

## ArevaEPRDCPEm Resource

---

**From:** BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]  
**Sent:** Monday, August 16, 2010 12:34 PM  
**To:** Tesfaye, Getachew  
**Cc:** DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); CORNELL Veronica (EXTERNAL AREVA)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 9  
**Attachments:** RAI 376 Supplement 9 Response US EPR DC - INTERIM.pdf

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:** 'Tefsaye, 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.

<b>Question #</b>	<b>Start Page</b>	<b>End Page</b>
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:

<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 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:** 'Tefsaye, 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

---

**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, July 15, 2010 7:13 PM  
**To:** 'Tesfaye, 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.

Question #	Start Page	End Page
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:

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 <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)

---

**From:** BRYAN Martin (EXT)  
**Sent:** Tuesday, July 13, 2010 6:08 PM  
**To:** 'Tefsaye, 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.

<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	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:** 'Tesfaye, 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  
702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

---

**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, May 20, 2010 4:24 PM  
**To:** 'Tesfaye, 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  
 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, April 26, 2010 12:49 PM  
**To:** 'Tefsaye, 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.

<b>Question #</b>	<b>Start Page</b>	<b>End Page</b>
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.

<b>Question #</b>	<b>Response Date</b>
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  
 702 561-3528 cell  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

**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:** 1843

**Mail Envelope Properties** (BC417D9255991046A37DD56CF597DB7107359183)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 376, FSAR Ch. 3, Supplement 9  
**Sent Date:** 8/16/2010 12:33:41 PM  
**Received Date:** 8/16/2010 12:33:45 PM  
**From:** BRYAN Martin (EXTERNAL AREVA)

**Created By:** Martin.Bryan.ext@areva.com

**Recipients:**

"DELANO Karen (AREVA)" <Karen.Delano@areva.com>

Tracking Status: None

"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>

Tracking Status: None

"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>

Tracking Status: None

"CORNELL Veronica (EXTERNAL AREVA)" <Veronica.Cornell.ext@areva.com>

Tracking Status: None

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

Tracking Status: None

**Post Office:** AUSLYNCMX02.adom.ad.corp

<b>Files</b>	<b>Size</b>	<b>Date &amp; Time</b>
MESSAGE	25503	8/16/2010 12:33:45 PM
RAI 376 Supplement 9 Response US EPR DC - INTERIM.pdf		60578

**Options**

**Priority:** Standard

**Return Notification:** No

**Reply Requested:** No

**Sensitivity:** Normal

**Expiration Date:**

**Recipients Received:**

**Response to**

**Request for Additional Information No. 376 Supplement 9**

**3/25/2010**

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

**AREVA NP Inc.**

**Docket No. 52-020**

**SRP Section: 03.08.01 - Concrete Containment**

**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)**

**Question 03.08.05-26:****Follow-up to RAI 155, Question 03.08.05-6**

The response to Item 2 of this RAI indicates that: "The Gazetas equation was used because it is more suitable for the assumed inhomogeneous subsurface conditions, and because it yields similar results as the Wong-Luco methodology."

The staff finds that the RAI response does not provide sufficient technical justification for the use of the Gazetas equation. As noted in the staff's evaluation of RAI 3.8.5-5 Item 1, the Gazetas equation was developed for dynamic, not static, conditions. To complete the response to this RAI, 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, and an explanation of why the Gazetas equation is "more suitable for the assumed inhomogeneous subsurface conditions." This information may be included in the supplemental response to RAI 3.8.5-5 Item 1.

**Response to Question 03.08.05-26:**

The statement quoted from the Response to RAI 155, Question 03.08.05-6 was meant to read:

"The Gazetas equation was used because it is more suitable for the assumed layered soil profiles described in U.S EPR FSAR, Tier 2, Section 3.7.1.3 and shown in Table 3.7.1-6."

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 used for analysis of the Nuclear Island (NI) Basemat Structure. The Gazetas' paper delineates methods to establish dynamic properties for foundation design by establishing static properties for the soil supporting the foundation. The calculated springs used in static analysis include the application of equivalent static seismic load. As additional justification, foundation springs will be developed from the soil-structure interaction (SSI) analysis and applied to the static model. This model will be analyzed for three directions of seismic motion, and the foundation/subbase interface will be linear. All design soil cases will be included. Resulting mat design forces and bearing pressures will be compared and justified. A comparison will be made to the SSI analysis results. Adjusted modulus values will be derived and used in the basemat model analysis, where required.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

**Question 03.08.05-27:****Follow-up to RAI 155, Question 03.08.05-7**

The response to this RAI provided additional information regarding the development and use of tri-linear springs in the analysis of the NI basemat foundation. 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 requires further clarification on the following issues: (a) provide information to demonstrate that the behavior of soils beneath and near the edge of a foundation can be represented by modulus reduction curves, presumably associated with simple one-dimensional site response analyses; (b) if the soil to the side of an embedded foundation is confined, provide information on why the tri-linear model with strain softening is appropriate for such an application, and that strain-stiffening does not occur; and (c) provide a basis for judging when a particular calculation yields "unrealistic" results. With regard to (c), explain why Figure 03.08.05-7.1-1 is compared to Figure 03.08.05-7.1-2 when, in both cases, the maximum values shown are relatively close. The staff notes that, unless these issues are clarified, the use of tri-linear springs with strain softening does not appear to be technically appropriate, and may underestimate soil bearing pressures or foundation stresses.
2. The response to Item 2 of this RAI indicates that non-linear (strain-softening) springs are specifically used for examination of maximum bearing pressures due to seismic overturning moments, and the sliding factor of safety. This appears to contradict FSAR Section 3.8.5.4.2, which states: "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. (...) This model is also used to determine the static pressure on the supporting soils. (...) Springs are used to represent soil that provides support for the concrete foundation basemat in the ANSYS model. (...) Tri-linear soil springs are developed for soil cases 4u and 2sn4u. (...) A second model was developed to evaluate the soil bearing pressures, sliding and overturning due to seismic events. This (second) model explicitly represents the nonlinearities of sliding and uplift, the transient nature of the seismic loadings, the properties of the soils, and the dynamic characteristics of the structure. (...) (In the second model) Soil is modeled with one layer of solid elements beneath the shells, representing the basemat." Explain which FE model was used to assess maximum bearing pressures due to seismic overturning moments, and sliding factor of safety. The staff notes that the "second model" is being evaluated under RAI 3.8.5-8.

In addition, the RAI response requires further clarification on the following issues: (a) provide the technical basis for stating that soil cases 1u, 4u and 2sn4u, previously defined as soft to medium soil sites with shear wave velocity properties selected for SSI analyses, are in fact classified as clay soils having hysteretic damping and static stress-strain properties appropriate for soils with a plasticity index (PI) greater than 50, as indicated in FSAR Section 3.8.5.4.2 and in the response to Items 3 and 4 of this RAI; (b) explain if sites with granular soils and shear wave velocity properties matching those of soil cases 1u, 4u or 2sn4u are excluded from the U.S. EPR design; (c) provide the technical basis for stating that tri-linear static and dynamic spring stiffness for soil cases 1u, 4u and 2sn4u represent bounding cases for clay soils or, more generally, for assuming that these non-linear

analyses yield bounding seismic responses for all soil types considered appropriate for foundation support. As indicated in Item 1 above, unless these issues are clarified, the use of tri-linear springs with strain softening does not appear to be technically appropriate, and may underestimate soil bearing pressures or foundation stresses.

3. The response to Item 3 of this RAI states that tri-linear springs are based on shear strain curves used in calculating dynamic spring constants for soil cases 4u and 2sn4u. It adds that these soils are assumed to be comprised of stiff clays having a PI of 60. However, the staff notes that soils having a PI of 50 or greater are typically labeled as fat clays, which may not be appropriate for foundation support of a NPP unless they are found in a highly pre-consolidated state. In that case, the clays would be expected to be stiff rather than soft. Provide additional information to justify why the characteristics of such soils can be considered appropriate for NPP applications.
4. The response to Item 4 of this RAI requires further information to explain why the tri-linear properties selected for these high PI soils are not so soft as to be unacceptable for use in a foundation of a NPP. Additional information in this regard is requested under Item 2 above.
5. The response to Item 5 of this RAI requires additional information to explain how the vertical displacement scale of Figure 03.08.05-7.5-1 was developed, as well as how the properties shown in the Figure relate to the S-wave and P-wave properties used to represent soil cases 4u or 2sn4u in SSI analyses. As indicated in Item 1 above, unless this issue is clarified, the use of tri-linear springs with strain softening does not appear to be technically appropriate, and may underestimate soil bearing pressures or foundation stresses.

**Response to Question 03.08.05-27:**

1. Tri-linear soil springs are no longer used for the design of the foundation basemat for soil cases 4u and 2sn4u. Tri-linear soil springs will be removed from U.S. EPR FSAR Tier 2, Section 3.8.5.4.2. U.S. EPR FSAR Tier 2, Table 3.8-14 that support the tri-linear soil springs discussion presented in Section 3.8.5.4.2 will also be deleted.
  - a. See response to Item 1 of this response.
  - b. See response to Item 1 of this response.
  - c. See response to Item 1 of this response. The comparison between U.S. EPR FSAR Tier 2, Figures 03.08.05-7.1-1 and 03.08.05-7.1-2 or the basis used to determine that the linear-elastic analysis yielded “unrealistic results” is no longer applicable.
2. See response to Item 1 above. The non-linear (strain-softening) springs mentioned in the response to RAI 155, Question 03.08.05-7, Item 2 will no longer be used in U.S. EPR analyses. As stated in U.S. EPR FSAR Tier 2, Section 3.8.5.4.2, the dynamic model is used to determine the dynamic soil bearing pressures as well as the sliding and overturning factors of safety.
  - a. In the Response to RAI 155 Question 03.08.05-07, soil cases 4u and 2sn4u with tri-linear soil springs and soil case 1u were described as representing clays with a plasticity index greater than 50..

- b. Sites with granular soils and shear wave velocity properties matching those of soil cases 1u, 4u, or 2sn4u are included in the U.S. EPR design.
  - c. Tri-linear soil springs are not used with soil case 1u. Soil case 1u is not specific to clay soil types, but is representative of soft soils, including clay soils. Soil case 1u is included to obtain large displacement results representative of soft soil types.
3. As discussed in Item 2.a of this response, soil cases 4u and 2sn4u were described as stiff clays when discussing the use of tri-linear soil springs. Tri-linear soil springs will no longer be used as described in Item 1.a of this response. Soil cases 4u and 2sn4u are suitable as shown in U.S. EPR FSAR Tier 2, Table 3.7.1-6, and are considered in the U.S EPR design certification.
4. See Item 3 of this response.
5. See Item 1 of this response. . U.S. EPR FSAR Tier 2, Figure 03.08.05-7.5-1 is no longer applicable.

Figures 3.8-110 and 3.8-113 will be revised to show results with revised soil spring stiffness values for soil cases 4u and 2sn4u in the final response to this RAI question.

**FSAR Impact:**

U.S. EPR FSAR, Tier 2, Section 3.8.5.4.2 and Table 3.8-14 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

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.

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.

03.08.05-27

~~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 structural interaction (SSI) analysis for points throughout the structure. These accelerations are applied to the building masses simultaneously, without consideration of timing. This methodology results in conservative sets of seismic forces, in some cases base shears are 20 percent to 55 percent larger than those calculated by the SSI analysis, applied to the structure. When these conservatively high forces are applied to soils represented by stiff springs the resulting overturning moment is exaggerated and skews the analysis results. The introduction of tri-linear springs to the model mitigates the exaggerated response.~~

03.08.05-27

Tri-linear springs development uses the linear development as the starting point. The subsurface soil is assumed to be relatively high plasticity clay. Based on the modulus degradation for clays with plasticity index in the range 50 to 70, a relationship is developed between displacement of the foundation basemat and the corresponding average reaction imposed by the underlying soil medium on the foundation basemat. Using an incremental approach, the methodology calculates the reaction at the base of the foundation basemat for a small increment of basemat displacement, using the appropriate soil spring associated with the shear modulus at this step. In the next incremental step, the solution is advanced using a reduced shear modulus consistent with the shear strain at a representative depth associated with the soil reaction from the previous step. For the two aforementioned soil cases (4u and 2sn4u) the resultant bearing pressure versus subgrade modulus values are provided in Table 3.8-14—Tri-Linear Subgrade Modulus vs. Bearing PressuresTable Deleted.

The results of the soil spring analyses are used in determining forces and moments in the basemat for concrete design and for determining the acceptability of the supporting soil media under static loading conditions.

A FEM model for SSI analysis of the embedded portions of the NI common basemat was used to evaluate the soil bearing pressures, sliding and overturning due to seismic events. This model explicitly represents the transient nature of the seismic loadings, the properties of the soils, and the dynamic characteristics of the structure. This approach produces a more realistic picture of the NI Common Basemat Structure response to seismic loadings than is possible using the static model alone.

The NI Common Basemat Structure superstructure is modeled using lumped parameter systems identical to those used for the soil-structure interaction analysis. The masses, stiffnesses, and eccentricities of the buildings are mathematically computed, and spatially arranged to represent the dynamic characteristics of the NI Common Basemat structures.

The model is excited by simultaneous application of three EUR seismic transients (CSDRS) to the base of the foundation basemat for soil cases 2sn4u, 4u, and 5a representing soft, medium and hard soils. Transients are applied, one each, in the three principal building directions. The weight of the building, including the water in the in-containment refueling water storage tank (IRWST), fuel pool, and the four emergency feedwater storage tanks (because this water is always present within the NI Common Basemat Structure), and full buoyancy are the other loadings included in this analysis.

Section 3.8.1, Section 3.8.3, and Section 3.8.4 provide descriptions of interfacing structures that induce loads on the NI Common Basemat Structure foundation basemat. The figures in those sections illustrate the concrete shear walls and columns that transfer loads to the NI Common Basemat Structure foundation basemat. The

**Table 3.8-14—~~Tri-Linear Subgrade Modulus vs. Bearing Pressures~~ Table Deleted**

<b>Soil Case</b>	<b>Bearing Pressure (ksf)</b>	<b>Subgrade Modulus (kef)</b>
4u	0.0—95	390
	95—375	224
	>375	116
2sn4u	0—65	260
	65—255	164
	>255	78

**Table 3.8-15—Table Deleted**

**Table 3.8-16—Table Deleted**