

## ArevaEPRDCPEm Resource

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**From:** BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]  
**Sent:** Tuesday, October 05, 2010 4:06 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. 283, FSAR Ch. 3, Supplement 7  
**Attachments:** RAI 283 Supplement 7 Response US EPR DC.pdf

.Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to questions of RAI No. 283 on October 2, 2009. AREVA NP submitted Supplement 1 to the response on November 12, 2009, to address 3 of the remaining 4 questions. AREVA NP submitted Supplement 2 to the response on November 30, 2009, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 3 to the response on February 22, 2010, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 4 to the response on March 25, 2010, to provide a new schedule for responding to the remaining question. On May 27, 2010, AREVA NP provided a revised schedule for RAI 283 Supplement 5 to allow time to interact with the NRC on the DRAFT response. On August 31, 2010, a revised schedule for Question 03.08.01-37 was provided in Supplement 6.

The attached file, "RAI 283 Supplement 7 Response US EPR DC.pdf" provides a technically correct and complete FINAL response to Question 03.08.01-37, as committed.

The following table indicates the respective pages in the response document, RAI 283 Supplement 7 Response US EPR DC.pdf," that contains AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 283 - 03.08.01-37	2	3

This completes the formal AREVA NP response to RAI 283. There are no additional questions associated with this RAI.

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:** Wednesday, June 30, 2010 7:08 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. 283, FSAR Ch. 3, Supplement 6

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to questions of RAI No. 283 on October 2, 2009. AREVA NP submitted Supplement 1 to the response on November 12, 2009, to address 3 of the remaining 4 questions. AREVA NP submitted Supplement 2 to the response on November 30, 2009, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 3 to the response on February 22, 2010, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 4 to the response on March 25, 2010, to provide a new schedule for responding to the remaining question. On May 27, 2010, AREVA NP provided a revised schedule for RAI 283 Supplement 5 to allow time to interact with the NRC on the DRAFT response.

Based upon NRC comments, a revised schedule for RAI 283 Supplement 6 is required to allow sufficient time for AREVA NP to develop a revised response and interact with the NRC on the new DRAFT response.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below:

Question #	Response Date
RAI 283 — 03.08.01-37	October 5, 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)

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**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, May 27, 2010 1:00 PM  
**To:** 'Tefaye, 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. 283, FSAR Ch. 3, Supplement 5

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to questions of RAI No. 283 on October 2, 2009. AREVA NP submitted Supplement 1 to the response on November 12, 2009, to address 3 of the remaining 4 questions. AREVA NP submitted Supplement 2 to the response on November 30, 2009, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 3 to the response on February 22, 2010, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 4 to the response on March 25, 2010, to provide a new schedule for responding to the remaining question.

As agreed with NRC, AREVA NP is providing a revised date for RAI 283 Supplement 5 to allow time to interact with the NRC on the response.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below:

Question #	Response Date
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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:** Thursday, March 25, 2010 12:26 PM  
**To:** 'Tsfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); VAN NOY Mark (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3, Supplement 4

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to questions of RAI No. 283 on October 2, 2009. AREVA NP submitted Supplement 1 to the response on November 12, 2009, to address 3 of the remaining 4 questions. AREVA NP submitted Supplement 2 to the response on November 30, 2009, to provide a new schedule for responding to the remaining question. AREVA NP submitted Supplement 3 to the response on February 22, 2010, to provide a new schedule for responding to the remaining question.

AREVA NP Inc. (AREVA NP) is unable to provide a response for RAI 283 Supplement 3 at this time. The response to Question 03.08.01-37 is dependent upon completion of the new embedded Finite Element Model (FEM) seismic analysis and verification of these results. AREVA will be prepared to discuss this response with the NRC during the U.S. EPR FSAR Section 3.7 and Section 3.8 audit scheduled for April 26 thru April 30, 2010, after which NRC comments will be incorporated and the final response submitted.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below:

Question #	Response Date
RAI 283 — 03.08.01-37	May 27, 2010

Sincerely,

Martin (Marty) C. Bryan  
Licensing Advisory Engineer  
AREVA NP Inc.  
Tel: (434) 832-3016  
[Martin.Bryan.ext@areva.com](mailto:Martin.Bryan.ext@areva.com)

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**From:** DUNCAN Leslie E (AREVA NP INC)  
**Sent:** Monday, February 22, 2010 2:48 PM  
**To:** 'Tsfaye, Getachew'

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

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to questions of RAI No. 283 on October 2, 2009. AREVA NP submitted Supplement 1 to the response on November 12, 2009, to address 3 of the remaining 4 questions. AREVA NP submitted Supplement 2 to the response on November 30, 2009, to provide a new schedule for responding to the remaining question.

AREVA NP is unable to provide a response for RAI 283 question 03.08.01-37 at this time. This RAI response addresses questions related to structural stability as discussed in U.S. EPR FSAR Tier 2, Section 3.8.1 and is interdependent with AREVA NP's response to RAI 190 Question 03.08.01-29. Additional time is required in order to evaluate potential embedded Finite Element Model (FEM) effect on In Structure Response Spectra (ISRS) for the Reactor Building Internal Structure (RBIS) and verify consistent results in answering interrelated RAI questions.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below:

Question #	Response Date
RAI 283 — 03.08.01-37	March 25, 2010

Sincerely,

Les Duncan  
Licensing Engineer  
**AREVA NP Inc.**  
An AREVA and Siemens Company  
Tel: (434) 832-2849  
[Leslie.Duncan@areva.com](mailto:Leslie.Duncan@areva.com)

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**From:** Pederson Ronda M (AREVA NP INC)  
**Sent:** Monday, November 30, 2009 8:01 PM  
**To:** 'Getachew Tesfaye'; 'Miernicki, Michael'  
**Cc:** BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); VAN NOY Mark (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) is unable to provide a response for RAI 283 Supplement 2 at this time. This RAI response addresses questions related to structural stability as discussed in U.S. EPR FSAR Tier 2, Section 3.8.1 and is interdependent with AREVA NP's response to RAI 190 Question 03.08.01-29. AREVA NP committed to respond to this related question by February 25, 2010.

The revised schedule for technically correct and complete responses to the remaining 1 question is provided below:

Question #	Response Date
RAI 283 — 03.08.01-37	February 25, 2010

Sincerely,

*Ronda Pederson*

[ronda.pederson@areva.com](mailto:ronda.pederson@areva.com)

Licensing Manager, U.S. EPR Design Certification

**AREVA NP Inc.**

An AREVA and Siemens company

3315 Old Forest Road

Lynchburg, VA 24506-0935

Phone: 434-832-3694

Cell: 434-841-8788

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**From:** Pederson Ronda M (AREVA NP INC)

**Sent:** Thursday, November 12, 2009 5:59 PM

**To:** 'Tesfaye, Getachew'

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

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for responses to the 4 questions of RAI No. 283 on October 2, 2009. The attached file, "RAI 283 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 3 of the remaining 4 questions, as committed.

Appended to this file are the affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 283 Questions 03.03.02-4, 03.08.01-38, and 03.08.03-20.

The following table indicates the respective page(s) in the response document, "RAI 283 Supplement 1 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 283 — 03.03.02-4	2	2
RAI 283 — 03.08.01-38	3	4
RAI 283 — 03.08.03-20	5	6

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

Question #	Response Date
RAI 283 — 03.08.01-37	December 10, 2009

Sincerely,

*Ronda Pederson*

[ronda.pederson@areva.com](mailto:ronda.pederson@areva.com)

Licensing Manager, U.S. EPR Design Certification

**AREVA NP Inc.**

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Lynchburg, VA 24506-0935  
Phone: 434-832-3694  
Cell: 434-841-8788

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**From:** Pederson Ronda M (AREVA NP INC)  
**Sent:** Friday, October 02, 2009 4:55 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); VAN NOY Mark (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 283 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 4 questions cannot be provided at this time.

The following table indicates the respective page(s) in the response document, "RAI 283 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 283 — 03.03.02-4	2	2
RAI 283 — 03.08.01-37	3	3
RAI 283 — 03.08.01-38	4	4
RAI 283 — 03.08.03-20	5	5

A complete answer is not provided for 4 of the 4 questions. The schedule for a technically correct and complete response to each of these questions is provided below.

Question #	Response Date
RAI 283 — 03.03.02-4	November 12, 2009
RAI 283 — 03.08.01-37	December 10, 2009
RAI 283 — 03.08.01-38	November 12, 2009
RAI 283 — 03.08.03-20	November 12, 2009

Sincerely,

*Ronda Pederson*

[ronda.pederson@areva.com](mailto:ronda.pederson@areva.com)

Licensing Manager, U.S. EPR Design Certification

**AREVA NP Inc.**

An AREVA and Siemens company

3315 Old Forest Road  
Lynchburg, VA 24506-0935  
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**From:** Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]  
**Sent:** Wednesday, September 02, 2009 6:44 PM  
**To:** ZZ-DL-A-USEPR-DL  
**Cc:** Jeng, David; Xu, Jim; Samaddar, Sujit; Miernicki, Michael; Patel, Jay; Colaccino, Joseph; ArevaEPRDCPEm Resource  
**Subject:** U.S. EPR Design Certification Application RAI No. 283 (2718, 3611,3614), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 25, 2009, and on September 2, 31, 2009, 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:** 2091

**Mail Envelope Properties** (BC417D9255991046A37DD56CF597DB7107CE668A)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 283, FSAR Ch. 3, Supplement 7  
**Sent Date:** 10/5/2010 4:05:40 PM  
**Received Date:** 10/5/2010 4:08:50 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

Files	Size	Date & Time
MESSAGE	14377	10/5/2010 4:08:50 PM
RAI 283 Supplement 7 Response US EPR DC.pdf		51687

**Options**

**Priority:** Standard

**Return Notification:** No

**Reply Requested:** No

**Sensitivity:** Normal

**Expiration Date:**

**Recipients Received:**



**Response to**  
**Request for Additional Information No. 283, Supplement 7**

**9/02/2009**

**U.S. EPR Standard Design Certification**  
**AREVA NP Inc.**  
**Docket No. 52-020**  
**SRP Section: 03.03.02 - Tornado Loads**  
**SRP Section: 03.08.01 - Concrete Containment**  
**SRP Section: 03.08.03 - Concrete and Steel Internal Structures of Steel or**  
**Concrete Containments**

**Application Section: FSAR Ch 3**

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

**Question 03.08.01-37:****Follow-up to RAI Question Number 3.8.1-2**

The applicant's response provided a description of the sliding and overturning stability analysis carried out for the Reactor Building Internal Structures (RBIS). This analysis indicates that the seismic lateral loads and overturning moments are transferred from the RBIS to the Nuclear Island common basemat through bearing pressure on the haunch walls and on the basemat.

The following additional information is needed to resolve this RAI:

1. The applicant states that the seismic loadings were applied to a finite element model "as static equivalent loadings (i.e., zero period acceleration or ZPA)." Clarify how the accelerations were distributed throughout the RBIS model (e.g., was the ZPA value at each degree of freedom from the seismic analysis utilized and applied to the corresponding node in the RBIS equivalent static analysis?)
2. The applicant mentions that the "U.S. EPR is designed to envelope a total of twelve different soil conditions, which result in twelve different sets of ZPAs. The ZPA values applicable to the RBIS were reviewed, and a total of four sets were determined to be potentially controlling for RBIS stability analysis." Explain the basis for selecting these representative soil cases and corresponding ZPAs.
3. The analysis provided by the applicant is essentially a stability analysis (i.e., overturning does not occur with an appropriate factor of safety). The staff notes that this type of analysis does not specifically address the issue of possible uplift. The applicant indicates that "vertical uplift between the liner plate and the internal structure or basemat is not credible because overturning is resisted by the configuration of the internal structure/haunch and the gravity loads due to the mass of the internal structure is greater than the vertical acceleration." This statement is not sufficient because preventing overturning of the entire RBIS does not ensure that no separation occurs at one side of the overturning moment. As stated in the original RAI, the applicant is requested to demonstrate that no uplift occurred between the containment internal structure and the containment liner as well as uplift between the containment liner and the NI basemat due to the overturning loads.

**Response to Question 03.08.01-37:**

The analysis described in the Response to RAI 155, Question 03.08.01-02 did not account for the resisting force of the haunch wall when calculating the factor of safety against sliding. The analysis has been superseded and the revised analysis is described in the Response to RAI 190, Question 03.08.01-29. The factors of safety in the revised analysis for sliding and overturning of the Reactor Building Internal Structures (RBIS) are 2.8 and 1.9, respectively. Local sliding due to rotation and compression of the base of the RBIS is addressed in the Response to RAI 190, Question 03.08.01-29. Because friction alone between the RBIS and the basemat is insufficient to prevent sliding of the RBIS, the wall-to-foundation connection (haunch wall) is designed to withstand a horizontal bearing load from the RBIS (see the Response to RAI 155, Question 03.08.05-08, Part 9). The stated factor of safety against sliding accounts for the resisting force of the haunch wall.

Specifically, the factor of safety against sliding is calculated as  $(\mu \cdot F_{vmin} + F_{haunch}) / F_{hmax}$  and the factory of safety against overturning is calculated as  $(F_{vmin} \cdot r) / (F_{hmax} \cdot z)$ , where;

- $F_{vmin}$  is the minimum vertical reaction seen throughout the duration of the time history analysis described in the Response to RAI 190, Question 03.08.01-29.
- $F_{hmax}$  is the maximum horizontal reaction seen throughout the duration of the time history analysis described in the Response to RAI 190, Question 03.08.01-29.
- $F_{haunch}$  is the horizontal bearing force for which the haunch wall is designed (see the Response to RAI 155, Question 03.08.05-08 Part 9).
- $\mu$  is the minimum coefficient of static friction (0.4).
- $r$  is shortest horizontal distance from the center of gravity of the RBIS to the haunch wall.
- $z$  is the maximum vertical distance from the center of gravity of the RBIS to the bottom of the RBIS.

The RBIS sliding and overturning factors of safety will be revised in U.S. EPR FSAR Tier 2, Section 3.8.5.5.1.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 3.8.5.5.1 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

Maximum soil bearing pressures under the NI Common Basemat Structure foundation basemat are 22,000 pounds per square foot for static loading conditions, and ~~35,000~~26,000 pounds per square foot for dynamic loading conditions.

In addition to forces and moments due to soil spring analyses, the NI Common Basemat Structure foundation basemat for the U.S. EPR plant considers other settlement effects (e.g., consolidation, construction sequence, lateral soil variability) by assuming a flexural settlement of 0.25 inches in 50 feet. The effects of other flexural settlement of the NI foundation basemat are investigated through manual calculations by representing the basemat as one foot wide fixed-fixed Bernoulli beams displaced at one support. The total differential displacement at the support of each strip is obtained by linearly extrapolating 0.25 inches per 50 feet for the entire length of the strip. The resulting values of moment and shear are calculated using an effective concrete modulus of elasticity adjusted for creep relaxation. The maximum values for moment and shear are applied over the entire length of the strip. These moment and shear values are then manually included with the results of the ANSYS model to provide a design that accounts for flexure and shear associated with the soil spring analysis and flexure and shear associated with other settlements.

The effects of tilt settlement on the soil bearing pressure were investigated by rotating the ANSYS model of the Nuclear Island about the East-West axis. The increases in soil bearing pressure within the NI Common Basemat were negligible.

Differential settlements and local settlements within the perimeter of the foundation are not likely to affect the structures, systems, or components due to the extremely thick foundation stiffened by numerous shear walls. The combined stiffness allows the NI Common Basemat Structure foundation basemat to bridge potential foundation irregularities.

For worst-case loading combinations on the NI Common Basemat Structure foundation basemat, the time history methodology used to calculate sliding and uplift safety factors due to seismic loadings is described in Section 3.8.5.4.2. The calculated values meet the requirements of Table 3.8-11.

03.08.01-37

For worst-case loading combinations on the RB internal structures basemat above the containment liner, the minimum safety factor against sliding is ~~2.8 and the 0.16 occurring for soil case 2sn4u, based solely on friction between the liner and the supporting concrete. Because friction will not prevent sliding, the surrounding concrete haunch wall is designed with sufficient capacity to resist the total base shear force. The minimum safety factor against overturning is 1.91.22 occurring for soil case 2sn4u.~~