

## ArevaEPRDCPEm Resource

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**From:** WELLS Russell (AREVA) [Russell.Wells@areva.com]  
**Sent:** Thursday, May 12, 2011 4:38 PM  
**To:** Tesfaye, Getachew  
**Cc:** Miernicki, Michael; CORNELL Veronica (EXTERNAL AREVA); WILLIAMSON Rick (AREVA); BREDEL Daniel (AREVA); BENNETT Kathy (AREVA); DELANO Karen (AREVA); HALLINGER Pat (EXTERNAL AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); WILLIFORD Dennis (AREVA)  
**Subject:** Draft Revised Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Question 03.08.05-25  
**Attachments:** RAI 376 Questions 3.8.5-25 Response US EPR DC (DRAFT Rev. 2).pdf

Getachew

Attached is a revised draft response for RAI No. 376, FSAR Ch 3, Question 03.08.05-25 in advance of the May 26, 2011 final response date.

Let me know if the staff has questions or if the draft response can be sent as a final response.

Please note that there are some legibility problems with the equations in FSAR Tier 2, Table 03.08.05-25-1. These will be corrected in the final response.

*Sincerely,*

*Russ Wells*

*U.S. EPR Design Certification Licensing Manager*

*AREVA NP, Inc.*

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

*Mail Stop OF-57*

*Lynchburg, VA 24506-0935*

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*Fax: 434-382-3884*

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

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**From:** WELLS Russell (RS/NB)  
**Sent:** Monday, May 02, 2011 10:30 AM  
**To:** Tesfaye, Getachew  
**Cc:** CORNELL Veronica (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. 376, FSAR Ch. 3, Supplement 20

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed.

AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 25, 2010, to provide a revised schedule for Question 03.08.05-29. On November 22, 2011, AREVA NP submitted Supplement 15 to provide FINAL responses to Questions 03.08.05-27 and 03.08.05-30. AREVA NP submitted Supplement 16 on February 8, 2011, to provide a revised schedule for Question 03.08.05-25 and FINAL responses to Questions 03.08.05-24, 03.08.05-26 and 03.08.05-29. On February 11, 2011, AREVA NP submitted Supplement 17, to provide a revised schedule for Question 03.08.05-28 and Question 03.08.05-31. AREVA NP submitted a revised schedule for Question 03.08.05-25 in Supplements 18 and 19 on March 18, 2011 and April 19, 2011, respectively.

Due to changes in the schedule for FSAR Sections 3.7 and 3.8 as discussed with NRC, the schedule for Questions 03.08.05-28 and 03.08.05-31 is being revised. The schedule for the remaining question is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-25	August 27, 2010 (Actual)	May 26, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	<b>July 8, 2011</b>
RAI 376-03.08.05-31	October 25, 2010 (Actual)	<b>July 8, 2011</b>

*Sincerely,*

*Russ Wells*

*U.S. EPR Design Certification Licensing Manager*

**AREVA NP, Inc.**

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Lynchburg, VA 24506-0935

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Fax: 434-382-3884

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

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

**Sent:** Tuesday, April 19, 2011 7:39 AM

**To:** 'Tefaye, Getachew'

**Cc:** CORNELL Veronica (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. 376, FSAR Ch. 3, Supplement 19

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14

questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 25, 2010, to provide a revised schedule for Question 03.08.05-29. On November 22, 2011, AREVA NP submitted Supplement 15 to provide FINAL responses to Questions 03.08.05-27 and 03.08.05-30. AREVA NP submitted Supplement 16 on February 8, 2011, to provide a revised schedule for Question 03.08.05-25 and FINAL responses to Questions 03.08.05-24, 03.08.05-26 and 03.08.05-29. On February 11, 2011, AREVA NP submitted Supplement 17, to provide a revised schedule for Question 03.08.05-28 and Question 03.08.05-31. AREVA NP submitted Supplement 18 on March 18, 2011, to provide a revised schedule for Question 03.08.05-25.

The schedule for Question 03.08.05-25 is being revised to allow AREVA NP additional time to address NRC comments. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-25	August 27, 2010 (Actual)	<b>May 26, 2011</b>
RAI 376-03.08.05-28	October 25, 2010 (Actual)	May 4, 2011
RAI 376-03.08.05-31	October 25, 2010 (Actual)	May 26, 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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*434-942-6375 (cell)*

*Fax: 434-382-3884*

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

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

**Sent:** Friday, March 18, 2011 4:43 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 18

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 25, 2010, to provide a revised schedule for Question 03.08.05-29. On November 22, 2011, AREVA NP submitted Supplement 15 to provide FINAL responses to Questions 03.08.05-27 and 03.08.05-30. AREVA NP submitted Supplement 16 on February 8, 2011, to provide a revised schedule for Question 03.08.05-25 and FINAL responses to Questions 03.08.05-24, 03.08.05-26 and 03.08.05-29. On February 11, 2011, AREVA NP submitted Supplement 17, to provide a revised schedule for Question 03.08.05-28 and Question 03.08.05-31.

The schedule for Question 03.08.05-25 is being revised to allow AREVA NP additional time to interact with the NRC. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-25	August 27, 2010 (Actual)	<b>April 21, 2011</b>
RAI 376-03.08.05-28	October 25, 2010 (Actual)	May 4, 2011
RAI 376-03.08.05-31	October 25, 2010 (Actual)	May 26, 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)

---

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

**Sent:** Friday, February 11, 2011 2:51 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 17

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 25, 2010, to provide a revised schedule for Question 03.08.05-29. On November 22, 2011, AREVA NP submitted Supplement 15 to provide FINAL responses to Questions 03.08.05-27 and 03.08.05-30. AREVA NP submitted Supplement 16 on February 8, 2011, to provide a revised schedule for Question 03.08.05-25 and FINAL responses to Questions 03.08.05-24, 03.08.05-26 and 03.08.05-29.

The schedule for Question 03.08.05-28 and Question 03.08.05-31 has changed. The schedule for the remaining question is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-25	August 27, 2010 (Actual)	March 30, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	May 4, 2011
RAI 376-03.08.05-31	October 25, 2010 (Actual)	May 26, 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:** Tuesday, February 08, 2011 5:23 PM  
**To:** Tesfaye, Getachew  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 16

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3

on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 25, 2010, to provide a revised schedule for Question 03.08.05-29. On November 22, 2011, AREVA NP submitted Supplement 15 to provide FINAL responses to Questions 03.08.05-27 and 03.08.05-30.

The attached file, "RAI 376 Supplement 16 Response US EPR DC.pdf" provides technically correct and complete FINAL responses to Questions 03.08.05-24, 03.08.05-26 and 03.08.05-29, as committed.

The following table indicates the respective pages in the response document, RAI 376 Supplement 16 Response US EPR DC.pdf," that contains AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376 – 03.08.05-24	2	5
RAI 376 – 03.08.05-26	6	6
RAI 376 – 03.08.05-29	7	7

The schedule for Question 03.08.05-25 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-25	August 27, 2010 (Actual)	March 30, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-31	October 25, 2010 (Actual)	February 17, 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:** Monday, November 22, 2010 7:33 PM  
**To:** 'Tefaye, Getachew'  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 15

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31. AREVA NP submitted Supplement 14 on October 27, 2010, to provide a revised schedule for Question 03.08.05-29.

The attached file, "RAI 376 Supplement 15 Response US EPR DC.pdf" provides technically correct and complete FINAL responses to Questions 03.08.05-27 and 03.08.05-30, 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 376 Question 03.08.05-27.

The following table indicates the respective pages in the response document, RAI 376 Supplement 15 Response US EPR DC.pdf," that contains AREVA NP's response to the subject questions. Please note that the similar table for RAI 376 Supplement 13 listed the RAI question as 354 when it should have been 376. The schedule for the remaining questions is unchanged.

Question #	Start Page	End Page
RAI 376 - 03.08.05-27	2	4
RAI 376 - 03.08.05-30	5	5

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	February 28, 2011
RAI 376-03.08.05-31	October 25, 2010 (Actual)	February 17, 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:** Wednesday, October 27, 2010 1:24 PM  
**To:** 'Tesyfaye, Getachew'  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 14

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively. On October 25, 2010, AREVA NP submitted Supplement 13 to provide INTERIM responses for Questions 03.08.05-28 and 03.08.05-31.

The schedule for Question 03.08.05-29 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

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

<b>Question #</b>	<b>Interim Response Date</b>	<b>Response Date</b>
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	February 28, 2011
RAI 376-03.08.05-30	N/A	November 22, 2010
RAI 376-03.08.05-31	October 25, 2010 (Actual)	February 17, 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:** Monday, October 25, 2010 4:37 PM

**To:** Tesfaye, Getachew

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 13

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted a revised schedule for the final response to question 03.08.05-30 in Supplements 11 and 12 on September 15, 2010 and October 7, 2010, respectively.

The attached file, "RAI 376 Supplement 13 Response US EPR DC-INTERIM.pdf" provides a technically correct and complete INTERIM response to Questions 03.08.05-28 and 03.08.05-31, as committed.

The following table indicates the respective pages in the response document, RAI 376 Supplement 13 Response US EPR DC - INTERIM.pdf," that contains AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 354 - 03.08.05-28	2	10
RAI 354 - 03.08.05-31	11	12

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	October 29, 2010
RAI 376-03.08.05-30	N/A	November 22, 2010
RAI 376-03.08.05-31	October 25, 2010 (Actual)	February 17, 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:** Thursday, October 07, 2010 2:50 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 12

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29. AREVA NP submitted Supplement 11 on September 15, 2010, to provide a revised schedule for the final response to question 03.08.05-30

The schedule for Question 03.08.05-30 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining questions is unchanged.

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

<b>Question #</b>	<b>Interim Response Date</b>	<b>Response Date</b>
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	October 29, 2010
RAI 376-03.08.05-30	N/A	<b>November 22, 2010</b>
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 15, 2010 9:21 AM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 11

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25. On August 27, 2010, AREVA NP submitted Supplement 10 to provide INTERIM responses for Questions 03.08.05-25 and 03.08.05-29.

The schedule for Question 03.08.05-30 is being revised to allow additional time for AREVA NP to interact with the NRC. The schedule for the remaining questions is unchanged.

The schedule for technically correct and complete responses to the remaining 8 questions is unchanged and provided below:

<b>Question #</b>	<b>Interim Response Date</b>	<b>Response Date</b>
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	October 29, 2010
RAI 376-03.08.05-30	N/A	October 14, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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, August 27, 2010 4:58 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 10-INTERIM

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29. AREVA NP submitted Supplement 9 on August 16, 2010, to provide INTERIM responses for Questions 03.08.05-26 and 03.08.05-27 and a revised schedule for INTERIM response to question 03.08.05-25.

The attached file, "RAI 376 Supplement 10 Response US EPR DC- INTERIM.pdf" provides a technically correct and complete INTERIM response to 2 of the remaining 8 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 376 Supplement 10 Response US EPR DC- INTERIM.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376 — 03.08.05-25	2	3
RAI 376 — 03.08.05-29	4	5

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 27, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010 (Actual)	October 29, 2010
RAI 376-03.08.05-30	N/A	September 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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:** Monday, August 16, 2010 12:34 PM  
**To:** 'Tsfaye, Getachew'  
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (External RS/NB)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 9

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed. AREVA NP submitted Supplement 8 on August 9, 2010, to provide a revised schedule for INTERIM response to question 03.08.05-29.

The schedule for INTERIM response to Question 03.08.05-25 is revised to allow AREVA NP additional time to prepare the response. The FINAL response date for Question 03.08.05-25 has not changed. The FINAL response date for Question 03.08.05-30 is being changed to account for the interaction with NRC being scheduled at a later date than the existing FINAL response date.

The attached file, "RAI 376 Supplement 9 Response - INTERIM.pdf" provides a technically correct and complete INTERIM response to 2 of the remaining 8 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 376 Supplement 9 Response - INTERIM.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376 — 03.08.05-26	2	2
RAI 376 — 03.08.05-27	3	5

The schedule for technically correct and complete responses to the remaining 8 questions is changed and provided below:

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	<b>September 8, 2010</b>	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010 (Actual)	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	<b>September 16, 2010</b>
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)  
**Sent:** Monday, August 09, 2010 5:45 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); CORNELL Veronica (EXT)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 8

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed. AREVA NP submitted Supplement 7 on July 29, 2010, to provide a FINAL response to 2 of the remaining 10 question, as committed.

The schedule for INTERIM response to Question 03.08.05-29 is revised to allow AREVA NP additional time to prepare the interim response. The final response date for Question 03.08.05-29 has not changed.

The schedule for technically correct and complete responses to the remaining 8 questions is unchanged and provided below:

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 27, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	August 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)

**Sent:** Thursday, July 29, 2010 7:56 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 7

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2

and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010 to provide an INTERIM response to question 03.08.05-24. AREVA NP submitted Supplement 6 on July 26, 2010, to provide a FINAL response to 3 of the remaining 13 question, as committed.

The attached file, "RAI 376 Supplement 7 FINAL Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the remaining 10 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 376 Questions 03.08.01-48 and 03.08.03-24.

The following table indicates the respective pages in the response document, RAI 376 Supplement 7 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376 — 03.08.01-48	2	3
RAI 376 — 03.08.03-24	4	8

The schedule for technically correct and complete responses to the remaining 8 questions is unchanged and provided below:

Question #	Interim Response Date	Response Date
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 9, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	August 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)  
**Sent:** Monday, July 26, 2010 4:00 PM  
**To:** 'Tesyfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 6

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted a revised schedule for the remaining 13 questions in Supplements 2 and 3 on June 8, 2010, and June 24, 2010, respectively. AREVA NP submitted Supplement 4 on July 13, 2010, to provide a revised schedule for question 03.08.05-30. AREVA NP submitted Supplement 5 on July 15, 2010, an INTERIM response to question 03.08.05-24.

The attached file, "RAI 376 Supplement 6 Response U.S. EPR DC.pdf" provides a technically correct and complete FINAL response to 3 of the remaining 13 questions, as committed. The schedule for the remaining 10 questions is unchanged.

The following table indicates the respective pages in the response document, "RAI 376 Supplement 6 Response U.S. EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376 — 03.08.01-47	2	3
RAI 376 — 03.08.03-21	4	5
RAI 376 — 03.08.03-22	6	7

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.01-48	N/A	July 29, 2010
RAI 376-03.08.03-24	N/A	July 29, 2010
RAI 376-03.08.05-24	July 15, 2010 (Actual)	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 9, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	August 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)  
**Sent:** Thursday, July 15, 2010 7:13 PM  
**To:** 'Tesyfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 5 - Interim



Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI No. 376 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on May 20, 2010 to address 1 of the remaining 14 questions. AREVA NP submitted Supplement 2 to the response on June 8, 2010, to change the schedule for responding to Question 03.08.05-30. AREVA NP submitted Supplement 3 to the response on June 24, 2010, to provide a changed schedule based upon the civil/structural re-planning activities and revised RAI response schedule presented to the NRC during the June 9, 2010, Public Meeting, and to allow time to interact with the NRC on the responses. AREVA NP submitted Supplement 4 on July 13, 2010 to provide a revised schedule for question 03.08.05-30. The attached file, "RAI 376 Question 03.08.05-24 Response - INTERIM.pdf" provides a technically correct and complete INTERIM response to 1 of the remaining 13 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 376 Question 03.08.05-24 Response - INTERIM.pdf," that contain AREVA NP's response to the subject questions.

<b>Question #</b>	<b>Start Page</b>	<b>End Page</b>
RAI 376 — 03.08.05-24	2	5

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

<b>Question #</b>	<b>Interim Response Date</b>	<b>Response Date</b>
RAI 376-03.08.01-47	N/A	August 17, 2010
RAI 376-03.08.01-48	N/A	July 29, 2010
RAI 376-03.08.03-21	N/A	July 26, 2010
RAI 376-03.08.03-22	N/A	July 26, 2010
RAI 376-03.08.03-24	N/A	July 29, 2010
RAI 376-03.08.05-24	July 15, 2010 <b>Actual</b>	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 9, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	August 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)  
**Sent:** Tuesday, July 13, 2010 6:08 PM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 4

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted Supplement 2 to the response on June 8, 2010, to provide a schedule for the remaining 13 questions, which were affected by the work underway to address NRC comments from the April 26, 2010, audit. AREVA NP submitted RAI No. 376 Supplement 3 on June 24, 2010, to reflect the revised RAI response schedule as a result of the civil/structural re-planning activities.

RAI 376 Supplement 4 revises the schedule for the response to Question 03.08.05-30 to allow time to interact with the NRC on the draft response. The schedule for the remaining 12 questions is unchanged.

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

Question #	Interim Response Date	Response Date
RAI 376-03.08.01-47	N/A	August 17, 2010
RAI 376-03.08.01-48	N/A	July 29, 2010
RAI 376-03.08.03-21	N/A	July 26, 2010
RAI 376-03.08.03-22	N/A	July 26, 2010
RAI 376-03.08.03-24	N/A	July 29, 2010
RAI 376-03.08.05-24	July 15, 2010	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 9, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	August 16, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)

**Sent:** Thursday, June 24, 2010 11:56 AM

**To:** 'Tesfaye, Getachew'

**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); RYAN Tom (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT); GARDNER George Darrell (AREVA NP INC)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions. AREVA NP submitted Supplement 2 to the response on June 8, 2010, to provide a schedule for the remaining 13 questions, which were affected by the work underway to address NRC comments from the April 26, 2010, audit.

Based upon the civil/structural re-planning activities and revised RAI response schedule presented to the NRC during the June 9, 2010, Public Meeting, and to allow time to interact with the NRC on the responses, the schedule has been changed. The schedule for 03.08.05-30 remains unchanged.

Prior to submittal of the final RAI response, AREVA NP will provide an interim RAI response that includes:

- (1) a description of the technical work (e.g., methodology)
- (2) U.S. EPR FSAR revised pages, as applicable

The revised schedule for an interim response and the technically correct and complete response to these questions is provided below.

Question #	Interim Response Date	Response Date
RAI 376-03.08.01-47	N/A	August 17, 2010
RAI 376-03.08.01-48	N/A	July 29, 2010
RAI 376-03.08.03-21	N/A	July 26, 2010
RAI 376-03.08.03-22	N/A	July 26, 2010
RAI 376-03.08.03-24	N/A	July 29, 2010
RAI 376-03.08.05-24	July 15, 2010	February 17, 2011
RAI 376-03.08.05-25	August 16, 2010	February 8, 2011
RAI 376-03.08.05-26	August 16, 2010	February 8, 2011
RAI 376-03.08.05-27	August 16, 2010	February 8, 2011
RAI 376-03.08.05-28	October 25, 2010	February 17, 2011
RAI 376-03.08.05-29	August 9, 2010	October 29, 2010
RAI 376-03.08.05-30	N/A	July 14, 2010
RAI 376-03.08.05-31	October 25, 2010	February 17, 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 (EXT)  
**Sent:** Tuesday, June 08, 2010 3:32 PM  
**To:** 'Tesyfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 376 on April 26, 2010. RAI 376 Supplement 1 provided a technically correct and complete response to 1 of 14 questions.

The schedule for the response to Question 03.08.05-30 has been changed. The final schedule for this question as well as the remaining questions below will be evaluated based on the information that will be presented at the June 9, 2010, public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 376-03.08.01-47	July 14, 2010
RAI 376-03.08.01-48	August 3, 2010
RAI 376-03.08.03-21	June 24, 2010
RAI 376-03.08.03-22	June 24, 2010
RAI 376-03.08.03-24	August 3, 2010
RAI 376-03.08.05-24	August 3, 2010
RAI 376-03.08.05-25	August 3, 2010
RAI 376-03.08.05-26	August 3, 2010
RAI 376-03.08.05-27	July 14, 2010
RAI 376-03.08.05-28	August 3, 2010
RAI 376-03.08.05-29	August 3, 2010
RAI 376-03.08.05-30	July 14, 2010
RAI 376-03.08.05-31	August 3, 2010

Sincerely,

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

**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, May 20, 2010 4:24 PM  
**To:** 'Tsfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI No. 376 on April 26, 2010. The attached file, "RAI 376 Supplement 1 Response US EPR DC.pdf," provides technically correct and complete responses to 1 of the remaining 14 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 376 Question 03.08.03-23.

The response to one question, 03.08.05-30, cannot be provided at this time due to its dependence on path-to-closure related work-planning currently being rescheduled and reviewed by the NRC.

The following table indicates the respective pages in the response document, "RAI 376 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376-03.08.03-23	2	2

A complete answer is not provided for 13 of the 14 questions. The schedule for a technically correct and complete response to these questions has been changed and is provided below.

Question #	Response Date
RAI 376-03.08.01-47	July 14, 2010
RAI 376-03.08.01-48	August 3, 2010
RAI 376-03.08.03-21	June 24, 2010
RAI 376-03.08.03-22	June 24, 2010
RAI 376-03.08.03-24	August 3, 2010
RAI 376-03.08.05-24	August 3, 2010
RAI 376-03.08.05-25	August 3, 2010
RAI 376-03.08.05-26	August 3, 2010
RAI 376-03.08.05-27	July 14, 2010
RAI 376-03.08.05-28	August 3, 2010
RAI 376-03.08.05-29	August 3, 2010
RAI 376-03.08.05-30	June 10, 2010
RAI 376-03.08.05-31	August 3, 2010

Sincerely,

Martin (Marty) C. Bryan  
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 Tel: (434) 832-3016  
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---

**From:** BRYAN Martin (EXT)  
**Sent:** Monday, April 26, 2010 12:49 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); RYAN Tom (AREVA NP INC); VAN NOY Mark (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376 (4355,4367,4377), FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 376 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 14 questions is not provided.

The following table indicates the respective pages in the response document, "RAI 376 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 376-03.08.01-47	2	2

RAI 376-03.08.01-48	3	4
RAI 376-03.08.03-21	5	6
RAI 376-03.08.03-22	7	7
RAI 376-03.08.03-23	8	8
RAI 376-03.08.03-24	9	10
RAI 376-03.08.05-24	11	12
RAI 376-03.08.05-25	13	13
RAI 376-03.08.05-26	14	14
RAI 376-03.08.05-27	15	16
RAI 376-03.08.05-28	17	19
RAI 376-03.08.05-29	20	20
RAI 376-03.08.05-30	21	21
RAI 376-03.08.05-31	22	22

A complete answer is not provided for 14 of the 14 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 376-03.08.01-47	July 14, 2010
RAI 376-03.08.01-48	August 3, 2010
RAI 376-03.08.03-21	June 24, 2010
RAI 376-03.08.03-22	June 24, 2010
RAI 376-03.08.03-23	May 20, 2010
RAI 376-03.08.03-24	August 3, 2010
RAI 376-03.08.05-24	August 3, 2010
RAI 376-03.08.05-25	August 3, 2010
RAI 376-03.08.05-26	August 3, 2010
RAI 376-03.08.05-27	July 14, 2010
RAI 376-03.08.05-28	August 3, 2010
RAI 376-03.08.05-29	August 3, 2010
RAI 376-03.08.05-30	May 20, 2010
RAI 376-03.08.05-31	August 3, 2010

Sincerely,  
Martin (Marty) C. Bryan  
U.S. EPR Design Certification Licensing Manager  
AREVA NP Inc.  
Tel: (434) 832-3016  
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---

**From:** Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]  
**Sent:** Thursday, March 25, 2010 2:13 PM  
**To:** ZZ-DL-A-USEPR-DL  
**Cc:** Xu, Jim; Hawkins, Kimberly; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource  
**Subject:** U.S. EPR Design Certification Application RAI No. 376 (4355,4367,4377), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on March 11, 2010, and on March 24, 2010, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. 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:** 2975

**Mail Envelope Properties** (1F1CC1BBDC66B842A46CAC03D6B1CD41045A4E1B)

**Subject:** Draft Revised Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Question 03.08.05-25  
**Sent Date:** 5/12/2011 4:38:21 PM  
**Received Date:** 5/12/2011 4:39:01 PM  
**From:** WELLS Russell (AREVA)

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

**Recipients:**

"Miernicki, Michael" <Michael.Miernicki@nrc.gov>

Tracking Status: None

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"Teschfaye, Getachew" <Getachew.Teschfaye@nrc.gov>

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<b>Files</b>	<b>Size</b>	<b>Date &amp; Time</b>	
MESSAGE	62692	5/12/2011 4:39:01 PM	
RAI 376 Questions 3.8.5-25 Response US EPR DC (DRAFT Rev. 2).pdf			2192432

**Options**

**Priority:** Standard

**Return Notification:** No

**Reply Requested:** No

**Sensitivity:** Normal

**Expiration Date:**

**Recipients Received:**



**Response to**

**Request for Additional Information No. 376  
Question 03.08.05-25 Revision 2**

**3/25/2010**

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

**AREVA NP Inc.**

**Docket No. 52-020**

**SRP Section: 03.08.01 - Concrete Containmentment**

**SRP Section: 03.08.03 - Concrete and Steel Internal Structures of Steel or Concrete  
Containments**

**SRP Section: 03.08.05 - Foundations**

**Application Section: 3.8**

**QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)**

**DRAFT**

**Question 03.08.05-25:****Follow-up to RAI 155, Question 03.08.05-5**

The response to this RAI provided additional information on the static FE model used to analyze and design the NI basemat foundation, and to determine the static bearing pressure on the supporting soils. The staff finds that further clarification is necessary on several issues, as discussed below. This clarification is necessary to determine if the foundation design meets the acceptance criteria in SRP 3.8.5.II.

1. The response to Item 1 of this RAI states that the Gazetas equation was developed for dynamic, not static, conditions. Provide additional technical justification on why the Gazetas equation is appropriate for use in the equivalent-static seismic analysis of the NI structures, for the design of the basemat foundation, and for the evaluation of soil bearing pressures. This technical justification should include a comparison with results obtained from the SSI analysis, for all soil types considered appropriate for foundation support.
2. The response to Item 2 of this RAI states that the simplified tri-linear soil spring stiffnesses are determined from the dynamic soil shear modulus. As indicated in the staff's evaluation of RAI 3.8.5-7, further clarification is required regarding the development and use of tri-linear springs in the analysis of the NI foundation basemat. The issues raised by Item 2 of this RAI response are evaluated under RAI 3.8.5-7.
3. The response to Item 3 of this RAI does not address the intent of the original RAI, which requests AREVA to discuss the issue of variability of soil conditions (i.e., stiff and soft spots in the foundation soil), and their effect in the design of the NI foundation basemat. The staff notes that FSAR Section 2.5.4.10.3 states that, "The design of the U.S. EPR is based on analyses that assume the underlying layers of soil and rock are horizontal with uniform properties. Furthermore, the U.S. EPR is designed for application at a site where the foundation conditions do not have extreme variation within the foundation footprints. However, the design does have margin that allows for adaptation to many sites that might be classified as non-uniform or having highly variable properties." From this statement, it follows that allowance for horizontal variability of soil conditions should be an important design consideration. The RAI response indicates that the softest soil case 1u bounds the design NI foundation basemat. It is not clear, however, if the design of the basemat has considered the potential effects of horizontal variability of soil conditions. Therefore, as requested in the original RAI, describe what studies were performed to evaluate the effects of different soil stiffnesses across the foundation footprint (e.g., higher soil stiffness in the central portion with lower soil stiffness beyond the center, and vice versa), or provide the technical basis for not doing such a study.

In addition, since the RAI response appears to indicate that the softest soil case 1u bounds the design NI foundation basemat, provide information on how bending and shear demands in the basemat will be modified for the case of stiffer foundation soils, and to confirm if the use of the soft soil cases bound the expected demands on the basemat.

**Response to Question 03.08.05-25:**

1. Gazetas' paper, "Foundation Vibrations," Foundation Engineering Handbook, 2nd Edition, H.Y. Fang, Ed., Van Nostrand Reinholds, Chapter 15, pp.553-593, 1991, forms the basis for

the calculation of the static foundation constants for the soil cases used for analyzing the Nuclear Island (NI) Basemat Structure, Emergency Power Generating Building (EPGB) and Essential Service Water Building (ESWB). Reference tables 15.1, 15.3, 15.4 and 15.5 of this paper provide the appropriate equations. For gravity loads and equivalent static loads, the Gazetas equation, using 50 percent of the dynamic shear modulus, was used for the soil springs. The full value was not used in the previous basemat model analysis.

The shear wave velocities in the U.S. EPR design are defined as strain compatible values used in the SASSI soil structure interaction (SSI) analysis. The shear wave velocities are associated with the shear strain level expected during the design seismic event.

Static foundation constants for the NI high frequency soil cases (h<sub>fub</sub>, h<sub>flb</sub> and h<sub>fbe</sub>) were determined using an elastic settlement analysis. The high frequency soil cases are based on the Bell Bend site-specific soil properties and profiles. The methodology models the NI structure with soil in a settlement computer code and the NI structure with springs in a structural analysis code. The displacements/spring values are iterated until two consecutive distributions show convergence. The convergence tolerance for displacements is 1 percent.

The static subgrade modulus is a function of the soil stiffness as well as the size and shape of the foundation and the loads imposed on the foundation. In general, the static spring constant is developed on the basis of field load tests, settlement analysis, or published data (e.g., NAVFAC D7.01 & 02, Bowles, Terzaghi). Site-specific information from plate load tests results is a characteristic value of subgrade modulus ( $k_1$ ) for the site soils. Presumptive values of  $k_1$  are available in the literature in terms of relative density for various cohesionless soils, and in terms of unconfined compressive strength for various cohesive soils. The published literature also provides relationships to modify  $k_1$  consistent with the dimensions of the foundation mat and the type of soils. The static subgrade modulus for a large foundation mat on cohesionless is 0.25 times  $k_1$  in accordance with "Evaluation of Coefficients of Subgrade Reaction," Geotechnique, Vol. 5, pp. 297 – 326, Karl Terzaghi.

The static shear modulus of a representative foundation continuum is expected to be approximately one-half of the dynamic (strain compatible) shear modulus. Because the EUR soil profiles are not characterized into types of soils, further refinement of this estimate is not practical. However, consistent with other requirements related to the foundation medium (e.g., minimum shear wave velocity, bearing capacity), the estimated static shear modulus associated with static loads, calculated using  $0.5G_d$ , is reasonable. The 0.5 factor is applied to  $G_d$  values as  $G_d$  varies throughout the depth for layered soil cases. The estimated values of the static shear modulus are used to develop foundation springs constants for structural analysis associated with static loads applied to the basemat model. The calculated values are used to determine the static bearing pressures.

The above methodology will be used for Seismic Category 1 structures.

Static bearing pressures for the NI basemat will be provided in the Response to RAI 376, Question 03.08.05-28. Static bearing pressures for the EPGB and ESWB will be provided in the Response to RAI 376, Question 03.08.05-31.

Foundation springs for the new basemat model analysis are developed based on the Gazetas and Wong-Luco methodologies. The full Gazetas value is used as the starting point for the seismic portion of the analysis. The springs are compared to equivalent springs

determined from the SASSI impedance data. Best fit results are incorporated into the analysis of the basemat model. The analysis is performed for three directions of seismic motions, and the results are compared to the SSI analysis results. The soil dynamic bearing pressures calculated from the SASSI analysis will be provided in the Response to RAI 376, Question 03.08.05-28 (NI) and Question 03.08.05-31 (EPGB and ESWB).

2. Tri-linear soil springs are no longer used for the design of the foundation basemat. See the Response to RAI 376, Question 03.08.05-27.
3. The design of the NI, EPGB, and ESWB foundations considers horizontal variability of the subgrade modulus for eight soil cases: five - EUR and three - high frequency. The foundation modulus and spring stiffness for each soil case varies from the center to the outer edges of the NI in an elliptical distribution. The high frequency soil cases are based on a site-specific rock site distribution where a foundation modulus is determined for each NI common basemat structure (i.e., Reactor Building, Safeguard Buildings, Fuel Building). For the elliptical distributions and the rock site distribution, the spring rate is less in the center and greater at the edges of the NI. U.S. EPR FSAR Tier 2, Table 3.8-13 and Figure 03.08.05-25-1 contain soil case definitions. NI soil case definitions are provided in Figure 3.8.5-25-1, and U.S. EPR FSAR Tier 2, Table 3.8-13. Soil case definitions for the EPGB are provided in Table 3.8.5-25-1. Table 3.8.5-25-1 will be added to the U.S. EPR FSAR. Soil case definitions for the ESWB will be provided in the Response to RAI 376, Question 03.08.05-31.

U.S. EPR FSAR Tier 2, Table 3.8-13 will be revised to reflect the current NI soil cases, and a new figure (Figure 3.8-145) will be added to show the soil spring distribution for the high frequency soil cases. U.S. EPR FSAR Tier 2, Section 3.8.5.4.2 will be revised to include the high frequency soil case spring distribution. U.S. EPR FSAR Tier 2, Sections 3.8.5.4.3 will be revised to provide the basis for the EPGB soil spring properties.

There are two aspects of horizontal variability to consider within each soil layer: the distribution of the foundation modulus and the physical properties of the soil. The distribution of the NI foundation modulus for each soil case is provided in U.S. EPR FSAR Tier 2, Table 3.8-13 and Figure 3.8.5-25-1. The soil physical properties are described in U.S. EPR FSAR Tier 2, Sections 2.5 and 3.7 and are assumed to be uniform within a soil layer.

The COL applicant is responsible for confirming the minimal horizontal variation in the site-specific soil properties with respect to the uniform soil properties. U.S. EPR FSAR Tier 2, COL Information Item 2.5-3 requires the COL applicant to confirm that the site-specific soil properties are enveloped by those used for the U.S. EPR design or perform reconciliation with the U.S. EPR design.

Previously, U.S. EPR FSAR Tier 2, Table 1.8-2 was modified to delete COL Information Item 2.5-11 and revise COL Information Item 2.5-10 to include a  $\pm 10$  percent criterion for determining lateral uniformity. In this response, COL Information Item 2.5-10 is revised to remove the  $\pm 10$  percent criterion and requirement for a geotechnical engineer to determine uniformity. The revised COL Information Item 2.5-10 states:

A COL applicant that references the U.S. EPR design certification will investigate and determine the uniformity of the soil layer(s) underlying the foundation basemats of Seismic Category I structures.

The U.S. EPR design assumes the foundation underlying layer of soil and rock is horizontal with uniform properties. The COL applicant will consider lateral uniformity as described in U.S. EPR FSAR Tier 2, Section 2.5.4.10.3. U.S. EPR FSAR Tier 2, Section 2.5.4.10.3 will be revised to clarify that the process for performing the site-specific evaluation will consider the sensitivity of the seismic and settlement analyses to the soil parameters. In addition, U.S. EPR FSAR Tier 2, Section 2.5.2.6 (Item 4) will be revised to clarify that the COL applicant must consider lateral uniformity when reconciling soil parameters.

Consideration of site-specific hard spots or soft spots in the U.S. EPR design is included in the reconciliation of settlement effects. In the Response to RAI 354, Question 3.8.5-22, COL Information Items 2.5-12, 3.8-18, 3.8-19, and 3.8-20 were added, and U.S. EPR FSAR Tier 2, Sections 2.5.4.10.2 and 3.8.5.4 were revised to require the COL applicant to perform a predictive settlement analysis and reconcile with the settlement profiles considered in the U.S. EPR design.

Soil case 1u is no longer considered in the U.S. EPR design. The soft soil case is represented by soil case 1n2ue and controls the design of the basemat in most areas. However, for the U.S. EPR design, each of the eight soil cases was considered in the analysis and critical section design.

**FSAR Impact:**

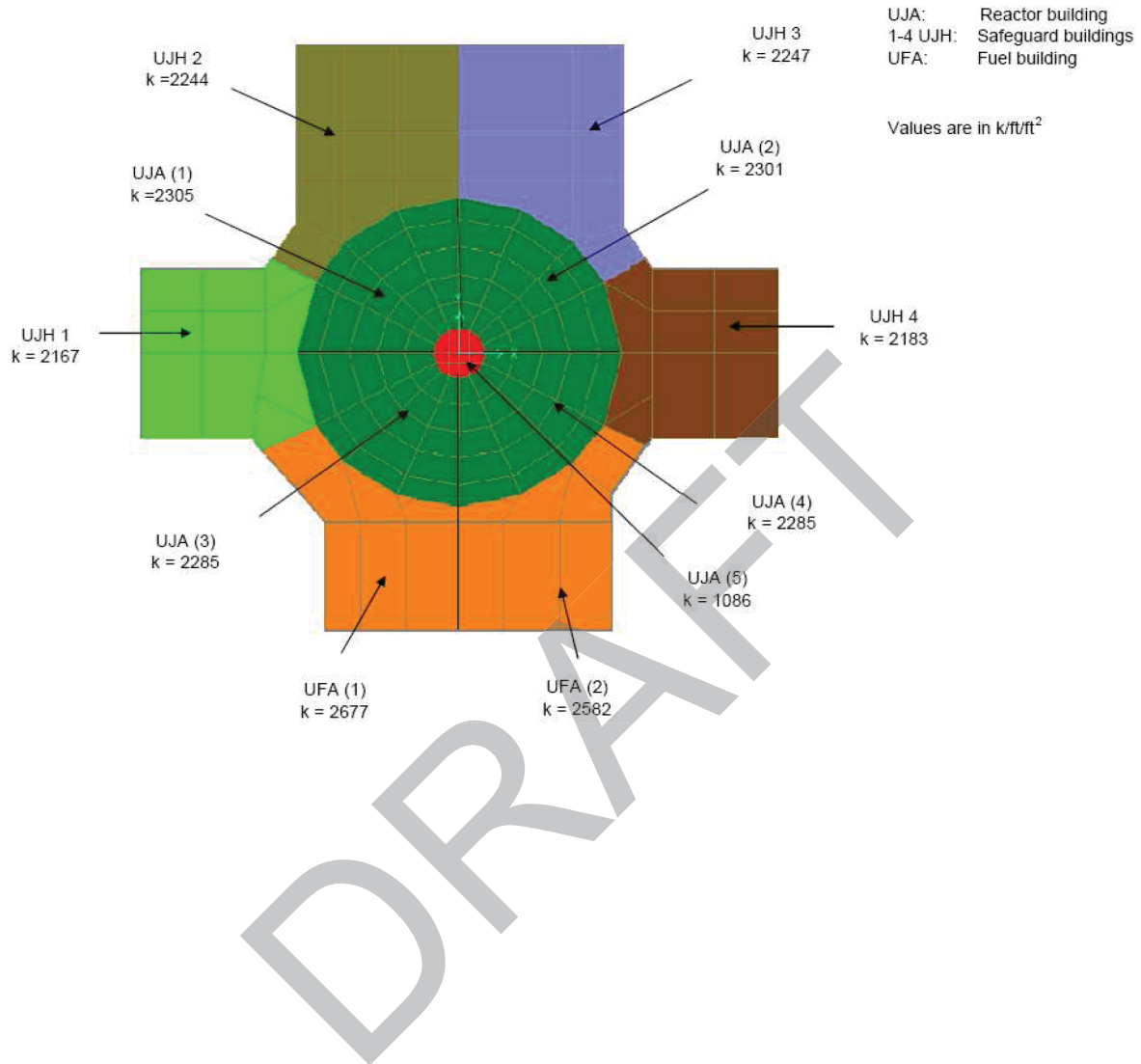
U.S. EPR FSAR Tier 2, Table 3.8-19 and Figure 3.8-145 will be added as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Table 1.8-2; Sections 2.5.2.6, 2.5.4.10.3, 3.8.5.4.2, and 3.8.5.4.3; and Table 3.8-13 will be revised as described in the response and indicated on the enclosed markup.

**Table 03.08.05-25-1—Static Foundation Modulus Values for EPGB Soil Cases**

Soil Case	K/ft <sup>3</sup>	Springs and Distribution	Min/Max Springs
		Distribution (b=l=88 ft)	
4ue	894	$K(x,y) = K_0 \left[ 5.69 - 4.94 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.75 K <sub>o</sub> , 2.29 K <sub>o</sub>
5ae	12175	$K(x,y) = K_0 \left[ 4.93 - 4.14 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.79 K <sub>o</sub> , 2.08 K <sub>o</sub>
1n5ae	3044	$K(x,y) = K_0 \left[ 5.31 - 4.54 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.77 K <sub>o</sub> , 2.18 K <sub>o</sub>
1n2ue	89	$K(x,y) = K_0 \left[ 5.27 - 4.49 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.78 K <sub>o</sub> , 2.18 K <sub>o</sub>
2sn4ue	359	$K(x,y) = K_0 \left[ 4.58 - 3.77 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.81 K <sub>o</sub> , 1.98 K <sub>o</sub>
34EPGB-UB	149	$K(x,y) = K_0 \left[ 4.83 - 4.03 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.8 K <sub>o</sub> , 2.05 K <sub>o</sub>
12ESWB-UB	370	$K(x,y) = K_0 \left[ 2.60 - 1.69 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	0.91 K <sub>o</sub> , 1.44 K <sub>o</sub>

**Figure 03.08.05-25-1—Foundation Modulus for High Frequency Soil Cases**



# U.S. EPR Final Safety Analysis Report Markups

DRAFT



**Table 1.8-2—U.S. EPR Combined License Information Items  
Sheet 7 of 40**

Item No.	Description	Section
2.5-9	A COL applicant that references the U.S. EPR design certification will reconcile the site-specific soil <u>and backfill</u> properties with those used for design of U.S. EPR Seismic Category I structures and foundations described in Section 3.8	2.5.4.2
2.5-10	<u>A COL applicant that references the U.S. EPR design certification will investigate and determine the uniformity of the soil layer(s) underlying the foundation basemats of Seismic Category I structures.</u>	2.5.4.10.3
<u>2.5-11</u>	<u>Deleted</u>	<u>Deleted</u>
<u>2.5-12</u>	<u>A COL applicant that references the U.S. EPR design certification will provide an assessment of predicted settlement values across the basemat of Seismic Category I structures during and post construction. The assessment will address both short term (elastic) and long term (heave and consolidation) settlement effects with the site-specific soil parameters, including the soil loading effects from adjacent structures.</u>	<u>2.5.4.10.2</u>
3.1-1	A COL applicant that references the U.S. EPR design certification will identify the site-specific QA Program Plan that demonstrates compliance with GDC-1.	3.1.1.1.1
3.2-1	A COL applicant that references the U.S. EPR design certification will identify the seismic classification of applicable site-specific SSC that are not identified in Table 3.2.2-1.	3.2.1
3.2-2	A COL applicant that references the U.S. EPR design certification will identify the quality group classification of site-specific <u>pressure-retaining components</u> that are not identified in Table 3.2.2-1.	3.2.2
3.3-1	A COL applicant that references the U.S. EPR design certification will determine site-specific wind and tornado characteristics and compare these to the standard plant criteria. If the site-specific wind and tornado characteristics are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.	3.3
3.3-2	A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for wind loads, will not affect the ability of other structures to perform their intended safety functions.	3.3.1

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Section 3.7.1.3 and Section 3.7.2.4.1 discuss that, for soil-structure interaction (SSI) analysis for the U.S. EPR design certification, the assumed ~~generic~~ shear wave velocities in each profile are taken to be strain-compatible values during seismic events.

Refer to Section 3.7.1 and Section 3.7.2 for additional description of soil-structure interaction analyses performed for the U.S. EPR. Liquefaction of soils and stability of slopes is addressed in Section 2.5.4.8 and Section 2.5.5, respectively.

#### 2.5.2.1 Seismicity

Seismicity is site specific and will be addressed by the COL applicant.

#### 2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

Geologic and tectonic characteristics are site specific and will be addressed by the COL applicant.

The guidance of RG 1.208 and RG 1.165 will be met, as appropriate, in performing the required studies to determine the SSE using probabilistic seismic hazard analyses.

#### 2.5.2.3 Correlation of Earthquake Activity with Seismic Sources

Correlation of earthquake activity with seismic sources is site specific and will be addressed by the COL applicant, consistent with the guidance of RG 1.208 and RG 1.165, as appropriate.

#### 2.5.2.4 Probabilistic Seismic Hazard Analysis and Controlling Earthquake

The probabilistic seismic hazard analysis is site specific and will be addressed by the COL applicant, consistent with the guidance of NUREG/CR-6372 (Reference 1), RG 1.165, and RG 1.208, as appropriate.

#### 2.5.2.5 Seismic Wave Transmission Characteristics of the Site

Seismic wave transmission characteristics are site specific and will be addressed by the COL applicant.

#### 2.5.2.6 Ground Motion Response Spectrum

A COL applicant that references the U.S. EPR design certification will compare the final site-specific soil characteristics with the U.S. EPR design ~~generic~~ soil parameters and verify that the site-specific seismic characteristics are enveloped by the CSDRS (~~anchored at 0.3g PGA~~) and the ~~10 generic~~ soil profiles discussed in Section 2.5.2 and Section 3.7.1 and summarized in Table 3.7.1-6. The applicant ~~will develop~~s site-specific ground motion response spectra (GMRS) and foundation input response spectra (FIRS). The FIRS shall be defined using the NEI approach (SHAKE outcrop) of

ISG-17. The applicant will also describe site-specific soil conditions and evaluate the acceptability of the U.S. EPR standard design described in Section 3.7.1 for the particular site. In making this comparison, the applicant will refer to Sections 3.7.1 and 3.7.2 for a description of the soil-structure interaction analyses performed for the U.S. EPR in addressing the following evaluation guidelines.

1. The applicant will confirm that the peak ground acceleration for the GMRS is less than the PGA for the CSDRS (0.3g or if high frequency content is present, 0.21g and 0.18g for the horizontal and vertical, respectively).
2. The applicant will confirm that the low-strain, best-estimate, value of shear wave velocity at the bottom of the foundation basemat of the NI Common Basemat Structures and other Seismic Category I structures is 1000 fps, or greater. This comparison will confirm that the NI Common Basemat Structures and other Seismic Category I structures are founded on competent material.
3. The applicant will demonstrate that the FIRS for the NI Common Basemat Structures is enveloped by the CSDRS. In addition, the applicant will demonstrate that the input motion, which considers the difference in elevation between each structure and the NI Common Basemat Structures, the embedment of the ESWB, and SSSI effect of the NI Common Basemat Structures is less than the modified CSDRS used for the design of the EPGB and the ESWB (see Section 3.7.1.1.1).
4. The applicant will demonstrate that the site specific profile is laterally uniform by confirming that individual layers with the profile have an angle of dip no greater than 20 degrees. The U.S. EPR analysis assumes the underlying layer of soil and rock are horizontal with uniform properties. The applicant will consider lateral uniformity of the site as described in Section 2.5.4.10.3.
5. The applicant will compare the final site-specific soil characteristics including backfill with the U.S. EPR design ~~generic~~ soil parameters and demonstrate that the idealized strain-compatible site soil profile is similar to or bounded by the ~~10-generic~~ soil profiles used for the U.S. EPR. The ~~10-generic~~ profiles include a range of uniform and layered site conditions. The applicant also considers the assumptions used in the SSI analyses including backfill, as described in Section 3.7.1 and Section 3.7.2. Site soil properties of soil columns beneath Category I structures must be bounded by design soil properties listed in Tables 3.7.1-6 and 3.7.2-9. The soil column beneath the embedded NI Common Basemat and the soil column, starting at grade, for the EPGB and ESWB must meet this requirement.
6. If the conditions of steps one through five are met, the characteristics of the site fall within the site parameters for the U.S. EPR and the site is acceptable.
7. If the conditions of steps one through five are not met, the applicant will demonstrate by other appropriate means that the U.S. EPR is acceptable at the proposed site. The applicant may perform intermediate-level additional studies to demonstrate that the particular site is bounded by the design of the U.S. EPR. An example of such studies is to show that the site-specific motion at top-of-basemat

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systems located on different basemats. The effects of total settlement and differential settlement ~~are~~ will be considered where these interfaces occur. As described in Section 3.8.4.1.8 and Section 3.8.4.1.9, the design of safety-related buried conduits and piping is site-specific. These features will be designed for site-specific values of total settlement and differential settlement expected at the interface with the foundation basemat after connections are made. Alternatively, site-specific structural features such as tunnels may be used to limit the imposition of differential settlement.

A COL applicant that references the U.S. EPR design certification will provide an assessment of predicted settlement values across the basemat of Seismic Category I structures during and post construction. The assessment will address both short term (elastic) and long term (heave and consolidation) settlement effects with the site-specific soil parameters, including the soil loading effects from adjacent structures.

Site-specific considerations for the predicted short and long term effects of settlement will be taken into account. Site-specific considerations include the effects of dewatering, excavation, foundation material preparation, umbilical connections, sequence of placement of the basemat, and site-specific construction sequence of the superstructure.

A COL applicant that references the U.S. EPR design certification will verify that the predicted differential ~~tilt~~ settlement value of ½ inch per 50 feet in any direction across the foundation basemat of a Seismic Category I structure is not exceeded. Settlement values larger than this may be demonstrated acceptable by performing additional site-specific evaluations.

Tilt settlement of the building is controlled to 1/2 inch in 50 ft such that equipment can be installed and operated as designed.

Section 3.8.5.4 addresses the analyses performed for settlement loading on the Seismic Category I structures. Section 3.8.5.5 addresses the acceptance criteria for settlement on Seismic Category I structures. Section 3.8.5.7 addresses settlement monitoring.

### 2.5.4.10.3 Uniformity and Variability of Foundation Support Media

The U.S.EPR design considers a broad range of subsurface conditions, and the effects of these various conditions were evaluated by an extensive series of SSI analyses which addressed subsurface stratigraphy, depth-to-bedrock, shear wave velocity, and its variation with depth. While the U.S. EPR design is intended to cover a broad range of soil conditions, it is recognized that it is impractical to address all possible subsurface variations. For this reason site specific subsurface conditions will be evaluated for applicability to the U.S. EPR.

The design of the U.S. EPR is based on analyses that assume the underlying layers of soil and rock are horizontal with uniform properties. Furthermore, the U.S. EPR is

designed for application at a site where the foundation conditions do not have extreme variation within the foundation footprints. However, the design does have margin that allows for adaptation to many sites that might be classified as non-uniform or having highly variable properties.

~~A COL applicant that references the U.S. EPR design certification will investigate and determine the uniformity of the underlying layers of site specific soil conditions beneath the foundation basemats. The classification of uniformity or non-uniformity will be established by a geotechnical engineer.~~ A COL applicant that references the U.S. EPR design certification will investigate and determine the uniformity of the soil layer(s) underlying the foundation basemats of Seismic Category I structures.

Soil structure interaction analysis, settlement analysis, and bearing ~~capacity~~pressure analysis for the U.S. EPR assume that the soil layers are horizontal and effects of non-horizontal layering are ignored. However, the layers of soil and rock beneath a specific site may dip with respect to the horizontal. If the dip is less than or equal to 20 degrees, the layer is defined as horizontal and analyses using horizontal layers are applicable, as described in NUREG/CR-0693 (Reference 4).

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Guidance for performing a site-specific evaluation of uniformity for soil profiles under the Seismic Category I structures is provided below. Alternate site-specific methodologies may be used with appropriate technical justification.

Uniformity within the layer may be checked by determining from the boring logs a series of “best-estimate” planes beneath the foundation footprint that define the top (and bottom) of each layer. Depending on specific site conditions, the planes can be based on stratigraphy, lithology, unconformities, intrusives, weathering, other

geologic/geotechnical properties or characteristics or combinations of the above. The site-specific evaluation will take into account the sensitivity of the seismic and settlement analysis to the soil parameters. Uniformity and best estimate shear wave

velocity within the layer will be established for all layers to a minimum depth of approximately 1.5 times an equivalent radius or no more than 1.0 times the maximum foundation basemat dimension. Typically this will be no less than 200 feet below the bottom of the foundation basemat. If the site can be classified as laterally uniform, it is satisfactory for the U.S. EPR based on analyses and evaluations performed to support design certification, provided that additional site-specific analyses are not required to consider differences in analytical modeling assumptions between the U.S. EPR design and those appropriate to the specific site.

If the site is found to have a dip angle greater than 20 degrees, or the site is found to have non-uniform soil conditions within a profile, site-specific analysis will be performed. This site-specific analysis may involve soil structure interaction analysis and/or an analysis that demonstrates that the foundation basemat stresses resulting from the variation of subgrade modulus or shear wave velocity across the footprint are

A differential settlement evaluation is performed for the Seismic Category I structures considering both short term (elastic) and long term (heave and consolidation) effects. The effects of differential foundation settlements are applied concurrently with the dead load using the same load factors. The U.S. EPR design requires separate Seismic Category I structures to be connected by site-specific designed Seismic Category I umbilicals (i.e., ductbank, embedded piping, and/or structural galleries containing piping, cable tray, and/or ductwork). The effects of site-specific differential settlement between the individual U.S. EPR Seismic Category I structures and the site-specific Seismic Category I umbilicals will be considered in the design of the connections and the construction sequence. ~~Also, the effects of varying settlements between adjacent foundations are considered for the design of mechanical and electrical systems (e.g., piping, cables) that are routed between structures founded on separate basemats.~~ See Section 3.8.4.4.5 for analysis and design procedures for Seismic Category I buried items that interface with structures on separate foundations.

#### 3.8.5.4.2 Nuclear Island Common Basemat Structure Foundation Basemat

The NI Common Basemat Structure foundation basemat is analyzed and designed using the ANSYS V10.0 SP1 finite element overall computer model (a static model) for NI Common Basemat Structure Seismic Category I structures, which is described in Section 3.8.1.4.1. The NI Common Basemat Structure model includes the RCB, RB internal structures, RSB, FB, and SBs, as well as the NI Common Basemat Structure foundation basemat. This model is also used to determine the static bearing pressure on the supporting soils. The dynamic model is used to determine dynamic soil bearing pressures as well as sliding and overturning factors of safety.

ANSYS SOLID45 solid elements are used to model the concrete basemat foundation in the NI Common Basemat Structure static analysis. SOLID45 is a three-dimensional, eight-node element that is suitable for moderately thick structures. Depending on the thickness of the basemat, between three to five layers of SOLID45 elements are used in the model, with an average of four elements in the typical 10 feet thick basemat areas. Figure 3.8-103—Nuclear Island Common Basemat Structure Foundation Basemat ANSYS Model illustrates the model used for design of the basemat.

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Springs are used to represent soil that provides support for the concrete foundation basemat in the ANSYS model. These springs represent the compressibility of the soil and were developed to reflect the pressure distribution under the NI Common

Basemat Structure. Springs values vary for ~~each soil case based on the soil properties and the spring location under the modeled foundation~~ each soil case and are based on the soil properties delineated in Section 2.5 and Table 3.7.1-6. The distribution used is elliptical in nature and takes the form of:

$$K(x,y) = K_o[A - B*(1 - x^2/2l^2 - y^2/2b^2)^{1/2}]$$

where:

$K(x, y)$  is the subgrade modulus at  $x, y$  corrected for mat stiffness (pounds/ft<sup>2</sup> per foot)

$K_o$  is the weighted average subgrade modulus (pounds/ft<sup>2</sup> per foot)

A & B are constants for a soil type based on its properties, bearing pressure distribution and shape of the foundation.

$x$  = is the coordinate in the length direction of the Foundation Mat (feet)

$y$  = is the coordinate in the width direction of the Foundation Mat (feet)

$b$  = half width of foundation

$l$  = half length of foundation.

The Gazetas equation (Reference 57) was used to evaluate the total soil spring ( $K_o$ ) for the design of the foundation basemat of the NI Common Basemat Structure. Although Gazetas addresses the dynamic stiffness of the foundation basemat, the use of one-half the dynamic shear modulus in the equation approximates the total stiffness of the supporting soil medium under static conditions. Table 3.8-13—Static Spring Distribution provides the distribution equations and  $K_o$  values for each soil case.

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The high frequency soil case (i.e., hfub, hfbe and hflb) static distributions are based on a site-specific rock site distribution where a foundation modulus is determined for each NI common basemat structure (see Figure 3.8-145).

Soil stiffness springs are modeled through the use of contact elements applied to the base of the NI Common Basemat Structure. These elements do not allow tension force transfer between the soil and the foundation. Sliding is not modeled in the static analysis. Figure 3.8-106—Elastic Displacement for Soil Case 1u, Figure 3.8-107—Elastic Displacement for Soil Case 2u, Figure 3.8-108—Elastic Displacement for Soil Case 1n2u, Figure 3.8-109—Elastic Displacement for Soil Case 3u, Figure 3.8-110—Elastic Displacement for Soil Case 4u, Figure 3.8-111—Elastic Displacement for Soil Case 5a, Figure 3.8-112—Elastic Displacement for Soil Case 5u, Figure 3.8-113—Elastic Displacement for Soil Case 2sn4u, Figure 3.8-114—Elastic Displacement for Soil Case 2n3u, and Figure 3.8-115—Elastic Displacement for Soil Case 3r3u illustrate elastic displacements, from loading, and dead load + 0.25\* live load + equipment load using the springs listed in Table 3.8-13.

~~Tri-linear soil springs are developed for design of the foundation basemat for soil cases 4u and 2sn4u, as defined in Section 3.7.1, in order to mitigate unrealistic analysis results generated by the NI Common Basemat Structure static model. Seismic forces were conservatively applied using maximum ZPA accelerations from the soil~~

Following this same approach, an enveloping differential load file is created for each soil case and added to the elastic soil spring analysis results in the load combinations with a dead load (i.e., the load factor used corresponds to the dead load factor).

The basemat design includes symmetrical main reinforcing steel in each direction and on each face to control development of any large cracks in the basemat.

Relative differential settlement contours are developed for each construction step using the second set of soil springs. The contours are relative to the minimum settlement value determined under the NI common basemat structure, and are shown in Figure 3.8-124 through Figure 3.8-134.

Detailed analysis and design procedures are described in the critical sections presented in Appendix 3E.

Section 3.8.3 provides a description of analysis and design of the RB internal structures basemat, which is located above the containment liner plate.

#### 3.8.5.4.3 Emergency Power Generating Buildings Foundation Basemats

Horizontal shear loads are transferred from the EPGB foundation basemat to the underlying soil by friction between the bottom of the basemat, mud mat, and the soil, and by passive earth pressure.

The EPGB foundation basemat is analyzed and designed using the GT STRUDL v.29.1 finite element analysis code. The finite element model contains both the building superstructure (i.e., reinforced concrete walls and elevated slabs) as well as the foundation basemat. Analysis of the EPGB includes all applicable design loads and design load combinations described in Section 3.8.4.3. Figure 3.8-104—Emergency Power Generating Building Foundation Basemat Model illustrates the foundation basemat portion of the overall EPGB finite element model.

The GT STRUDL finite element model representing the EPGB foundation basemat consists of SBHQ6 rectangular elements, each with six degrees of freedom. This element type is capable of capturing both in-plane and out-of-plane behavior. Elastic boundary conditions are included in the finite element model in order to simulate the stiffness of the supporting soil. Basemat flexibility and SSI are addressed by inclusion of the basemat section properties and aforementioned soil spring boundary conditions in the finite element model.

The foundation basemat is included in the overall GT STRUDL finite element model used for static analysis of the foundation basemat, along with compression-only soil springs representing static soil stiffness properties ~~of soft, medium and hard soils~~ in

Table 3.8-19. Soil spring development and distribution methodologies are the same as those used for the NI soil cases and are described in Section 3.8.5.4.2. Compression-

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Table 3.8-13—Static Spring Distribution

Label	Soil Case	Recommended Springs and Distribution		Min/Max Spring
		K <sub>o</sub> (k/ft <sup>3</sup> )	Distribution (b = l = ~52.4m)	
<del>Ce</del>	<del>1u</del>	<del>11.2</del>	<del><math>K(x,y)=K_o [4.07 - 3.50*\sqrt{1-x^2/2l^2-y^2/2b^2}]</math></del>	<del>0.57 K<sub>o</sub>, 1.99 K<sub>o</sub></del>
<del>F</del>	<del>2u</del>	<del>62.0</del>	<del><math>K(x,y)=K_o [3.74 - 3.12*\sqrt{1-x^2/2l^2-y^2/2b^2}]</math></del>	<del>0.62 K<sub>o</sub>, 1.88 K<sub>o</sub></del>
I	1n2ue	55.8	$K(x,y)=K_o [3.74 - 3.12*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.62 K <sub>o</sub> , 1.88 K <sub>o</sub>
<del>Jj</del>	<del>3u</del>	<del>166</del>	<del><math>K(x,y)=K_o [3.41 - 2.74*\sqrt{1-x^2/2l^2-y^2/2b^2}]</math></del>	<del>0.67 K<sub>o</sub>, 1.78 K<sub>o</sub></del>
K	4ue	390	$K(x,y)=K_o [3.12 - 2.42*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.70 K <sub>o</sub> , 1.68 K <sub>o</sub>
L	5ae	5190	$K(x,y)=K_o [2.01 - 1.15*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.86 K <sub>o</sub> , 1.33 K <sub>o</sub>
<del>Ll</del>	<del>5u</del>	<del>721</del>	<del><math>K(x,y)=K_o [2.58 - 1.80*\sqrt{1-x^2/2l^2-y^2/2b^2}]</math></del>	<del>0.78 K<sub>o</sub>, 1.51 K<sub>o</sub></del>
N	2sn4ue	260	$K(x,y)=K_o [3.33 - 2.65*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.68 K <sub>o</sub> , 1.75 K <sub>o</sub>
<del>O</del>	<del>2n3u</del>	<del>166</del>	<del><math>K(x,y)=K_o [3.46 - 2.80*\sqrt{1-x^2/2l^2-y^2/2b^2}]</math></del>	<del>0.66 K<sub>o</sub>, 1.79 K<sub>o</sub></del>
P	3r3u	194	$K(x,y)=K_o [3.41 - 2.75*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.66 K <sub>o</sub> , 1.77 K <sub>o</sub>
	1n5ae	5190	$K(x,y)=K_o [2.01 - 1.15*\sqrt{1-x^2/2l^2-y^2/2b^2}]$	0.86 K <sub>o</sub> , 1.33 K <sub>o</sub>

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**Table 3.8-19—Static Foundation Modulus Values for EPGB Soil Cases**

<u>Soil Case</u>	<u>K/ft<sup>3</sup></u>	<u>Springs and Distribution</u>	<u>Min/Max Springs</u>
		<u>Distribution (b=l=88 ft)</u>	
<u>4ue</u>	<u>894</u>	$K(x,y) = K_0 \left[ 5.69 - 4.94 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.75 K<sub>0</sub>, 2.29 K<sub>0</sub></u>
<u>5ae</u>	<u>12175</u>	$K(x,y) = K_0 \left[ 4.93 - 4.14 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.79 K<sub>0</sub>, 2.08 K<sub>0</sub></u>
<u>1n5ae</u>	<u>3044</u>	$K(x,y) = K_0 \left[ 5.31 - 4.54 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.77 K<sub>0</sub>, 2.18 K<sub>0</sub></u>
<u>1n2ue</u>	<u>89</u>	$K(x,y) = K_0 \left[ 5.27 - 4.49 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.78 K<sub>0</sub>, 2.18 K<sub>0</sub></u>
<u>2sn4ue</u>	<u>359</u>	$K(x,y) = K_0 \left[ 4.58 - 3.77 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.81 K<sub>0</sub>, 1.98 K<sub>0</sub></u>
<u>34EPGB-UB</u>	<u>149</u>	$K(x,y) = K_0 \left[ 4.83 - 4.03 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.8 K<sub>0</sub>, 2.05 K<sub>0</sub></u>
<u>12EPGB-UB</u>	<u>370</u>	$K(x,y) = K_0 \left[ 2.60 - 1.69 \sqrt{1 - \frac{x^2}{2l^2} - \frac{y^2}{2b^2}} \right]$	<u>0.91 K<sub>0</sub>, 1.44 K<sub>0</sub></u>