A single failure of a system, structure, or component required to bring the plant to safe shutdown (in the event of a fire, no additional single failure, unrelated to the damage caused by the fire, is considered).
- A sustained loss of either onsite or offsite AC power.

07.01-30

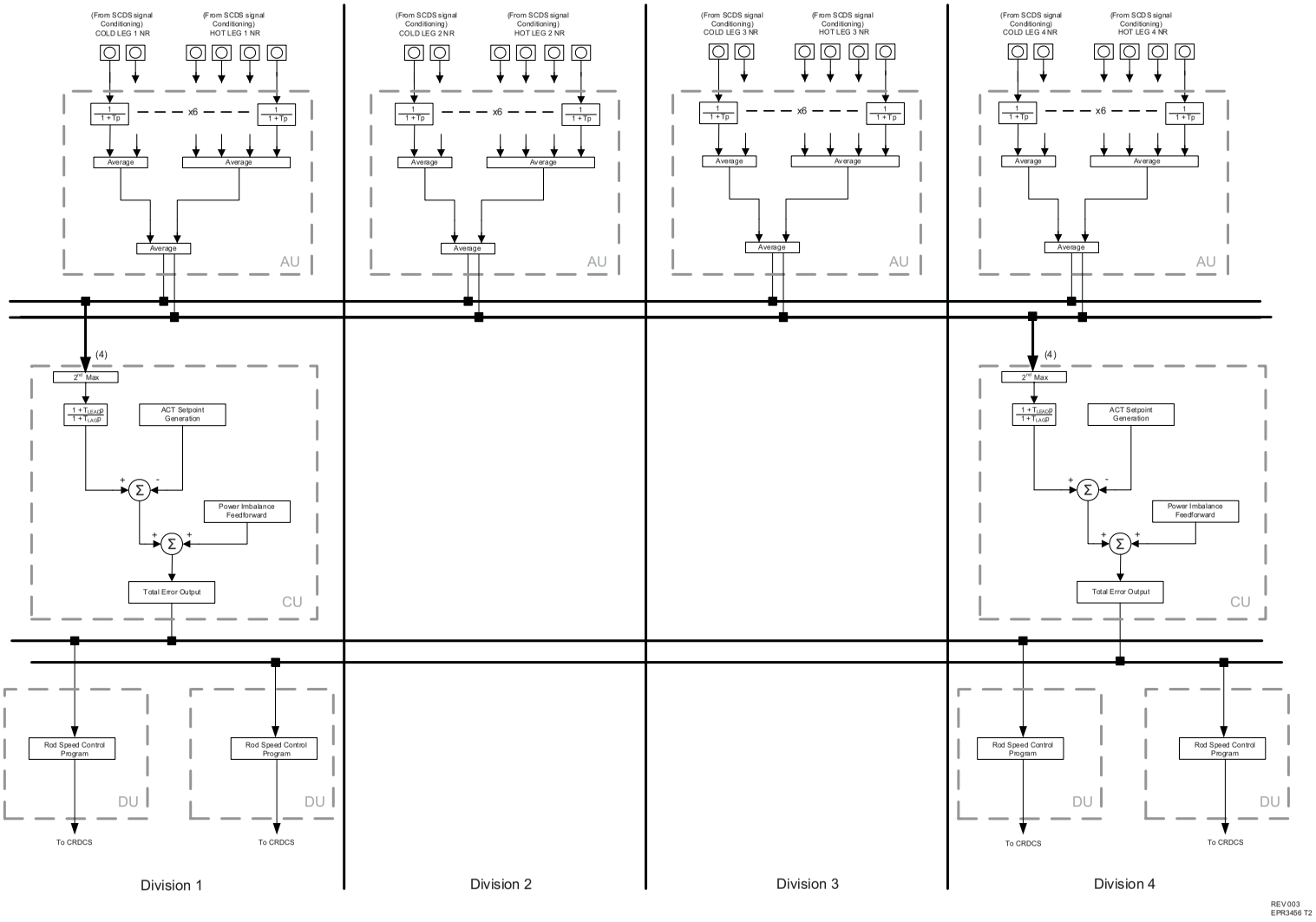
~~The RSS contains HMI workstations necessary to bring the plant to, and maintain it in, a safe shutdown state. The HMI control functions of the RSS are isolated during normal, emergency, routine shutdown, refueling, or maintenance operations as long as the MCR is available. The HMI workstations both in the MCR and the RSS will continue to display all parameters available on each workstation while the control functions are isolated. Also, these workstations contain PICS equipment, SICS equipment and select communication equipment.~~ The RSS contains both the PICS and the SICS. The PICS provides most of the necessary controls for safe shutdown. The SICS controls are only those controls needed to achieve safe shutdown that are unavailable on the PICS. These SICS controls are listed in Section 7.4.1.1. The architecture of the SICS and PICS is described in Section 7.1. Communication equipment is described in Section 9.5.2.

The SICS and PICS provide~~s~~ the displays and controls in the RSS to allow the monitoring and control of the following safe shutdown functions during a postulated fire in the MCR or during an event that could cause the MCR to become uninhabitable, coupled with a single failure:

- Reactivity control.
- Reactor coolant makeup.
- Reactor coolant system pressure control.
- Decay heat removal.

07.01-30

Figure 7.7-6—Signal Flow from ~~PS~~SCDS through CU



Next File

7.8.2.1.5 GDC 13 - Instrumentation and Control

See Section 7.1 for a description of compliance with GDC 13.

7.8.2.1.6 GDC 19 - Control Room

See Section 7.1 for a description of compliance with GDC 19.

7.8.2.1.7 GDC 24 - Separation of Protection and Control Systems

The ~~SICS~~SCDS and PACS meet the requirements of GDC 24. See Section 7.1 for a description of compliance with GDC 24.

7.8.2.1.8 Generic Letter 85-06 - Quality Assurance Guidance for ATWS Equipment that is not Safety Related

AREVA NP Inc. implements quality requirements to ATWS equipment in accordance with Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety Related~~.~~" (Reference 4).

7.8.3 References

07.01-30

1. ANP-10304, Revision ~~1~~4, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.
2. NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analysis of Reactor Protection Systems," U.S. Nuclear Regulatory Commission, December 1994.
3. SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," U.S. Nuclear Regulatory Commission, April 1993.
4. Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related," U.S. Nuclear Regulatory Commission, April 16, 1986.

Next File

1.1.3 Postulated accident mitigation.

1.1.4 Postulated post-accident mitigation operations.

2.0 PREREQUISITES

2.1 Construction activities on the SAS have been completed.

2.2 ~~SAS~~Signal conditioning and distribution system (SCDS) instrumentation has been calibrated and is functional for performance of this test.

2.3 Support system~~(s)~~ required for operation of the SAS ~~is~~are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions are available or performing this test.

3.0 TEST METHOD

3.1 ~~Demonstrate the operation of the SAS meets design requirements~~Simulate SCDS sensor inputs over the instrument range and verify that SAS receives SCDS inputs.

3.2 Verify that SAS ~~operates~~responds as designed over the design range using ~~actual or~~ simulated signals from SCDS.

3.3 Verify that SAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the SAS design.

07.01-30

3.5 Verify the functionality of the SAS self-test features by simulating SAS component failures and observing through human-machine interfaces that the self-test features identified the failure.

3.6 Verify both operating bypass, and maintenance bypass features, including, where applicable, observation that bypasses are cancelled automatically.

3.7 Test the SAS response to loss of power and subsequent power restoration as follows:

3.7.1 Simulate normal steady state full power conditions for the SAS.

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

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

3.7.4 Upon completion of the startup self test, verify the SAS outputs return to their normal steady state full power condition.

3.7.5 Repeat test for all SAS divisions.

3.7.4 Upon completion of the startup self test, verify the SAS outputs return to their normal steady state full power condition.

3.7.5 Repeat test for all SAS divisions.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 SAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Monitoring and control of safety related automatic and manual functions after initiation through the Protection System.

5.2 Monitoring and control of essential auxiliary support systems.

5.3 Processing Type A-C PAM variables for display on the SICS.

07.01-30

5.4 ~~Certain i~~Interlock functions respond as described in Section 7.8.

5.5 SAS equipment passes all applicable self tests.

5.6 The SAS outputs attain a predefined state upon loss and restoration of electrical power.

14.2.12.11.16 Remote Shutdown Station (Test #140)

1.0 OBJECTIVE

1.1 To verify proper operation of the remote shutdown station (RSS).

1.2 To determine transfer of control occurs and that the plant can be controlled and cooled down from the RSS.

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

2.0 PREREQUISITES

2.1 All construction activities on the RSS have been completed.

2.2 The RSS instrumentation has been calibrated and is functional for performing the following test.

2.3 The communication systems between the MCR and RSS location have been demonstrated to be functional.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Simulate signals to verify that operation of RSS instrumentation meets design requirements.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Simulate incore signals into the signal conditioning circuits using external test instrumentation.

3.3 Test each amplifier for as designed operation in accordance with the manufacturer instruction manual using the internal test circuits.

07.01-30

3.4 Simulate variable inputs to the amplifier and record its output values ~~displayed by the DPS~~.

3.5 Verify that the incore instrumentation system operates over the design range using actual or simulated signals.

3.6 Verify that the incore instrumentation system responds as designed to actual or simulated limiting malfunctions or failures.

3.7 Verify that the incore instrumentation system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.8 Verify redundancy and electrical independence of the incore design.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Cabling insulation resistance readings.

4.2 Status and performance of the internal test circuits.

4.3 Values of simulated input and derived output signals for correlation purposes.

5.0 ACCEPTANCE CRITERIA

5.1 The incore instrumentation is arranged as shown on the plant layout drawings. Reference Figure 4.4-8 for additional information.

5.2 The self-powered neutron detectors generate neutron flux measurement signals as input to the protection system using simulated signals.

5.3 The core outlet thermocouples generate core outlet temperature measurement signals as input to the safety automation system using simulated signals.

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

occur. For example, pump breakers racked to test to prevent inadvertent pump start, or pump motors uncoupled.:

2.5.1 Reactor trip circuit 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 signal to the PACS modules.

2.5.5 The TG I&C system is capable of providing a turbine signal response to a PS signal.

07.01-30

2.5.6 The CRDCS trip contactors are capable of responding to a PS signal.

2.5.7 The PS is receiving signals from the SCDS.

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.

3.3 Simulate PS inputs from SCDS 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 in response to PS signal to the CRDCS.

3.5.4 TG I&C turbine trip signal in response to a reactor trip.

07.01-30

3.6 Simulate ~~PS~~SCDS 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 actuator ~~system~~ response.

3.8 Verify both operating bypass and maintenance bypass features, including, where applicable, observation that bypasses are cancelled automatically.~~Check the operation of bypass features including, where applicable, observation that operating bypasses are cancelled automatically.~~

07.01-30

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.

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 outputs ~~status information~~ to the ~~non-safety-related control systems~~following~~.~~:

5.7.1 PAS.

5.7.2 SAS.

5.7.3 PACS.

5.7.4 TG I&C.

5.7.5 CRDCS.

5.7.6 Reactor trip circuit breakers.

07.01-30

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.

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.

07.01-30

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

5.12 PS equipment passes all applicable self tests.

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.

2.0 PREREQUISITES

2.1 Construction activities on the RCSL have been completed.

2.2 RCSL software is installed and instrumentation that provides RCSL input and control signals has been calibrated and is operating satisfactorily~~. prior to performing the following test.~~

07.01-30

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for operation of the RCSL are functional.

2.5 Cabling has been completed between the RCSL and interface equipment.

5.3 The RHRS is used to achieve cold shutdown at a cooldown rate not in excess of Technical Specification limits.

5.4 The turbine bypass valves can be operated to control RCS temperature.

5.5 The RCPs can be secured one at a time at HZP conditions and the RCP seal package, including the standstill seal, can be verified to limit RCS leakage within design limits.

5.6 Unrestricted expansion for selected points on piping systems and components as designed. ~~As specified by the individual pre-core HFT procedures~~.

5.7 Verification that components return to their baseline ambient position as designed.

5.8 Verification that as designed gaps exist for selected piping systems and components as designed.

14.2.12.13.2 Pre–Core Instrument Correlation (Test #162)

1.0 OBJECTIVE

07.01-30

1.1 To demonstrate that the inputs and appropriate outputs between the following safety-related ~~digital~~ systems are in agreement:

1.1.1 Plant Protection system.

1.1.2 Process instrumentation.

1.1.3 Discrete indication and alarm system.

1.1.4 ~~DPS.~~

1.2 To verify safety-related temperature and pressure instrumentation accuracy and operation by comparing similar channels of instrumentation.

2.0 PREREQUISITES

2.1 Instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Record safety-related wide range instrumentation readings as directed by the pre-core HFT.

3.2 Record safety-related narrow range instrumentation readings as directed by the pre-core HFT.

4.0 DATA REQUIRED

4.1 PICS and SICS readings.

4.2 DAS readings.

4.3 ~~DPS readings.~~

1.0 OBJECTIVE

1.1 To predict the pre-core RCS flow rate.

1.2 To establish baseline RCS pressure drops.

1.3 To collect RCP coastdown data.

2.0 PREREQUISITES

2.1 Permanently installed instrumentation has been calibrated and is functional.

2.2 Test instrumentation has been checked and calibrated.

2.3 Reactor vessel internals have been installed with full flow debris filters, dummy fuel assemblies, or equivalent that approximates the pressure drop across the core.

2.4 RCS operating at nominal HZP (pressure and temperature) conditions.

07.01-30

2.5 Desired RCPs are operating.

2.6 ~~The associated digital DPS(s) are in operation.~~

3.0 TEST METHOD

3.1 The RCS flow instrumentation has been normalized to 100 percent RCS flow.

3.2 RCS flow, pressure drops, and the data necessary to calculate RCS flows for four RCP operations shall be obtained for various RCP configurations.

3.3 Measure RCP coastdown data for each RCP during a simultaneous four-pump coastdown.

3.3.1 Table 14.3-1 Item 1-6.

3.4 Verify that each RCP doesn't rotate in the reverse direction when other RCPs are operating.

3.5 Verify that operating restrictions for RCP restart are followed.

4.0 DATA REQUIRED

4.1 Steam generator differential pressure.

4.2 RCP differential pressure.

4.3 RCS flow indication.

4.4 RCS temperature and pressures at practical locations.

4.5 RCP speed (rpm).

4.6 RCP motor current.

4.7 Reactor vessel differential pressure.

4.8 Operating RCP configuration corresponding to data set.

14.2.12.16.1 Low Power Biological Shield Survey (Test #193)

1.0 OBJECTIVE

1.1 To measure radiation in accessible locations of the plant outside of the biological shield.

1.2 To obtain baseline levels for comparison with future measurements of level buildup with operation.

2.0 PREREQUISITES

2.1 Radiation survey instruments are calibrated and operating satisfactorily prior to performing the following test.

2.2 Background radiation levels have been measured in designated areas prior to initial criticality.

3.0 TEST METHOD

3.1 Measure gamma and neutron dose rates while holding reactor power at the specified power plateau.

4.0 DATA REQUIRED

4.1 Reactor power level.

4.2 Gamma and neutron dose rates at each specified location.

5.0 ACCEPTANCE CRITERIA

5.1 The biological shield in containment meets design requirements (refer to Section 12.3.2.2).

07.01-30

14.2.12.16.2 Comparison of ~~Digital~~Control Systems and Design Predictions (Test #194)

1.0 OBJECTIVE

1.1 To compare measured plant parameters with predicted values (i.e., design models).

1.2 To compare control room indications with those collected from field sensors (i.e., transmitters) remotely.

1.3 This procedure shall be repeated at the following plateaus:

1.3.1 ≤ 5 percent reactor power.

~~5 percent reactor power.~~

1.3.2 25 percent reactor power in accordance with RG 1.68.

1.3.3 50 percent reactor power in accordance with RG 1.68.

1.3.4 75 percent reactor power.

1.3.5 ≥98 percent reactor power in accordance with RG 1.68.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 Pressurizer level and pressure.

4.1.2 RCS temperatures.

4.1.3 RCCA position.

4.1.4 Power level and demand.

4.1.5 SG levels and pressures.

4.1.6 Feedwater and steam flow.

4.1.7 Feedwater temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The control systems maintain critical parameters within established control bands during steady-state operation. This test overlaps with the comparison of ~~digital~~control systems and design predictions test (Test #194) and shall be coordinated with that test.

07.01-30

5.2 The control systems rapidly return critical parameters to steady-state following a transient.

5.3 Control systems do not cause transients in plant systems that are field observable.

5.4 The non-safety control systems control parameters in a way that does not challenge safety limits established in the accident analyses assumptions.

14.2.12.17 Phase IV: Power Ascension Tests, ≥10 Percent Power Ascension Plateau (Prior to Turbine Synchronization)

Some of the following tests are performed in more than one plateau, in those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.17.1 Baseline NSSS Integrity Monitoring (Test #197)

1.0 OBJECTIVE

1.1 To obtain initial operating data for the RCS monitoring systems. This data shall be used to determine system performance data (i.e., acceptance criteria) as well as to establish baseline data for system trending. Data shall be collected on the following systems:

1.1.1 Loose parts and vibration monitoring.

1.1.2 Diagnostics of rotating machinery.

1.1.3 Leak detection.

1.1.4 Fatigue monitoring.

1.1.5 Seismic monitoring.

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2.3 The incore detector systems, related ~~digital~~ processing computers, and POWERTRAX-E are functional.

2.4 Verify that theoretical time dependent decay constant functions for the vanadium steel flux measurement balls (AMS) have been entered into the measurement software.

3.0 TEST METHOD

3.1 Calculate/measure the resident time in the core to achieve AMS vanadium ball stack saturation at the current reactor power (neutron fluence).

3.2 Verify that the AMS residence time exceeds the time to reach AMS vanadium ball stack saturation at the current power level.

3.3 Perform an AMS flux map with the measuring table sequence set in "normal" (A, B, C, and D sequence) and analyze the map using POWERTRAX-E.

3.4 Perform an AMS flux map with the measuring table sequence set in "reverse from normal" (A, B, C, and D sequence) and analyze the map using POWERTRAX-E.

3.5 Compare the AMS flux maps generated by the "normal" and the "reverse from normal" sequence using POWERTRAX-E focusing on differences that could be attributed to change in sequence. If xenon equilibrium has not been achieved, the maps may not be identical. If this is the case, verify that differences are not due to sequence.

3.6 Verify that the time dependent decay constant functions are adequate or establish revised time dependent decay constant functions.

3.7 Verify that the POWERTRAX-E AMS sequence flux maps are not used to calibrate the SPNDs unless equilibrium xenon conditions have been achieved.

3.8 Perform an AMS flux map with the measuring table sequence set in "normal" (A, B, C, and D sequence) once equilibrium xenon conditions have been achieved. If the previous AMS flux maps were not performed with equilibrium xenon conditions, analyze the map using POWERTRAX-E.

3.9 Calibrate the SPNDs using constants generated by POWERTRAX-E prior to increasing reactor power to the next power ascension plateau.

4.0 DATA REQUIRED

4.1 Reactor power as indicated by the secondary calorimetric.

4.2 Reactor power as indicated by the primary enthalpy calorimetric.

4.3 RCCA position.

4.4 Boron concentration and boron-10 isotopic abundance.

4.5 Incore detector system data.

Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
188	Post-Core Incore Instrumentation	FSAR	Appendix A, 2.g		
189	Leak Detection Systems	FSAR	Appendix A, 2.d		
190	Critical Boron Concentration: All Rods Out	FSAR	Appendix A, 3		
191	Isothermal Temperature Coefficient	FSAR	Appendix A, 4.a		
192	Rod Worth	FSAR	Appendix A, 4.b		
193	Low Power Biological Shield Survey 07.01-30	FSAR	Appendix A, 4.f		
194	Comparison of ~~Digital~~Control Systems and Design Predictions	FSAR	Appendix A, 4.u & 5.r		
195	Main, Startup and Emergency Feedwater Systems	FSAR	Appendix A, 4.k, 5.1, 5.v, & 5.oo	RG 1.20	
196	Natural Circulation	FSAR	Appendix A, 4.t & 5.m		
197	Baseline NSSS Integrity Monitoring	FSAR	Appendix A, 4 & 5.n.	RG 1.20	
198	Total Loss of Offsite Power	FSAR	Appendix A, 5.jj		
199	Control Systems Checkout	FSAR	Appendix A, ~~4.k.u~~4.k, 4.u, 5.s, & 5.oo		
200	Load Swings	FSAR	Appendix A, 5.v & 5.hh		
201	Secondary Calorimetric Power	FSAR	Appendix A, 5.y		
202	Primary Calorimetric	FSAR	Appendix A, 5.m & 5.y		
203	Ventilation Capability	FSAR	Appendix A, 5.x & 5.ff		
204	Sampling Primary and Secondary Systems	FSAR	Appendix A, 5.aa		

Testing and evaluation is conducted throughout the HSI design at various stages of development so that the complex HSI design functions properly before the design process is resolved and validation occurs (see Figure 18.1-2).

Activities such as concept testing, mock-up activities, trade-off evaluations, and performance-based tests are utilized at various stages of the design. The criteria used to decide which type of testing or evaluation technique is applicable are described in the U.S. EPR Human Factors Verification and Validation Implementation Plan (Reference 17).

18.7.8 HSI Design Results and Documentation

As described in Section 4.5 of EPR HFE Program Management Plan (Reference 2), the HSI designs are documented using specific design control process requirements. The various configuration management, design change controls, design verification, and design quality control tools are also described in Reference 1.

18.7.9 References

1. ANP-10266NPA, Revision 0, "AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR," AREVA NP Inc., December 2008.

2. U.S. EPR HFE Program Management Plan, AREVA NP Inc., ~~2009~~2010.

3. NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980.

4. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 2, U.S. Nuclear Regulatory Commission, February 2004.

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5. ANP-10304, Revision ~~1~~4, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.

6. NUREG-0700, "Human-System Interface Design Review Guidelines," Revision 2, U.S. Nuclear Regulatory Commission, May 2002.

7. NUREG/CR-6633, "Advanced Information Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

8. NUREG/CR-6634, "Computer-Based Procedure Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

9. NUREG/CR-6635, "Soft Controls: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

10. NUREG/CR-6636, "Maintainability of Digital Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

55. IEC-62340, "Nuclear Power Plants – Instrumentation and Control Systems Important to Safety – Requirements to Cope with Common Cause failure (CCF)," Edition 1.0, International Electrotechnical Commission, 12-7-2007.

56. IEC-60880, "Nuclear Power Plants – Instrumentation and Control Systems Important to Safety – Software Aspects for Computer-Based Systems Performing Category A Functions," Edition 2.0, International Electrotechnical Commission, 5-9-2006.

57. IEC-61508, "Functional Safety of Electrical / Electronic / Programmable Electronic Safety-Related Systems," International Electrotechnical Commission.

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58. ANP-10304, Revision ~~1~~4, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~June 2011.

59. ANP-10290, Revision 1, "Environmental Report Standard Design Certification," AREVA NP Inc., September 2009.

Table 19.1-102—U.S. EPR Design Features Contributing to Low Risk
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No	U.S. EPR Design Feature Description	Disposition
	Because of the level of redundancy of such systems, concerns regarding the potential for common-cause failures must be addressed. A number of important measures have been taken to limit the potential for CCFs for the digital I&C systems of the U.S. EPR, including the following:	Tier 2, Section 7.1.1.4.1; Tier 2, Section 7.2.1.1~~; ANP-10309P, (Reference 53), Section 10~~
	• The Protection System employs subsystems called diversity groups to accomplish essential actuations. These subsystems are functionally diverse and independent. The diversity results from the use of different application programs and different parameter/sensor inputs. No information is shared between diversity groups via network connections. • The outputs of the protective system (PS) are connected to diverse reactor trip devices. • The ESF functions are also divided between the diverse subsystems to obtain maximum functional diversity.	07.01-30
	In addition to the functional diversity provided by the subsystems within the PS and the diversity of the reactor trip devices, there is additional defense-in-depth provided in the I&C architecture. This includes the following:	
	• Trip reduction features of the RCSL and PAS systems, which provide control, surveillance, and limitation functions to reduce reactor trips and PS challenges. Among these features is the automatic power reduction that is not credited in the PRA.	Tier 2, Section 7.1.1.4.5; Tier 2, Section 7.1.1.4.6
	• Backup trip and actuation functions are performed by the non-safety-related I&C system (i.e., the PAS).	Tier 2, Section 7.4.1.1
	The potential for software CCFs is minimized by such measures as the following: • High quality software design tools. • A deterministic operating system. • Built in monitoring and testing. • Built in functional diversity.	Tier 2, Section 7.1.1.1; Tier 2, Section 7.1.1.2
10	**Diversity of some elements of HVAC** Diversity is incorporated into the design of the safety chilled water system through the use of air cooling for the refrigeration units in Divisions 1 and 4, and CCW cooling for the refrigeration units of Divisions 2 and 3.	Tier 2, Section 9.2.8.2.2; Tier 2, Section 9.2.8.4