

ArevaEPRDCPEm Resource

From: WELLS Russell (AREVA) [Russell.Wells@areva.com]
Sent: Thursday, March 17, 2011 8:45 AM
To: Tesfaye, Getachew
Cc: CORNELL Veronica (EXTERNAL AREVA); BREDEL Daniel (AREVA); COLEMAN Sue (AREVA); BENNETT Kathy (AREVA); DELANO Karen (AREVA); HALLINGER Pat (EXTERNAL AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); WILLIFORD Dennis (AREVA)
Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3, Question 03.08.04-10
Attachments: RAI 335 Question 03.08.04-10 Response US EPR DC - DRAFT.pdf

Getachew,

Attached is a revised draft response for RAI No. 335, FSAR Ch 3, Question 03.08.04-10 in advance of the April 8, 2011 final response date.

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

Phone: 434-832-3884 (work)

434-942-6375 (cell)

Fax: 434-382-3884

Russell.Wells@Areva.com

From: WELLS Russell (RS/NB)
Sent: Thursday, March 03, 2011 6:04 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3, Supplement 8

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 and Supplement 3 to the response on June 4, 2010, and June 24, 2010, respectively, to provide a revised schedule for responding to the remaining 3 questions. AREVA NP submitted Supplement 4 on July 20, 2010, to provide INTERIM responses to Question 03.08.01-44 and Question 03.08.04-09. AREVA NP submitted Supplement 5 on August 20, 2010, to provide an INTERIM response to Question 03.08.04-10. AREVA NP submitted Supplement 6 on January 13, 2011, to provide a revised schedule for Question 03.08.01-44 and Question 03.08.04-10. AREVA NP submitted Supplement 7 on February 11, 2011, to provide a revised schedule for Question 03.08.04-09 and Question 03.08.04-10.

The schedule for Question 03.08.01-44 is being revised to allow AREVA NP additional time to address NRC audit 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	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010 (Actual)	June 14, 2011
RAI 335 — 03.08.04-09	July 21, 2010 (Actual)	April 28, 2011
RAI 335 — 03.08.04-10	August 20, 2010 (Actual)	April 8, 2011

Sincerely,

Russ Wells

U.S. EPR Design Certification Licensing Manager

AREVA NP, Inc.

3315 Old Forest Road, P.O. Box 10935

Mail Stop OF-57

Lynchburg, VA 24506-0935

Phone: 434-832-3884 (work)

434-942-6375 (cell)

Fax: 434-382-3884

Russell.Wells@Areva.com

From: BRYAN Martin (External RS/NB)

Sent: Friday, February 11, 2011 1:14 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. 335, FSAR Ch. 3, Supplement 7

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 and Supplement 3 to the response on June 4, 2010, and June 24, 2010, respectively, to provide a revised schedule for responding to the remaining 3 questions. AREVA NP submitted Supplement 4 on July 20, 2010, to provide INTERIM responses to Question 03.08.01-44 and Question 03.08.04-09. AREVA NP submitted Supplement 5 on August 20, 2010, to provide an INTERIM response to Question 03.08.04-10. AREVA NP submitted Supplement 6 on January 13, 2011, to provide a revised schedule for Question 03.08.01-44 and Question 03.08.04-10.

The schedule for Question 03.08.04-09 and Question 03.08.04-10 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	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010 (Actual)	March 3, 2011
RAI 335 — 03.08.04-09	July 21, 2010 (Actual)	April 28, 2011
RAI 335 — 03.08.04-10	August 20, 2010 (Actual)	April 8, 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

From: BRYAN Martin (External RS/NB)
Sent: Thursday, January 13, 2011 5:09 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. 335, FSAR Ch. 3, Supplement 6, Interim

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 and Supplement 3 to the response on June 4, 2010, and June 24, 2010, respectively, to provide a revised schedule for responding to the remaining 3 questions. AREVA NP submitted Supplement 4 on July 20, 2010, to provide INTERIM responses to Question 03.08.01-44 and Question 03.08.04-09. AREVA NP submitted Supplement 5 on August 20, 2010, to provide an INTERIM response to Question 03.08.04-10.

The schedule for Question 03.08.01-44 is being revised to allow AREVA NP additional time for to address NRC feedback. The schedule for Question 03.08.04-10 is being revised to allow additional time for AREVA NP to interact with the NRC.

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

Question #	Interim Response Date	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010 (Actual)	March 3, 2011
RAI 335 — 03.08.04-09	July 21, 2010 (Actual)	February 15, 2011
RAI 335 — 03.08.04-10	August 20, 2010 (Actual)	March 3, 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

From: BRYAN Martin (External RS/NB)
Sent: Friday, August 20, 2010 3:31 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. 335, FSAR Ch. 3, Supplement 5, Interim

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 and Supplement 3 to the response on June 4, 2010, and June 24, 2010, respectively, to provide a revised schedule for responding to the remaining 3 questions. AREVA NP submitted Supplement 4 on July 20, 2010, to provide INTERIM responses to Question 03.08.01-44 and Question 03.08.04-09.

The attached file, "RAI 335 Supplement 5 US EPR DC – INTERIM.pdf" provides technically correct and complete INTERIM response to Question 03.08.04-10, as committed.

The following table indicates the respective pages in the response document, "RAI 335 Supplement 5 US EPR DC – INTERIM.pdf," that contain AREVA NP's INTERIM response to Question 03.08.04-10.

Question #	Start Page	End Page
RAI 335 — 03.08.04-10	2	3

The schedule for technically correct and complete FINAL responses to the remaining 3 questions is unchanged and provided below:

Question #	Interim Response Date	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010 (Actual)	January 13, 2011
RAI 335 — 03.08.04-09	July 21, 2010 (Actual)	February 15, 2011
RAI 335 — 03.08.04-10	August 20, 2010 (Actual)	January 21, 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

From: BRYAN Martin (EXT)
Sent: Tuesday, July 20, 2010 5:17 PM
To: 'Tesyfaye, 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. 335, FSAR Ch. 3, Supplement 4, Interim

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 to the response on June 4, 2010, to provide a schedule for the remaining 3 questions that were affected by the work underway to address NRC comments from the April 26, 2010, audit. AREVA NP submitted Supplement 3 to the response on June 24, 2010, to provide a revised schedule for responding to the remaining 3 questions based on the June 9, 2010, NRC public meeting with AREVA.

The attached file, "RAI 335 Supplement 4 US EPR DC – INTERIM.pdf" provides technically correct and complete INTERIM response to Question 03.08.01-44 and Question 03.08.04-09, as committed.

The following table indicates the respective pages in the response document, "RAI 335 Supplement 4 US EPR DC – INTERIM.pdf," that contain AREVA NP's INTERIM response to Question 03.08.01-44 and Question 03.08.04-09.

Question #	Start Page	End Page
RAI 335 — 03.08.01-44	2	8
RAI 335 — 03.08.04-09	9	11

The schedule for technically correct and complete FINAL response to the remaining 3 questions is unchanged and provided below:

Question #	Interim Response Date	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010 (Actual)	January 13, 2011
RAI 335 — 03.08.04-09	July 21, 2010 (Actual)	February 15, 2011
RAI 335 — 03.08.04-10	August 23, 2010	January 21, 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

From: BRYAN Martin (EXT)
Sent: Thursday, June 24, 2010 12:27 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); RYAN Tom (AREVA NP INC); GARDNER George Darrell (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions. AREVA NP submitted Supplement 2 to the response on June 4, 2010, to provide a schedule for the remaining 3 questions that 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 for the remaining three questions has been changed.

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	Final Response Date
RAI 335 — 03.08.01-44	July 21, 2010	January 13, 2011
RAI 335 — 03.08.04-09	July 21, 2010	February 15, 2011
RAI 335 — 03.08.04-10	August 23, 2010	January 21, 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

From: BRYAN Martin (EXT)
Sent: Friday, June 04, 2010 3:45 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. 335, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. AREVA NP submitted Supplement 1 to the response on March 12, 2010, to address 3 of the remaining 6 questions.

The response to Question 03.08.04-09 is affected as a result of work currently underway to address NRC comments from the April 26, 2010, audit and a revised schedule is provided below. However, the response date for all three questions will be revised based on information presented at the June 9, 2010 public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 335 — 03.08.01-44	August 13, 2010
RAI 335 — 03.08.04-09	August 13, 2010
RAI 335 — 03.08.04-10	August 13, 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

From: BRYAN Martin (EXT)
Sent: Friday, March 12, 2010 5:06 PM
To: 'Tefaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); VAN NOY Mark (EXT); GARDNER George Darrell (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI No. 335 on January 18, 2010. The attached file, "RAI 335 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 3 of the remaining 6 questions, as committed. The response to Question 03.08.04-10 is deferred due to its dependency on results of work currently underway to support other responses on related topics.

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 335 Questions 03.08.01-45, and 03.08.04-8.

The following table indicates the respective pages in the response document, "RAI 335 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 335 — 03.08.01-45	2	2
RAI 335 — 03.08.01-46	3	3
RAI 335 — 03.08.04-08	4	5

The schedule for technically correct and complete responses to the remaining 3 questions has been changed and is provided below:

Question #	Response Date
RAI 335 — 03.08.01-44	August 13, 2010
RAI 335 — 03.08.04-09	June 4, 2010
RAI 335 — 08.08.04-10	August 13, 2010

Sincerely,

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

From: DUNCAN Leslie E (AREVA NP INC)
Sent: Monday, January 18, 2010 3:24 PM
To: 'Tefaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 335, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 335 Response US EPR DC.pdf" provides a schedule since technically correct and complete responses to the 6 questions are not provided.

The following table indicates the respective pages in the response document, "RAI 335 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 335 - 03.08.01-44	2	3
RAI 335 - 03.08.01-45	4	4
RAI 335 - 03.08.01-46	5	5
RAI 335 - 03.08.04-08	6	6
RAI 335 - 03.08.04-09	7	7
RAI 335 - 03.08.04-10	8	9

A complete answer is not provided for 6 of the 6 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 335 - 03.08.01-44	August 13, 2010
RAI 335 - 03.08.01-45	March 12, 2010
RAI 335 - 03.08.01-46	March 12, 2010
RAI 335 - 03.08.04-08	March 12, 2010
RAI 335 - 03.08.04-09	June 4, 2010
RAI 335 - 03.08.04-10	March 12, 2010

Sincerely,

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

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Saturday, December 05, 2009 6:52 AM
To: ZZ-DL-A-USEPR-DL
Cc: Xu, Jim; Hawkins, Kimberly; Patel, Jay; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 335 (4059, 4061),FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on November 30, 2009, and on December 4, 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 with the exception of typographical error correction in Draft RAI Question 03.08.04-8 identified by AREVA. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs, excluding the time period of **December 25, 2009 thru January 3, 2010, to account for the holiday season** as discussed with AREVA NP. For any RAIs that cannot be answered **within 40 days**, it is expected that a date for receipt of this information will be provided to the staff within the 40-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: 2716

Mail Envelope Properties (1F1CC1BBDC66B842A46CAC03D6B1CD410419E4AA)

Subject: Draft Response to U.S. EPR Design Certification Application RAI No. 335, FSAR
Ch. 3, Question 03.08.04-10
Sent Date: 3/17/2011 8:45:17 AM
Received Date: 3/17/2011 8:45:21 AM
From: WELLS Russell (AREVA)

Created By: Russell.Wells@areva.com

Recipients:

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

Tracking Status: None

"BREDEL Daniel (AREVA)" <Daniel.Bredel@areva.com>

Tracking Status: None

"COLEMAN Sue (AREVA)" <Sue.Coleman@areva.com>

Tracking Status: None

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

Tracking Status: None

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

Tracking Status: None

"HALLINGER Pat (EXTERNAL AREVA)" <Pat.Hallinger.ext@areva.com>

Tracking Status: None

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

Tracking Status: None

"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>

Tracking Status: None

"WILLIFORD Dennis (AREVA)" <Dennis.Williford@areva.com>

Tracking Status: None

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

Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	Size	Date & Time	
MESSAGE	19370	3/17/2011 8:45:21 AM	
RAI 335 Question 03.08.04-10 Response US EPR DC - DRAFT.pdf			485933

Options

Priority: Standard

Return Notification: No

Reply Requested: No

Sensitivity: Normal

Expiration Date:

Recipients Received:

Response to

**Request for Additional Information No. 335 (4059, 4061)
Question 03.08.04-10, Revision 1**

12/05/2009

U. S. EPR Standard Design Certification

AREVA NP Inc.

Docket No. 52-020

SRP Section: 03.08.01 - Concrete Containment

SRP Section: 03.08.04 - Other Seismic Category I Structures

Application Section: FSAR Section 3.8

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

DRAFT

Question 03.08.04-10:**Follow-up to RAI Question 03.08.04-5**

The staff notes that FSAR Section 9.1.2 (Revision 1) mentions that the design of the spent fuel storage racks is the responsibility of the COL applicant and makes only general statements regarding design loads, (Section 9.1.2.1 Item 10) and required dynamic and stress analyses (Section 9.1.2.3). Similarly, the response to RAI 155, Supplement 2, Question 3.8.1-7 makes only general statements regarding design load cases. Therefore, this information does not address the intent of the RAI.

Since the spent fuel storage racks are free-standing, and their analysis and design is deferred to the COL application, AREVA at this stage needs to clarify how they determined the loads imposed on the spent fuel pool. Both the procedure to determine the loads and the magnitude of these loads (e.g., sliding, rocking, twisting, impact on the pool walls and slabs) need to be described. This information should be included in the relevant sections of the FSAR so that, when the detailed design of the storage racks is actually carried out, the COL applicant can perform the necessary comparison between the assumed loads and the loads obtained from the detailed analysis. The applicant is requested to describe the analysis and procedures for the spent fuel pool and racks, and explain how they compare to the criteria in Appendix D to SRP Section 3.8.4, "Guidance on Spent Fuel Pool Racks." Include this information in the FSAR.

In addition, describe the specific procedures used to determine the seismic forces on walls and slabs due to water in the pool. In this regard, FSAR Section 3.8.4.4.1, item "Hydrodynamic Loads" states that for the static FE model of the Nuclear Island structure:

"Hydrodynamic loads are applied to the walls and floors of the spent fuel pool and liquid storage tanks in the SBs and in the ESWBs to account for the impulsive and impactive effects of the water moving and sloshing in the tanks as a result of seismic excitation. These loads are considered as part of the seismic SSE loads, and components of these loads in the three orthogonal directions are combined in the same manner as other seismic loads. The requirements of ASCE 4-98, "Seismic Analysis of Safety-Related Nuclear Structures," ASCE Manual No. 58, USAEC TID-7024, and other proven methods are used to determine hydrodynamic loadings. The effect of tank structure flexibility on spectral acceleration is included when determining the hydrodynamic pressure on the tank wall for the impulsive mode."

Elaborate on how the hydrodynamic loads are determined and provide a summary of the relevant calculations for the spent fuel pool. This summary should include the magnitude of convective and impulsive masses, corresponding frequencies, and a description of the methodology used to convert the dynamic effects of these water masses to loads applied to the static FE model. Confirm if the same methodology is used for the other seismic Category I pools in the U.S. EPR.

Finally, since FSAR Appendix 3E will be revised according to the resolution of RAI 155, Questions 03.08.01-20 and 03.08.04-6, confirm that the spent fuel pool will be included as a Critical Section under one of the three critical section selection criteria (qualitative, quantitative, or supplemental).

Response to Question 03.08.04-10:

The design of the spent fuel storage racks is incorporated in U.S. EPR FSAR Tier 2, Section 9.1.2. The new and spent fuel pool (SFP) assemblies design and analysis are provided in Technical Report TN-Rack.0101, "U.S. EPR New and Spent Fuel Storage Rack Technical Report", submitted to the U.S. NRC Document Control Desk on December 8, 2009. The spent fuel racks (SFR) and fuel assemblies (FA) loads imposed on the SFP are provided in Technical Report TN-Rack.0101. Technical Report TN-Rack.0101, Chapter 3 provides weights, impact loads, and stuck fuel assembly loads. Technical Report, TN-Rack.0101, Appendix 3C provides rack sliding and uplift, rack foot, lateral, and vertical loads. Based on U.S. EPR FSAR Tier 2, Appendix 3C, the racks do not generate impact loads on the perimeter pool walls, and have a minimum safety factor against tipping of 1.1. Compliance with the rack design criteria of SRP 3.8.4, Appendix D is addressed in Technical Report TN-Rack.0101. Technical Report TN-Rack.0101 is incorporated by reference in U.S. EPR FSAR Tier 2, Section 9.1.

Technical Report TN-Rack.0101 is incorporated by reference in the U.S. EPR FSAR. The report contains specifics on the rack design, the methodology used to determine loads, and the magnitude of the loads on the pool walls and floor.

As described in Technical Report TN-Rack.0101 and local SFP analysis, a whole pool dynamic LS-DYNA finite element model (FEM) is created that includes modeling of pool concrete walls (as rigid boundary), fuel racks, and water. The results of the whole pool multi-rack model analysis are used to determine the hydrodynamic loads (pressure, forces, and moments) exerted on the pool walls and floor from the water and racks during a seismic event, including horizontal displacement between racks and pool floor, uplift of the fuel racks, and impact loads on the pool floor.

The equivalent static SFP loads applied in the Nuclear Island (NI) analysis are not the Technical Report TN-Rack.0101 loads. The SFP design loads from racks and water in the pool are calculated separately and are applied in the overall ANSYS NI model as equivalent static pressures on SFP wall and slab. The rack equivalent static loads are based on estimated pool fuel capacity and previous nuclear plant rack analytical data, while the SFP water loads are determined following the methodology of the TID-7024, "Nuclear Reactors and Earthquakes." The design loads used for SFP analysis are compared to the maximum wall pressures determined through post-processing of the whole pool multi-rack dynamic analysis results, and are verified as adequate. This response provides details on how the design loads are calculated.

The SFP rack loads used in the static analysis of the NI consist of rack and fuel weight and rack seismic forces, which are applied in the overall ANSYS model as pressure on the walls and pool slab. Rack loads are based on SFP capacity of 1056 cells, which are conservatively extrapolated to 1400. The 1400 cell capacity includes rack and FA weight (dead loads). Live loads include the weight of 241 FA added to a weight of 241 rod cluster control assemblies (RCCA). This combination of dead and live loads is converted to uniform pressure on the slab of the SFP. The magnitude of this pressure is 2176 psf. The SFP rack dead and live loads are used to calculate the seismic loads on the SFP slab and walls, which include the following:

- Vertical seismic load on the SFP slab includes equivalent seismic rack load and rack impact load. The equivalent seismic rack load is based on 100 percent dead and 25 percent live loads, used in this response as rack load, multiplied by the SFP floor zero period

acceleration (ZPA). The equivalent seismic rack load in this response is referred to as rack load. The rack impact load is calculated using the equivalent seismic rack load increased by a dynamic factor of two. The vertical seismic load is applied as a uniform pressure on the entire SFP slab area. The magnitude of the vertical seismic load is 3699 psf and is applied for seismic events in each of the three orthogonal directions (x, y, and z).

- Lateral seismic load on the SFP slab is calculated based on the rack load, equivalent seismic rack load, and rack impact load multiplied by a friction coefficient of 0.6. The lateral seismic load is applied as a uniform pressure on the SFP slab with a magnitude of 5993 psf for seismic events in the two horizontal directions.
- Lateral seismic load on the SFP walls, resulting from rack horizontal movement during a seismic event, is calculated and applied on the SFP walls up to an elevation corresponding to assumed height of the racks. A hydrodynamic pressure is selected based on previous nuclear plant rack analytical data. The hydrodynamic pressure is increased along the height of the racks on 3.28 ft (1m) increments to account for changes in seismic acceleration between the top and bottom of the rack. The base acceleration is the peak acceleration from the in-structure response spectra (ISRS) at the SFP slab elevation, using a 4 percent damping curve. The pressure magnitude changes from 18207 psf at the rack bottom (first increment) to 22962 psf at the rack top (last increment). The loads from each increment are averaged and applied as uniform pressures on each wall for the two horizontal seismic events corresponding to the direction of the earthquake.

The SFP water loads used in the NI static analysis consist of hydrostatic and hydrodynamic forces applied in the ANSYS model as pressure on the walls and pool slab. The hydrostatic pressure on the slab is applied as uniform load, while the hydrostatic pressure on the walls is applied as triangular pressure load. The hydrostatic pressure on the pool slab is 2932 psf. The hydrostatic pressure on the walls increases gradually to a maximum of 2837 psf at the bottom of the SFP. The hydrodynamic loads on the SFP walls and slab are:

- Hydrodynamic pressure on SFP walls and slab resulting from seismic load in Z (vertical up and down) direction are calculated by multiplying the pool slab ZPA in the Z direction and the mass of the fluid. The magnitude of the calculated and applied uniform pressure on the pool slab is 4222 psf. The pressure on the walls is calculated using 3.28 ft (1m) increments and has a magnitude of 152 psf at the first increment near the water surface, and 4086 psf at the last increment at the bottom of the pool. The loads from each increment are separated to three bands, and the pressure is averaged over the band height, and applied as a uniform wall pressure over the band heights. Figure 03.08.04-10-1 shows the application of the uniform pressure on the walls in the static model.
- Hydrodynamic pressure on SFP walls and slab resulting from seismic load in the X (East-West) direction have convective and impulsive pressures that are calculated using the methodology described in TID-7024, Chapter 6 and Appendix F. For the impulsive pressures, the natural frequency of the east and west walls is 33Hz, based on accelerations obtained from the in-structure response spectra (ISRS) using 7 percent damping. For the convective pressures, the natural frequency of the sloshing fluid is determined, and the accelerations are obtained from the ISRS using 0.5 percent damping. Convective and impulsive pressures are calculated along the height of the walls and from the centerline of the pool slab using 3.28 ft (1m) increments. Convective and impulsive pressures are summed and applied as a triangular load on the pool slab with zero magnitude at the pool centerline, while the incremental wall pressures are further grouped to three bands.

Pressures over the band heights are averaged for application in the NI analytical model as uniform pressure. The load magnitudes for the walls are:

- 145 psf impulsive and 88 psf convective pressure at the top wall segments.
- 1661 psf impulsive and 12 psf convective pressure at the bottom wall segments.

For the pool slab, the maximum pressure at the slab ends is 1778 psf impulsive and 12 psf convective. On average, the convective pressure is approximately 3 percent of the total calculated pressure for the walls and approximately 1 percent for the slab. Figure 03.08.04-10-2 illustrates the uniform pressures and magnitudes applied in the static model.

- Hydrodynamic pressure on SFP walls and slab resulting from the seismic load in the Y (North-South) direction are calculated the same as in the X direction, except pressure is applied to the north and south walls. The natural frequency is 19 Hz. The load magnitudes for the walls are:
 - 226 psf impulsive and 99 psf convective pressure at the top wall segments.
 - 1510 psf impulsive and 2 psf convective pressure at the bottom wall segments.

For the pool slab, the maximum pressure at the slab ends is 1937 psf impulsive and 2 psf convective. On average, the convective pressure is approximately 2 percent of the total calculated pressure for the walls and less than 1 percent for the slab. Figure 03.08.04-10-3 illustrates the uniform pressures and magnitudes applied in the static model.

The directional seismic rack and water loads in the SFP are combined consistent with the methodology described in the Response to RAI 376, Question 03.08.03-24.

The methodology for calculating the SFP hydrodynamic loads is consistent with the method described in the Response to RAI 412, Question 03.07.02-74.

SFP pressures described in this response are used for global loading and static analysis of the NI Common Basemat Structure. These pressures envelop the pressures identified in the whole pool seismic load analysis described in the third paragraph of this response. The overall design of the SFP uses the results from the global analysis. However, impact loads from rack and fuel drop identified in the whole multi-rack fuel pool analysis are used in the SFP design for local effects, such as bending and punching shear checks.

U.S. EPR FSAR Tier 2, Section 3.8.4.4.2 will be revised to describe the SFP local analysis.

The Fuel Building SFP walls and slab are selected as a critical section and will be included in U.S. EPR FSAR Tier 2, Appendix 3E, in the Response to RAI 155, Question 03.08.04-06.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.8.4.4.2 will be revised as described in the response and indicated on the enclosed markup.

Figure 03.08.04-10-1—Hydrodynamic Pressure on SFP Walls due to Seismic Load in -Z (vertical down) Direction

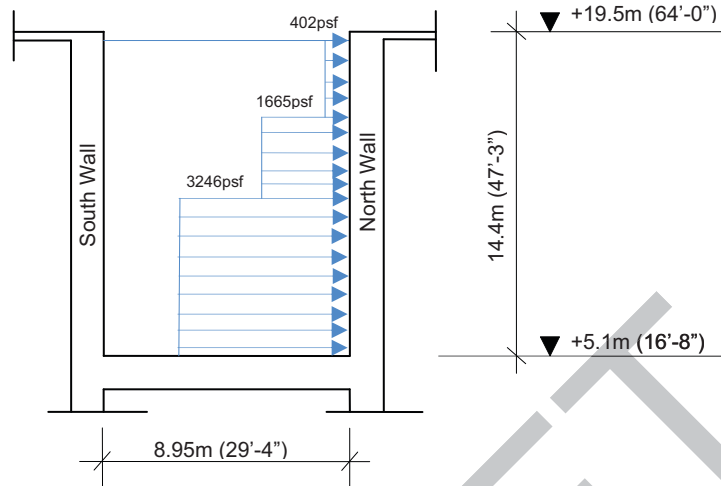


Figure 03.08.04-10-2—Hydrodynamic Pressure on SFP East and West Walls and Slab due to Seismic Load in +X (East) Direction

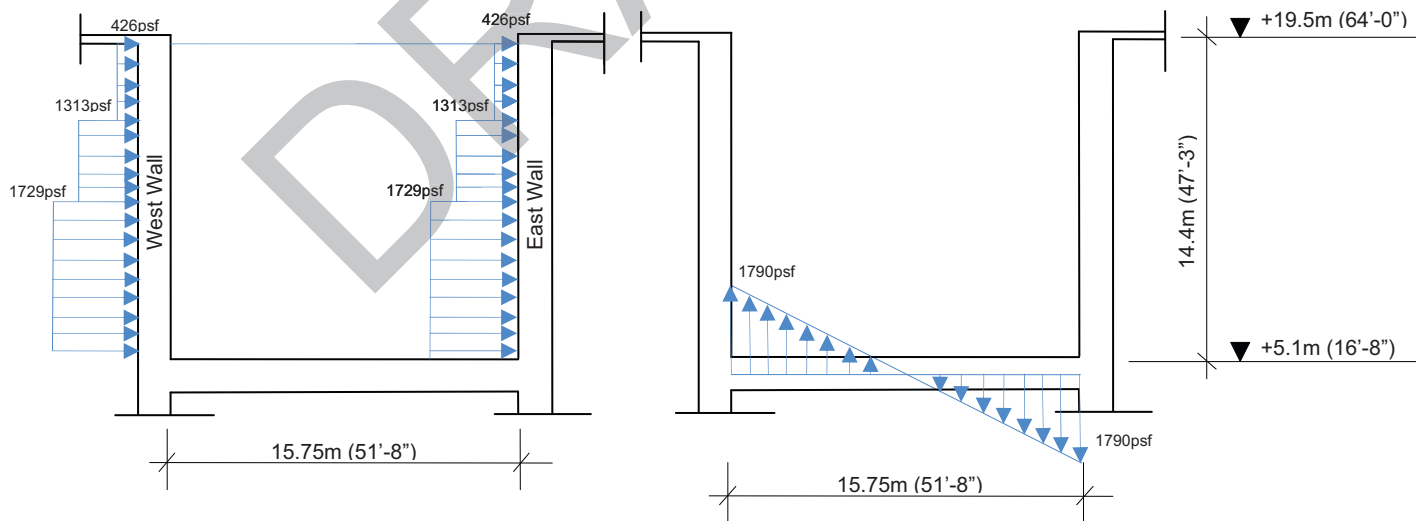
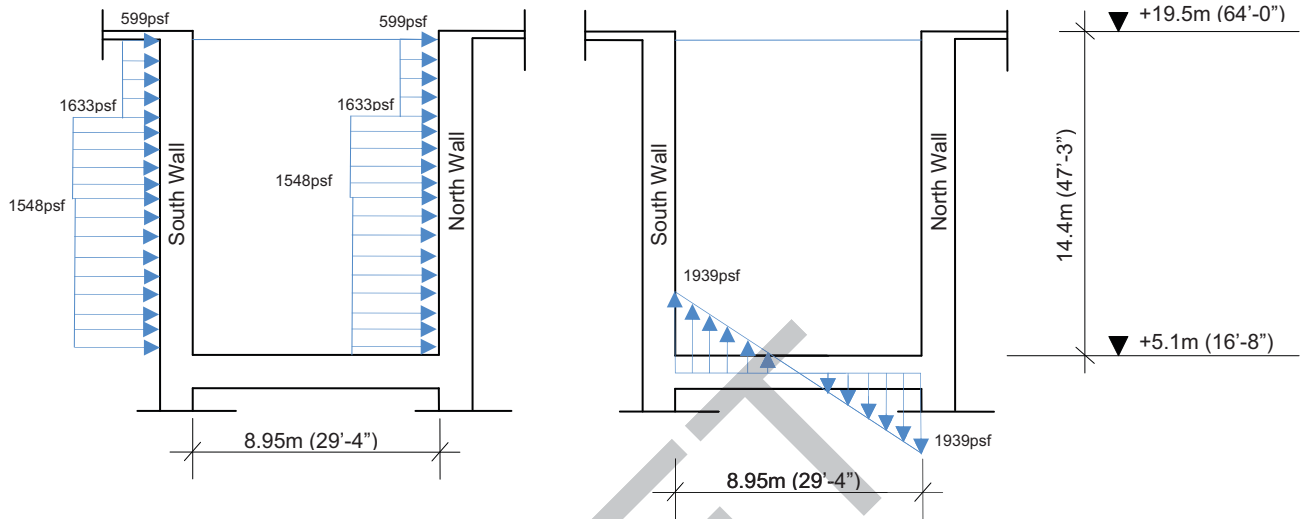


Figure 03.08.04-10-3—Hydrodynamic Pressure on SFP North and South Walls and Slab due to Seismic Load in +Y (North) Direction



U.S. EPR Final Safety Analysis Report Markups

DRAFT

strikes, aircraft impact, explosions, and other loading conditions. Exterior walls and roofs of the hardened SBs 2 and 3, RSB, and the FB are modeled to be independent of the internal structures, because there is no physical connection of internal walls and slabs in these structures with the outside walls and roof.

ANSYS SHELL43 solid shell elements are used to model walls and floors and other concrete elements in the NI Common Basemat Structure. SHELL43 is a three-dimensional, four-node shell element that is suitable for moderately thick shell structures. SHELL43 can also provide out-of-plane shear forces and has an elastic-plastic capability. BEAM44 members are used to model beams and columns. The ANSYS finite element computer program is used to analyze the NI Common Basemat Structure for the loads and load combinations described in Section 3.8.4.3.

The finite element model used for the analysis of the NI Common Basemat Structure is shown in Figure 3.8-86—ANSYS Finite Element Model of Nuclear Island Common Basemat Structure - Outside View, Figure 3.8-87—ANSYS Finite Element Model of Nuclear Island Common Basemat Structure - Section Through Fuel Building and Safeguard Building 2/3 Island, and Figure 3.8-88—ANSYS Finite Element Model of Nuclear Island Common Basemat Structure - Section Through Safeguard Buildings 4 and 1.

03.08.04-10

Local analyses are used to analyze other Seismic Category I structures for locally applied loadings that have no significant effect on the overall behavior of the structures. Local analyses are performed for the pipe rupture loads described in Section 3.8.4.4.1, ~~and~~ for the missile impact loads also described in Section 3.8.4.4.1, and for the spent fuel pool, as well as for other loadings and local structural areas. Spent fuel pool local analysis is performed using LS-DYNA, Version 971 software. The whole pool finite element model contains the pool concrete walls, fuel racks, and water.

Section 9.1.2 addresses fuel storage racks.

Subsystem supports (i.e., pipe supports, HVAC duct supports, electrical conduit supports, cable tray supports) are analyzed and designed using local analyses. Analysis and design of subsystem supports are performed in accordance with the same criteria and codes specified for design of other Seismic Category I structures. See Section 3.7.3 for additional descriptions of methods used for seismic analyses of distribution systems.

~~Section 9.1.2 addresses fuel storage racks.~~

3.8.4.4.3 Emergency Power Generating Buildings

The EPGBs are reinforced concrete shear wall structures. Vertical loads transfer to the reinforced concrete foundation basemat through the reinforced concrete walls. Lateral