

## ArevaEPRDCPEm Resource

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**From:** WELLS Russell (AREVA) [Russell.Wells@areva.com]  
**Sent:** Wednesday, April 20, 2011 7:50 AM  
**To:** Tesfaye, Getachew  
**Cc:** BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 413, FSAR Ch. 7, Supplement 10  
**Attachments:** RAI 413 Supplement 10 Response US EPR DC.PDF

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule. Supplement 3 response to RAI No. 413 was sent on January 28, 2011, to provide technically correct and complete responses to seven questions. Supplement 4 response to RAI No. 413 was sent on February 1, 2011, to provide technically correct and complete responses to seven questions. Supplement 5 response to RAI No. 413 was sent on February 23, 2011, to provide technically correct and complete responses to five questions. Supplement 6 response to RAI No. 413 was sent on February 24, 2011, to provide a revised schedule. Supplement 7 response to RAI No. 413 was sent on March 2, 2011, to provide technically correct and complete response to one question. Supplement 8 response to RAI No. 413 was sent on March 15, 2011, to provide technically correct and complete response to two questions. Supplement 9 response to RAI No. 413 was sent on March 23, 2011, to provide technically correct and complete response to ten questions.

The attached file, "RAI 413 Supplement 10 Response US EPR DC.pdf" provides a technically correct and complete response to Question 07.08-13, 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 413, Question 07.08-13.

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 413 07.08-13 | 2          | 3        |

This concludes the formal AREVA NP response to RAI 413, and there are no questions from this RAI for which AREVA NP has not provided responses.

*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*

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**From:** WELLS Russell (RS/NB)  
**Sent:** Wednesday, March 23, 2011 4:57 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. 413, Supplement 9

Getachew,

AREVA NP Inc. letter NRC 11:029 dated March 23, 2011 provides a technically correct and complete response to 10 of the remaining 11 questions for RAI 413. AREVA NP considers some of the material contained in the response to be proprietary information. As required by 10 CFR 2.390(b), an affidavit is provided to support the withholding of the proprietary information from public disclosure. Proprietary and non-proprietary versions of the enclosure to this letter are provided separately.

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

| <b>Question #</b> | <b>Start Page</b> | <b>End Page</b> |
|-------------------|-------------------|-----------------|
| RAI 413 07.08-19  | 2                 | 12              |
| RAI 413 07.08-21  | 13                | 24              |
| RAI 413 07.08-22  | 25                | 27              |
| RAI 413 07.08-26  | 28                | 33              |
| RAI 413 07.08-27  | 34                | 36              |
| RAI 413 07.08-28  | 37                | 40              |
| RAI 413 07.08-29  | 41                | 46              |
| RAI 413 07.08-32  | 47                | 52              |
| RAI 413 07.08-35  | 53                | 55              |
| RAI 413 07.08-38  | 56                | 59              |

The schedule for the technically correct and complete response to the remaining questions is unchanged and is provided below.

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-13 | April 21, 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*

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[Russell.Wells@Areva.com](mailto:Russell.Wells@Areva.com)

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**From:** WELLS Russell (RS/NB)

**Sent:** Tuesday, March 15, 2011 10:34 AM

**To:** 'Tesyfaye, 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. 413, Supplement 8

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule. Supplement 3 response to RAI No. 413 was sent on January 28, 2011, to provide technically correct and complete responses to seven questions. Supplement 4 response to RAI No. 413 was sent on February 1, 2011, to provide technically correct and complete responses to seven questions. Supplement 5 response to RAI No. 413 was sent on February 23, 2011, to provide technically correct and complete responses to five questions. Supplement 6 response to RAI No. 413 was sent on February 24, 2011, to provide a revised schedule. Supplement 7 response to RAI No. 413 was sent on March 2, 2011, to provide technically correct and complete response to one question. Based on discussions with NRC, the attached file, "RAI 413 Supplement 8 Response US EPR DC.pdf" provides technically correct and complete responses to two of the remaining 13 questions, as committed.

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 413 07.08-17 | 2          | 3        |
| RAI 413 07.08-42 | 4          | 6        |

The response schedule for the remaining questions is unchanged and is shown below.

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-13 | April 21, 2011 |
| RAI 413 07.08-19 | April 5, 2011  |
| RAI 413 07.08-21 | April 5, 2011  |
| RAI 413 07.08-22 | April 5, 2011  |
| RAI 413 07.08-26 | April 5, 2011  |
| RAI 413 07.08-27 | April 5, 2011  |
| RAI 413 07.08-28 | April 5, 2011  |
| RAI 413 07.08-29 | April 5, 2011  |
| RAI 413 07.08-32 | April 14, 2011 |
| RAI 413 07.08-35 | April 14, 2011 |
| RAI 413 07.08-38 | April 14, 2011 |

Sincerely,

Martin (Marty) C. Bryan  
U.S. EPR Design Certification Licensing Manager  
AREVA NP Inc.  
Tel: (434) 832-3016  
702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

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**From:** WELLS Russell (RS/NB)  
**Sent:** Wednesday, March 02, 2011 3:34 PM  
**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. 413, Supplement 7

Getachew,

AREVA NP Inc. letter NRC 11:019 dated March 2, 2011 provides the final response for RAI 413, Supplement 7, question 07.08-39. AREVA NP considers some of the material contained in the response to be proprietary information. As required by 10 CFR 2.390(b), an affidavit is provided to support the withholding of the proprietary information from public disclosure. Proprietary and non-proprietary versions of the enclosure to this letter are provided separately.

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 413 07.08-39 | 2          | 30       |

The response schedule for the remaining questions is unchanged and is shown below.

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-13 | April 21, 2011 |
| RAI 413 07.08-17 | April 5, 2011  |
| RAI 413 07.08-19 | April 5, 2011  |
| RAI 413 07.08-21 | April 5, 2011  |
| RAI 413 07.08-22 | April 5, 2011  |
| RAI 413 07.08-26 | April 5, 2011  |
| RAI 413 07.08-27 | April 5, 2011  |
| RAI 413 07.08-28 | April 5, 2011  |
| RAI 413 07.08-29 | April 5, 2011  |
| RAI 413 07.08-32 | April 14, 2011 |
| RAI 413 07.08-35 | April 14, 2011 |
| RAI 413 07.08-38 | April 14, 2011 |
| RAI 413 07.08-42 | April 5, 2011  |

*Sincerely,*

*Russ Wells*

*U.S. EPR Design Certification Licensing Manager*

*AREVA NP, Inc.*

*3315 Old Forest Road, P.O. Box 10935*

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*[Russell.Wells@Areva.com](mailto:Russell.Wells@Areva.com)*

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**From:** BRYAN Martin (External RS/NB)

**Sent:** Thursday, February 24, 2011 1:58 PM

**To:** Tesfaye, Getachew

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); WELLS Russell (RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 413, FSAR Ch. 7, Supplement 6

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule. Supplement 3 response to RAI No. 413 was sent on January 28, 2011, to provide technically correct and complete responses to seven questions. Supplement 4 response to RAI No. 413 was sent on February 1, 2011, to provide technically correct and complete responses to seven questions. Supplement 5 response to RAI No. 413 was sent on February 23, 2011, to provide technically correct and complete responses to five questions.

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

The schedule for technically correct and complete responses to the remaining 14 questions is provided below:

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-13 | April 21, 2011 |
| RAI 413 07.08-17 | April 5, 2011  |
| RAI 413 07.08-19 | April 5, 2011  |
| RAI 413 07.08-21 | April 5, 2011  |
| RAI 413 07.08-22 | April 5, 2011  |
| RAI 413 07.08-26 | April 5, 2011  |
| RAI 413 07.08-27 | April 5, 2011  |
| RAI 413 07.08-28 | April 5, 2011  |
| RAI 413 07.08-29 | April 5, 2011  |
| RAI 413 07.08-32 | April 14, 2011 |
| RAI 413 07.08-35 | April 14, 2011 |
| RAI 413 07.08-38 | April 14, 2011 |
| RAI 413 07.08-39 | April 5, 2011  |
| RAI 413 07.08-42 | April 5, 2011  |

Sincerely,

Martin (Marty) C. Bryan  
 U.S. EPR Design Certification Licensing Manager  
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 Tel: (434) 832-3016  
 702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

---

**From:** WELLS Russell (RS/NB)  
**Sent:** Wednesday, February 23, 2011 2:08 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); BRYAN Martin (External RS/NB); RYAN Tom (RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 413, FSAR Ch. 7, Supplement 5

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule. Supplement 3 response to RAI No. 413 was sent on January 28, 2011, to provide technically correct and complete responses to seven questions. Supplement 4 response to RAI No. 413 was sent on February 1, 2011, to provide technically correct and complete responses to seven questions. Based on discussions with NRC, the attached file, "RAI 413 Supplement 5 Response US EPR DC.pdf" provides technically correct and complete responses to five of the remaining 19 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 413 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|------------|------------|----------|
|------------|------------|----------|

|                  |   |   |
|------------------|---|---|
| RAI 413 07.08-10 | 2 | 2 |
| RAI 413 07.08-11 | 3 | 4 |
| RAI 413 07.08-12 | 5 | 6 |
| RAI 413 07.08-14 | 7 | 7 |
| RAI 413 07.08-16 | 8 | 8 |

The schedule for technically correct and complete responses to the remaining 14 questions is unchanged and provided below:

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-13 | March 15, 2011 |
| RAI 413 07.08-17 | March 15, 2011 |
| RAI 413 07.08-19 | March 31, 2011 |
| RAI 413 07.08-21 | March 2, 2011  |
| RAI 413 07.08-22 | March 2, 2011  |
| RAI 413 07.08-26 | March 31, 2011 |
| RAI 413 07.08-27 | March 2, 2011  |
| RAI 413 07.08-28 | March 2, 2011  |
| RAI 413 07.08-29 | March 31, 2011 |
| RAI 413 07.08-32 | March 31, 2011 |
| RAI 413 07.08-35 | March 2, 2011  |
| RAI 413 07.08-38 | March 2, 2011  |
| RAI 413 07.08-39 | March 2, 2011  |
| RAI 413 07.08-42 | March 15, 2011 |

Sincerely,

*Russ Wells*  
*U.S. EPR Design Certification Licensing Manager*  
**AREVA NP, Inc.**  
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[Russell.Wells@Areva.com](mailto:Russell.Wells@Areva.com)

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**From:** BRYAN Martin (External RS/NB)  
**Sent:** Tuesday, February 01, 2011 6:06 PM  
**To:** 'Tefaye, 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. 413, FSAR Ch. 7, Supplement 4

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule. Supplement 3 response to RAI No. 413 was sent on January 28, 2011, to provide technically correct and complete responses to seven questions. Based on discussions with NRC, the attached file, "RAI 413 Supplement 4 Response US EPR DC.pdf" provides technically correct and complete responses to seven of the remaining 26 questions, 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 413 Question 07.08-20.

The following table indicates the respective pages in the response document, "RAI 413 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| <b>Question #</b> | <b>Start Page</b> | <b>End Page</b> |
|-------------------|-------------------|-----------------|
| RAI 413 07.08-15  | 2                 | 2               |
| RAI 413 07.08-18  | 3                 | 4               |
| RAI 413 07.08-20  | 5                 | 6               |
| RAI 413 07.08-23  | 7                 | 11              |
| RAI 413 07.08-25  | 12                | 14              |
| RAI 413 07.08-33  | 15                | 19              |
| RAI 413 07.08-34  | 20                | 33              |

The schedule for technically correct and complete responses to the remaining 19 questions is unchanged and provided below:

| <b>Question #</b> | <b>Response Date</b> |
|-------------------|----------------------|
| RAI 413 07.08-10  | March 15, 2011       |
| RAI 413 07.08-11  | March 15, 2011       |
| RAI 413 07.08-12  | March 15, 2011       |
| RAI 413 07.08-13  | March 15, 2011       |
| RAI 413 07.08-14  | March 15, 2011       |
| RAI 413 07.08-16  | March 15, 2011       |
| RAI 413 07.08-17  | March 15, 2011       |
| RAI 413 07.08-19  | March 31, 2011       |
| RAI 413 07.08-21  | March 2, 2011        |
| RAI 413 07.08-22  | March 2, 2011        |
| RAI 413 07.08-26  | March 31, 2011       |
| RAI 413 07.08-27  | March 2, 2011        |
| RAI 413 07.08-28  | March 2, 2011        |
| RAI 413 07.08-29  | March 31, 2011       |
| RAI 413 07.08-32  | March 31, 2011       |
| RAI 413 07.08-35  | March 2, 2011        |
| RAI 413 07.08-38  | March 2, 2011        |
| RAI 413 07.08-39  | March 2, 2011        |
| RAI 413 07.08-42  | March 15, 2011       |

Sincerely,



Martin (Marty) C. Bryan  
U.S. EPR Design Certification Licensing Manager  
AREVA NP Inc.  
Tel: (434) 832-3016  
702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

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**From:** BRYAN Martin (External RS/NB)  
**Sent:** Friday, January 28, 2011 5:41 PM  
**To:** 'Tefsaye, 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. 413, FSAR Ch. 7, Supplement 3

Getachew,

The proprietary and non-proprietary responses for RAI 413 Supplement 3 are submitted via AREVA NP Inc. letter, "Response to U.S. EPR Design Certification Application RAI No. 413, Supplement 3, Questions 07.08-24, 07.08-30, 07.08-31, 07.08-36, 07.08-37, 07.08-40, and 07.08-41" NRC 11:010, dated January 28, 2011. An affidavit to support withholding of information from public disclosure, per 10CFR2.390(b), is provided as an enclosure to that letter.

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule. Supplement 2 response to RAI No. 413 was sent on December 13, 2010, to provide a revised schedule.

The following table indicates the respective pages in the response document, "RAI 413 Supplement 3 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

| Question #       | Start Page | End Page |
|------------------|------------|----------|
| RAI 413 07.08-24 | 2          | 11       |
| RAI 413 07.08-30 | 12         | 12       |
| RAI 413 07.08-31 | 13         | 22       |
| RAI 413 07.08-36 | 23         | 24       |
| RAI 413 07.08-37 | 25         | 26       |
| RAI 413 07.08-40 | 27         | 38       |
| RAI 413 07.08-41 | 39         | 43       |

To provide additional time to interact with the NRC a revised schedule is provided below (bolded dates have changed).

| Question #       | Response Date  |
|------------------|----------------|
| RAI 413 07.08-10 | March 15, 2011 |
| RAI 413 07.08-11 | March 15, 2011 |
| RAI 413 07.08-12 | March 15, 2011 |

|                  |                       |
|------------------|-----------------------|
| RAI 413 07.08-13 | March 15, 2011        |
| RAI 413 07.08-14 | March 15, 2011        |
| RAI 413 07.08-15 | <b>March 2, 2011</b>  |
| RAI 413 07.08-16 | March 15, 2011        |
| RAI 413 07.08-17 | March 15, 2011        |
| RAI 413 07.08-18 | <b>March 2, 2011</b>  |
| RAI 413 07.08-19 | <b>March 31, 2011</b> |
| RAI 413 07.08-20 | <b>March 2, 2011</b>  |
| RAI 413 07.08-21 | <b>March 2, 2011</b>  |
| RAI 413 07.08-22 | <b>March 2, 2011</b>  |
| RAI 413 07.08-23 | <b>March 2, 2011</b>  |
| RAI 413 07.08-25 | <b>March 2, 2011</b>  |
| RAI 413 07.08-26 | <b>March 31, 2011</b> |
| RAI 413 07.08-27 | <b>March 2, 2011</b>  |
| RAI 413 07.08-28 | <b>March 2, 2011</b>  |
| RAI 413 07.08-29 | <b>March 31, 2011</b> |
| RAI 413 07.08-32 | <b>March 31, 2011</b> |
| RAI 413 07.08-33 | <b>March 2, 2011</b>  |
| RAI 413 07.08-34 | <b>March 2, 2011</b>  |
| RAI 413 07.08-35 | <b>March 2, 2011</b>  |
| RAI 413 07.08-38 | <b>March 2, 2011</b>  |
| RAI 413 07.08-39 | <b>March 2, 2011</b>  |
| RAI 413 07.08-42 | March 15, 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](mailto:Martin.Bryan.ext@areva.com)

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**From:** BRYAN Martin (External RS/NB)  
**Sent:** Monday, December 13, 2010 8:40 PM  
**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. 413, FSAR Ch. 7, Supplement 2

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. Supplement 1 response to RAI No. 413 was sent on November 19, 2010, to provide a revised schedule.

To provide additional time to interact with the NRC a revised schedule is provided below (bolded dates have changed).

| Question # | Response Date |
|------------|---------------|
|------------|---------------|

|                  |                          |
|------------------|--------------------------|
| RAI 413 07.08-10 | March 15, 2011           |
| RAI 413 07.08-11 | March 15, 2011           |
| RAI 413 07.08-12 | March 15, 2011           |
| RAI 413 07.08-13 | March 15, 2011           |
| RAI 413 07.08-14 | March 15, 2011           |
| RAI 413 07.08-15 | <b>January 28, 2011</b>  |
| RAI 413 07.08-16 | March 15, 2011           |
| RAI 413 07.08-17 | March 15, 2011           |
| RAI 413 07.08-18 | <b>January 28, 2011</b>  |
| RAI 413 07.08-19 | <b>February 22, 2011</b> |
| RAI 413 07.08-20 | <b>January 28, 2011</b>  |
| RAI 413 07.08-21 | January 28, 2011         |
| RAI 413 07.08-22 | <b>January 28, 2011</b>  |
| RAI 413 07.08-23 | <b>January 28, 2011</b>  |
| RAI 413 07.08-24 | January 28, 2011         |
| RAI 413 07.08-25 | <b>January 28, 2011</b>  |
| RAI 413 07.08-26 | <b>February 22, 2011</b> |
| RAI 413 07.08-27 | <b>January 28, 2011</b>  |
| RAI 413 07.08-28 | <b>January 28, 2011</b>  |
| RAI 413 07.08-29 | February 22, 2011        |
| RAI 413 07.08-30 | January 28, 2011         |
| RAI 413 07.08-31 | January 28, 2011         |
| RAI 413 07.08-32 | February 22, 2011        |
| RAI 413 07.08-33 | <b>January 28, 2011</b>  |
| RAI 413 07.08-34 | <b>January 28, 2011</b>  |
| RAI 413 07.08-35 | January 28, 2011         |
| RAI 413 07.08-36 | <b>January 28, 2011</b>  |
| RAI 413 07.08-37 | January 28, 2011         |
| RAI 413 07.08-38 | <b>January 28, 2011</b>  |
| RAI 413 07.08-39 | <b>January 28, 2011</b>  |
| RAI 413 07.08-40 | January 28, 2011         |
| RAI 413 07.08-41 | <b>January 28, 2011</b>  |
| RAI 413 07.08-42 | March 15, 2011           |

Sincerely,

Martin (Marty) C. Bryan  
U.S. EPR Design Certification Licensing Manager  
AREVA NP Inc.  
Tel: (434) 832-3016  
702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

---

**From:** BRYAN Martin (External RS/NB)  
**Sent:** Friday, November 19, 2010 4:51 PM  
**To:** 'Tesyfaye, 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. 413, FSAR Ch. 7

Getachew,

AREVA NP provided a schedule for technically complete and correct responses to the questions in RAI 413 on September 08, 2010. To provide additional time to interact with the NRC a revised schedule is provided below for questions 07.08-36, 07.08-39, and 07.08-41.

| <b>Question #</b> | <b>Response Date</b>     |
|-------------------|--------------------------|
| RAI 413 07.08-10  | March 15, 2011           |
| RAI 413 07.08-11  | March 15, 2011           |
| RAI 413 07.08-12  | March 15, 2011           |
| RAI 413 07.08-13  | March 15, 2011           |
| RAI 413 07.08-14  | March 15, 2011           |
| RAI 413 07.08-15  | December 17, 2010        |
| RAI 413 07.08-16  | March 15, 2011           |
| RAI 413 07.08-17  | March 15, 2011           |
| RAI 413 07.08-18  | December 17, 2010        |
| RAI 413 07.08-19  | January 28, 2011         |
| RAI 413 07.08-20  | December 17, 2010        |
| RAI 413 07.08-21  | January 28, 2011         |
| RAI 413 07.08-22  | December 17, 2010        |
| RAI 413 07.08-23  | December 17, 2010        |
| RAI 413 07.08-24  | January 28, 2011         |
| RAI 413 07.08-25  | December 17, 2010        |
| RAI 413 07.08-26  | December 17, 2010        |
| RAI 413 07.08-27  | December 17, 2010        |
| RAI 413 07.08-28  | December 17, 2010        |
| RAI 413 07.08-29  | January 28, 2011         |
| RAI 413 07.08-30  | January 28, 2011         |
| RAI 413 07.08-31  | January 28, 2011         |
| RAI 413 07.08-32  | January 28, 2011         |
| RAI 413 07.08-33  | December 17, 2010        |
| RAI 413 07.08-34  | December 17, 2010        |
| RAI 413 07.08-35  | January 28, 2011         |
| RAI 413 07.08-36  | <b>December 15, 2010</b> |
| RAI 413 07.08-37  | January 28, 2011         |
| RAI 413 07.08-38  | December 17, 2010        |
| RAI 413 07.08-39  | <b>December 15, 2010</b> |
| RAI 413 07.08-40  | January 28, 2011         |
| RAI 413 07.08-41  | <b>December 15, 2010</b> |
| RAI 413 07.08-42  | March 15, 2011           |

Sincerely,

Martin (Marty) C. Bryan  
U.S. EPR Design Certification Licensing Manager  
AREVA NP Inc.  
Tel: (434) 832-3016  
702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

---

**From:** BRYAN Martin (External RS/NB)  
**Sent:** Wednesday, September 08, 2010 4:33 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. 413, FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information RAI 413.

The following table indicates the respective pages in the response document, "RAI 413 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| <b>Question #</b> | <b>Start Page</b> | <b>End Page</b> |
|-------------------|-------------------|-----------------|
| RAI 413 07.08-10  | 2                 | 2               |
| RAI 413 07.08-11  | 3                 | 3               |
| RAI 413 07.08-12  | 4                 | 4               |
| RAI 413 07.08-13  | 5                 | 5               |
| RAI 413 07.08-14  | 6                 | 6               |
| RAI 413 07.08-15  | 7                 | 7               |
| RAI 413 07.08-16  | 8                 | 8               |
| RAI 413 07.08-17  | 9                 | 9               |
| RAI 413 07.08-18  | 10                | 10              |
| RAI 413 07.08-19  | 11                | 11              |
| RAI 413 07.08-20  | 12                | 12              |
| RAI 413 07.08-21  | 13                | 13              |
| RAI 413 07.08-22  | 14                | 14              |
| RAI 413 07.08-23  | 15                | 15              |
| RAI 413 07.08-24  | 16                | 16              |
| RAI 413 07.08-25  | 17                | 18              |
| RAI 413 07.08-26  | 19                | 19              |
| RAI 413 07.08-27  | 20                | 20              |
| RAI 413 07.08-28  | 21                | 21              |
| RAI 413 07.08-29  | 22                | 22              |
| RAI 413 07.08-30  | 23                | 23              |
| RAI 413 07.08-31  | 24                | 24              |
| RAI 413 07.08-32  | 25                | 25              |
| RAI 413 07.08-33  | 26                | 26              |
| RAI 413 07.08-34  | 27                | 27              |
| RAI 413 07.08-35  | 28                | 28              |
| RAI 413 07.08-36  | 29                | 29              |
| RAI 413 07.08-37  | 30                | 30              |
| RAI 413 07.08-38  | 31                | 31              |
| RAI 413 07.08-39  | 32                | 32              |
| RAI 413 07.08-40  | 33                | 33              |
| RAI 413 07.08-41  | 34                | 34              |
| RAI 413 07.08-42  | 35                | 35              |

A complete answer is not provided for 33 of the 33 questions. The schedule for a technically correct and complete response to these questions is provided below.

| Question #       | Response Date     |
|------------------|-------------------|
| RAI 413 07.08-10 | March 15, 2011    |
| RAI 413 07.08-11 | March 15, 2011    |
| RAI 413 07.08-12 | March 15, 2011    |
| RAI 413 07.08-13 | March 15, 2011    |
| RAI 413 07.08-14 | March 15, 2011    |
| RAI 413 07.08-15 | December 17, 2010 |
| RAI 413 07.08-16 | March 15, 2011    |
| RAI 413 07.08-17 | March 15, 2011    |
| RAI 413 07.08-18 | December 17, 2010 |
| RAI 413 07.08-19 | January 28, 2011  |
| RAI 413 07.08-20 | December 17, 2010 |
| RAI 413 07.08-21 | January 28, 2011  |
| RAI 413 07.08-22 | December 17, 2010 |
| RAI 413 07.08-23 | December 17, 2010 |
| RAI 413 07.08-24 | January 28, 2011  |
| RAI 413 07.08-25 | December 17, 2010 |
| RAI 413 07.08-26 | December 17, 2010 |
| RAI 413 07.08-27 | December 17, 2010 |
| RAI 413 07.08-28 | December 17, 2010 |
| RAI 413 07.08-29 | January 28, 2011  |
| RAI 413 07.08-30 | January 28, 2011  |
| RAI 413 07.08-31 | January 28, 2011  |
| RAI 413 07.08-32 | January 28, 2011  |
| RAI 413 07.08-33 | December 17, 2010 |
| RAI 413 07.08-34 | December 17, 2010 |
| RAI 413 07.08-35 | January 28, 2011  |
| RAI 413 07.08-36 | November 19, 2010 |
| RAI 413 07.08-37 | January 28, 2011  |
| RAI 413 07.08-38 | December 17, 2010 |
| RAI 413 07.08-39 | November 19, 2010 |
| RAI 413 07.08-40 | January 28, 2011  |
| RAI 413 07.08-41 | November 19, 2010 |
| RAI 413 07.08-42 | March 15, 2011    |

Sincerely,

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**From:** Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]  
**Sent:** Monday, August 09, 2010 3:46 PM  
**To:** ZZ-DL-A-USEPR-DL  
**Cc:** Mott, Kenneth; Spaulding, Deirdre; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource  
**Subject:** U.S. EPR Design Certification Application RAI No. 413(4772), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on June 4, 2010, and discussed with your staff on July 22, 2010. Draft RAI Questions 07.08-19, 07.08-21, 07.08-23, and 07.08-41, 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:** 2868

**Mail Envelope Properties** (1F1CC1BBDC66B842A46CAC03D6B1CD410442968B)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 413, FSAR Ch. 7, Supplement 10  
**Sent Date:** 4/20/2011 7:50:12 AM  
**Received Date:** 4/20/2011 7:50:16 AM  
**From:** WELLS Russell (AREVA)

**Created By:** Russell.Wells@areva.com

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"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>  
Tracking Status: None  
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| MESSAGE                                      | 28917       | 4/20/2011 7:50:16 AM   |
| RAI 413 Supplement 10 Response US EPR DC.PDF |             | 125653                 |

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



**Response to**

**Request for Additional Information No. 413(4772), Supplement 10**

**8/9/2010**

**U.S. EPR Standard Design Certification**

**AREVA NP Inc.**

**Docket No. 52-020**

**SRP Section: 07.08 - Diverse Instrumentation and Control Systems**

**Application Section: ANP-10304**

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

**Question 07.08-13:**

Describe in detail the electrical isolation circuitry that is used between the PS and the DAS system, starting from the output of a sensor.

IEEE Std 603-1998, Section 5.6.3.1, Interconnected equipment, states, among other things, that no credible failure on the non-safety side of an isolation device shall prevent any portion of a safety system from meeting its minimum performance requirements during and following any design basis event requiring that safety function. A failure in an isolation device shall be evaluated in the same manner as a failure of other equipment in a safety system. GDC 24, states, in part, that Interconnection of the protection and control systems shall be limited to assure that safety is not significantly impaired.

BTP 7-11, "Guidance On Application And Qualification Of Isolation Devices," Revision 5 (BTP 7-11), provides guidelines for reviewing the use of electrical isolation devices to allow connections between safety and non-safety related systems. BTP 7-11 deals with the criteria and methods used to confirm that the design of isolation devices assures that credible failures in the connected non-safety channels will not prevent the safety systems from meeting their required functions. In order to address this guidance to evaluate conformance to the Commission's requirements, the staff requested design information about credited isolation devices during the second round of RAIs (ML081690513), ANP-10284Q2P, RAI question 19, for the review of the applicant's D3 topical report, "U.S. EPR Instrumentation and Control Diversity and Defense-in-Depth Methodology Topical Report," ANP-10284 (ML071760188). However, the applicant requested that the staff no longer issue a separate safety evaluation report (SER) for ANP-10284, but to incorporate the D3 review into the overall SER of the new D3 technical report, ANP-10304. The staff has utilized the entire response to RAI question 19 of ANP-10284Q2P (including all figures and schematics) when performing its safety evaluations. Therefore, the entire response should be submitted in relationship to the new D3 technical report, ANP-10304.

**Response to Question 07.08-13:**

In the previous DCS architecture, the diverse actuation system (DAS) was connected to the process information and control system (PICS). In the new architecture the connection between the DAS and PICS has been removed and replaced by hardwired connections to the safety information and control system (SICS). There is still a connection from the protection system (PS) to the PICS, however, there is no direct connection between the PS and the DAS.

The PS and the DAS implement similar reactor trip and engineered safety feature (ESF) actuation functions. For this reason, they also share some of the same sensors. The signal conditioning and distribution system (SCDS) receives input from safety-related sensors and black boxes, and non-safety-related sensors and black boxes needed on the SICS, DAS, and RCSL. When conditioned, these signals are distributed to the DCS where they are needed, including the PS and the DAS. The SCDS uses qualified electrical isolation devices when sending these safety-related signals to non-safety systems such as DAS.

The revision to Technical Report ANP-10304, "U.S. EPR Instrumentation and Control Diversity and Defense-in-Depth Methodology Topical Report" will be separately transmitted. To support the revision to Technical Report ANP-10304, changes to U.S. EPR FSAR Tier 2 sections that reference Technical Report ANP-10304 (with the exception of Chapter 7) are included with this response.

Proposed changes to the instrumentation and controls architecture were communicated to the NRC staff in the public meeting on February 15, 2011. U.S. EPR FSAR Tier 2, Section 7.8 will be revised to incorporate the revised I&C architecture. This section is provided in its entirety with this response to facilitate NRC review.

**FSAR Impact:**

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

# U.S. EPR Final Safety Analysis Report Markups

**Table 1.6-1—Reports Referenced  
Sheet 2 of 4**

| Report No.<br>(See Notes 1, 2,<br>and 3)        | Title  | Date<br>Submitted<br>to NRC      | FSAR Section<br>Number(s)                           |
|---|--|----------------------------------|---|
| ANP-10286P<br>ANP-10286NP                       | U.S. EPR Rod Ejection Accident<br>Methodology Topical Report   | 11/20/07                         | 4.3 and 15  |
| ANP-10287P<br>ANP-10287NP                       | Incore Trip Setpoint and Transient<br>Methodology for U.S. EPR Topical<br>Report   | 11/27/07                         | 4, 6, 7, and 15                                     |
| ANP-10288P<br>ANP-10288NP<br>Revision 1         | U.S. EPR Post-LOCA Boron<br>Precipitation and Boron Dilution<br>Technical Report   | 01/10                            | 15  |
| ANP-10290<br>Revision 1                         | AREVA NP Environmental Report<br>Standard Design Certification   | 9/11/09                          | 19.2  |
| ANP-10291P<br>ANP-10291NP                       | Small Break LOCA and Non-LOCA<br>Sensitivity Studies and Methodology<br>Technical Report                                     | 5/09                             | 15  |
| ANP-10292<br>Revision 1                         | U.S. EPR Conformance with Standard<br>Review Plan (NUREG-0800) Technical<br>Report   | 5/09                             | 1.9   |
| ANP-10293                                       | U.S. EPR Design Features to Address<br>GSI-191 Technical Report  | 2/08                             | 15.6.5.4.3  |
| ANP-10294<br>Revision 1                         | U.S. EPR Reactor Coolant Pump Motor<br>Flywheel Structural Analysis Technical<br>Report                                      | 3/09                             | 5.4.1.6.6   |
| ANP-10295<br>Revision 1                         | U.S. EPR Security Design Features  | 10/09                            | 13.6  |
| ANP-10296                                       | U.S. EPR Design Features that Enhance<br>Security  | 12/08                            | 13.6  |
| ANP-10299P<br>Revision 2                        | Applicability of AREVA NP<br>Containment Response Evaluation<br>Methodology to the U.S. EPR for Large<br>Break LOCA Analysis | 12/09                            | 6.2.1 and 6.2.2                                     |
| ANP-10304<br>Revision <del>1</del> <sup>2</sup> | U.S. EPR Diversity and Defense in Depth<br>Assessment Technical Report   | <del>12/09</del> <sup>3/11</sup> | <u>1.9, 7.1, 7.2, 7.3,<br/>7.7, 7.8, 18.7, 19.1</u> |
| ANP-10306P                                      | Comprehensive Vibration Assessment<br>Program for U.S. EPR Reactor Internals<br>Technical Report                             | 12/09                            | 3.9.2.1.1, 3.9.2.3,<br>3.9.2.4, and 3.9.2.7         |
| <u>ANP-10310P</u>                               | <u>Methodology for 100% Combinatorial<br/>Testing of the U.S. EPR™ Priority<br/>Module Technical Report</u>                  | <u>10/09</u>                     | <u>7.1</u>  |

07.08-13



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

#### 7.2.2.3.7 Compliance to Requirements for RT Setpoint Determination (Clause 6.8 of IEEE 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 Reference 3. The methodology to determine setpoints for all other RT functions is documented in Reference 5. The single-sided measurement uncertainty reduction factor shall not be used in determining U.S. EPR setpoints.

#### 7.2.3 References

1. ANP-10309P, Revision 01, "U.S. EPR Digital Protection System Technical Report," AREVA NP Inc., ~~November 2009~~ March 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.
4. ANP-10304, Revision 12, "U.S. EPR Instrumentation and Controls Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~ March 2011.
5. ANP-10275P, Revision 0, "U.S. EPR Instrument Setpoint Methodology Topical Report," AREVA NP Inc., March 2007.
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 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.

07.08-13



**7.8 Diverse I&C Systems**

The safety instrumentation and controls (I&C) systems that execute automatic reactor trip (RT) and engineered safety feature (ESF) actuation and control functions for accident mitigation are described in Sections 7.2 and 7.3. These systems are designed to perform the required safety functions in the event of a single random failure.

07.08-13 →

The overall ~~I&C architecture~~ distributed control system (DCS) design can also withstand software common cause failure (SWCCF) that prevents the PS from performing its function. The design has sufficient diversity and defense-in-depth to tolerate the following ~~beyond design basis~~ events:

- An anticipated transient without scram (ATWS), which is defined as an anticipated operational occurrence (AOO) followed by a failure of the RT portion of the protection system (PS).
- An AOO or a postulated accident concurrent with a software common-cause failure (CCF) that prevents the PS from performing RT or ESF actuation functions.

This section describes the I&C systems and functional requirements ~~provided~~ credited to mitigate these events.

07.08-13 →

AREVA NP Technical Report ANP-10304 (Reference 1) describes the following:

- The defense-in-depth concept for the U.S. EPR.
- The design features that prevent and mitigate a software CCF of the safety I&C systems.
- An assessment of the I&C architecture relative to each of the 14 guidelines in NUREG/CR-6303.
- The results of a plant response analysis demonstrating that the U.S. EPR satisfies applicable acceptance criteria for a postulated SWCCF of the PS concurrent with an AOO or PA.

**7.8.1 Description**

**7.8.1.1 Systems Description**

**7.8.1.1.1 Safety Information and Control System**

The safety information and control system (SICS) provides the ability to manually trip the reactor ~~using a hardwired actuation path that~~ and initiate system-level critical safety functions via the diverse actuation system (DAS), which is not affected by a software CCF of the PS. The SICS is the primary human machine interface (HMI) for the DAS.

07.08-13 →

The SICS is described in Section 7.1.

#### 7.8.1.1.2

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#### ~~Deleted~~ ~~Process Information and Control System~~

~~The PICS provides monitoring and control of plant safety systems via the PAS, DAS, and the priority and actuator control system (PACS). The PICS is diverse from the SICS.~~

~~The PICS is not subject to the postulated CCF of the PS, and is the HMI normally used by the operator during all plant conditions, as long as it is available. Therefore, the postulated CCF of the PS will not affect the PICS in a manner that induces the operator to attempt to operate the plant outside safety limits or in violation of the limiting conditions of operation.~~

~~The PICS is described in Section 7.1.~~

#### 7.8.1.1.3

#### Diverse Actuation System

07.08-13 →

The DAS executes manual functions initiated from ~~PIC~~SICS and automatic functions to mitigate an ATWS or software CCF of the PS. The DAS is diverse from the PS.

The DAS executes the automatic RT, ESF actuation, and alarm and display functions listed in Section 7.8.1.2. Sensor information is acquired by the DAS from the ~~PS and SAS~~ signal conditioning and distribution system (SCDS) using a hardwired signal that ~~is electrically isolated within the safety I&C systems and~~ is not affected by a software CCF. This path is described in Section 7.1.1.6. The DAS also processes the manual, system level actuation of critical safety functions as described in Section 7.8.1.2.3.

For RT functions, outputs from the DAS are sent to the shunt trip coils of the RT breakers, which are a diverse means of opening the breakers from the undervoltage coils which are actuated by the PS. An output is also sent to the control transistors of the CRDCS, which are a diverse means of dropping the control rods from the trip contactors which are de-energized by the PS.

For ESF actuations, outputs from the DAS are sent directly to the PACS. This path is not affected by a software CCF of the PS. Outputs for turbine trip are sent directly to the turbine generator I&C via a hardwired connection (one per division). The TG I&C performs two-out-of-four voting logic on the turbine trip signals.

The following features are implemented so that the automatic DAS functions do not interfere with PS actuations under normal circumstances and so that the PS is given the opportunity to actuate before the DAS:

- DAS setpoints are selected to provide reasonable assurance that they will be reached after a corresponding PS setpoint is reached.



- Voting logic within the DAS is such that single failures do not result in spurious actuations of the automatic DAS functions.
- Priority logic within the PACS dictates that in case of conflicting orders between the PS and the DAS, the PS orders have a higher priority (the priority rules are described in Section 7.1).

The DAS functions are designed so that once initiated, they proceed to completion. The DAS functions use the same techniques as the similar PS functions to satisfy this requirement. These techniques are described in Section 7.2.2.1.6 and Section 7.3.2.3.4.

07.08-13 →

The DAS ~~has online self testing features, which minimizes the need for bypassing the system for periodic testing. Portions of the DAS that are not tested by the self test features~~ shall be periodically tested to ensure the system will execute its functions. Sensors that are shared by the protection system and the DAS are periodically tested as part of the PS and are not required to be tested separately as part of the DAS periodic testing.

Alarms and indications are processed by the DAS and are sent to the PICS (via PAS) and SICS for display. The DAS provides accurate status information to the operator in the main control room on the PICS (via PAS) and on SICS. This includes system operation status (i.e., bypass, initiate, standby, normal), power availability, and any system faults or messages pertinent to plant operation. ~~Confirmation of actuation of components by DAS is obtained through check back signals from the PACS to verify the status of the actuator.~~

The DAS is further described in Section 7.1.

#### 7.8.1.1.4 Priority and Actuator Control System

The PACS supports the execution of automatic and manual functions required to mitigate an ATWS and a software CCF of the PS. The PACS is diverse in operation from the PS. The PACS is not used in the actuation path for the RT function.

The PACS receives actuation orders from the various I&C systems and sends the order of highest priority to the plant actuators. The priority modules in the PACS are not subject to SWCCF by virtue of 100 percent combinatorial, proof-of-design testing. The PACS (including the methodology for performing 100 percent combinatorial testing) is described in Section 7.1.

#### 7.8.1.2

07.08-13 →

#### ~~Functional Descriptions~~ Signal Conditioning and Distribution System

The SCDS provides conditioned signals from the sensors and black boxes to multiple DCS subsystems for further processing. The outputs of the SCDS are hardwired and are sent independently to each system and are not affected by a software CCF of the PS.

07.08-13 →

The SCDS is also connected directly to the SICS via hardwire for the display of certain sensor information. The display of this information is not affected by a software CCF of the PS.

The SCDS is described in Section 7.1.

### 7.8.1.2.1 Automatic DAS Functions

The following functions are performed automatically by the DAS to mitigate an ATWS or SWCCF of the PS concurrent with an AOO or PA:

- RT on low SG pressure.
- RT on low SG level.
- RT on high SG level.
- RT on low RCS flow (two loops).
- RT on low-low RCS flow (one loop).
- RT on high neutron flux (power range).
- RT on low hot leg pressure.
- RT on high pressurizer pressure.
- Turbine trip on RT.
- EFWS actuation on low SG level.
- SIS actuation on low pressurizer pressure ~~with signal to PAS to generate partial cooldown through TBS.~~
- Main steam isolation on low SG pressure.
- Containment isolation on high activity (also includes functions that cascade from containment isolation: Annulus ventilation and Safeguards Building HVAC reconfiguration)
- MFW isolation on low SG pressure.
- MFW isolation on high SG level.
- Opening of containment H<sub>2</sub>hydrogen mixing dampers on high containment pressure, or high containment compartments differential pressure.

07.08-13 →

- Start SBO diesels.

Reference 1 describes how these functions act to mitigate AOOs or PAs in the presence of an SWCCF that renders the PS ineffective.

#### 7.8.1.2.2 DAS Permissives

Permissive signals are used to enable, disable, or modify the operation of DAS RT and ESF functions based on plant conditions.

The state of a permissive signal is defined either as validated or inhibited:

- A validated permissive signal carries a logical value of 1.
- An inhibited permissive signal carries a logical value of 0.

There are two Permissives, D2 and D3, which are implemented in the DAS.

##### D2 Permissive

The D2 Permissive is intended, in normal operation, to allow the operator to reach the shutdown states without inadvertent DAS function actuation. The D2 Permissive uses the same excore power measurement devices as the Protection System P2 Permissive. The D2 Permissive is validated when the indicated power is higher than its setpoint of 10% nominal power. The validation of the D2 Permissive will follow the same two-out-of-four logics as the P2 Permissive shown in Figure 7.2-25—P2 Permissive Logic.

The D2 Permissive is automatically validated when the power increases above 10% and can be manually inhibited when the power is below the setpoint (10% power). The validation of the D2 Permissive automatically enables all of the DAS functions (RT and ESF) except the RT on Low-low Reactor Coolant System (RCS) Flow (One Loop). The inhibition of the D2 Permissive automatically disables all of the DAS functions (RT and ESF) except the RT on Low-low RCS Flow (One Loop).

##### D3 Permissive

The D3 Permissive is intended to prevent a full reactor trip actuation following a partial reactor trip due to the loss of one Reactor Coolant Pump (RCP) event. The D3 Permissive uses the same excore power measurement devices as the Protection System P3 Permissive. The D3 Permissive is automatically validated when the indicated power is higher its setpoint of 70% nominal power. The validation of the D3 Permissive will follow the same ~~three~~<sup>two</sup>-out-of-four logics as shown in Figure 7.2-26—P3 Permissive Logic. 07.08-13

The D3 Permissive is automatically validated when the power increases above 70% and automatically inhibited when the power decreases below 70%. The validation of the D3 Permissive automatically enables the RT on the Low-low RCS Flow (One Loop).

The inhibition of the D3 Permissive automatically disables the RT on a Low-low RCS Flow (One Loop).

### 7.8.1.2.3 Manual Actuation of Critical Safety Functions

Manual actuation of critical safety functions is provided in accordance with SECY 93-087 (Reference 3). These manual functions are processed by I&C systems that are not subject to the postulated SWCCF of the PS. The functions provided for each critical safety function, and the I&C systems that process each function are identified:

- Reactivity control – Manual RT (SICS) DAS.
- Core heat removal – Manual EFW actuation (PICSSICS – DAS – PACS).
- Manual MSRT actuation (PICSSICS – PASPACS).
- Reactor coolant inventory – Manual SIS actuation (PICSSICS – DAS – PACS).
- Containment isolation – Manual stage 1 containment isolation (PICSSICS – DAS – PACS).
- Containment integrity – Manual SIS actuation (PICSSICS – DAS – PACS).
- Manual opening of containment hydrogen mixing dampers (SICS - DAS - PACS).

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### 7.8.1.2.4 Indications and Alarms

The following indications and alarms are processed by the DASSCDS and provided to the operator on the PICS and SICS:

- Post-Accident Monitoring Variables – The operator is provided with indications to monitor the plant following an actuation by the DAS. ~~Each division of the DAS~~The SICS acquires Type A, B, and C post-accident monitoring variables from the SCDS. The ~~DASSCDS~~ processes the information and sends it to the PICSSICS for display to the operator. Post-accident monitoring variables are described in Section 7.5.
- Indication and Alarm of DAS Status – When an automatic RT or ESF function is actuated by DAS, alarms are generated and sent to the PICS (via PAS) and SICS to alert the operator. ~~The PICS also displays the bypassed and inoperable status of the DAS when appropriate.~~

## 7.8.2 Analysis

### 7.8.2.1 Regulatory Requirements

#### 7.8.2.1.1 10 CFR 50.55a(a)(1) - Quality Standards

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The safety-related portions of the SICS, SCDS, and the PACS meet the requirements of 10 CFR 50.55a(a)(1). See Section 7.1 for a complete description on compliance with 10 CFR 50.55a(a)(1).

#### 7.8.2.1.2 10 CFR 50.55a(h)(3) - Safety Systems

The safety-related portion of the SICS, SCDS, and the PACS meet the requirements of 10 CFR 50.55a(h)(3). ~~The PIGS and DAS are non-safety related systems and are~~ The DAS is a non-safety-related system and is independent from the safety I&C systems. See Section 7.1 for a complete description on compliance with 10 CFR 50.55a(h)(3).

#### 7.8.2.1.3 10 CFR 50.62 - Requirements for Reduction of Risk from ATWS Events for Light-Water-Cooled Nuclear Power Plants

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~~The DAS is provided for ATWS mitigation, and meets~~ The DAS, SCDS, and PACS are provided for ATWS mitigation, and meet the requirements of 10 CFR 50.62. The DAS automatically initiates RT, turbine trip, and EFW on conditions indicative of an ATWS to mitigate the event. The DAS performs its function reliably based on the system design and quality assurance measures taken. The DAS is independent from the PS. See Section 7.1 and Section 7.8.1.1.3 for more information on the DAS.

#### 7.8.2.1.4 GDC 1 - Quality Standards and Records

See Section 7.1 for a description of compliance with GDC 1.

#### 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 SIGSSSCDS 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."

### 7.8.3 References

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1. ANP-10304, Revision ~~1~~<sup>2</sup>, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~<sup>March 2011</sup>.
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.

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.
5. ANP-10304, Revision ~~1~~2, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~March 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.

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ANP-10304, Revision ~~1~~2, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., ~~December 2009~~March 2011.

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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.
58. ANP-10304, Revision 12, “U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report,” AREVA NP Inc., ~~December 2009~~ March 2011.
59. ANP-10290, Revision 1, “Environmental Report Standard Design Certification,” AREVA NP Inc., September 2009.

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