ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Tuesday, August 10, 2010 6:44 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. 370, FSAR Ch. 3, Supplement 3
Attachments: RAI 370 Supplement 3 Response US EPR DC - PUBLIC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 370 on April 26, 2010. AREVA NP submitted Supplement 1 and Supplement 2 to the response on June 8, 2010 and June 24, 2010, respectively, to provide a schedule for the remaining 4 questions.

Because the response file contains security-related sensitive information that should be withheld from public disclosure in accordance with 10 CFR 2.390, a public version is provided with the security-related sensitive information redacted. This email and attached file do not contain any security-related information. An unredacted security-related version is provided under separate email.

The attached file, "RAI 370 Supplement 3 Response US EPR DC-PUBLIC.pdf" provides technically correct and complete responses to Questions 03.07.02-64 and 03.07.02-65, as committed.

The schedule for Question 03.07.03-38 is being revised to allow additional time for AREVA NP to address NRC comments. The schedule for Question 03.07.01-27 question is unchanged.

The following table indicates the respective pages in the response document, "RAI 370 Supplement 3 Response US EPR DC -PUBLIC," that contain the AREVA NP response to the subject questions.

Question #	Start Page	End Page
RAI 370 - 03.07.02-64	2	3
RAI 370 - 03.07.02-65	4	7

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

Question #	Response Date
RAI 370-03.07.01-27	May 18, 2011
RAI 370-03.07.03-38	September 2, 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: Thursday, June 24, 2010 12:31 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. 370, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 370 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 8, 2010, to provide a schedule for the remaining 4 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 revised schedule for the technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 370-03.07.01-27	May 18, 2011
RAI 370-03.07.02-64	August 10, 2010
RAI 370-03.07.02-65	August 10, 2010
RAI 370-03.07.03-38	August 10, 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: Tuesday, June 08, 2010 3:57 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. 370, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 370 on April 26, 2010.

The schedule for question 03.07.01-27 is not being changed by this supplement. The schedule for Questions 03.07.02-64, 03.07.02-65 and 03.07.03-38 has been changed. The dates for the 4 remaining questions will be evaluated and revised, as necessary, based on the information that will be presented at the June 9, 2010, public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 370-03.07.01-27	August 3, 2010
RAI 370-03.07.02-64	July 8, 2010
RAI 370-03.07.02-65	July 8, 2010
RAI 370-03.07.03-38	July 8, 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: Monday, April 26, 2010 1:18 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); RYAN Tom (AREVA NP INC); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 370, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 370 Response US EPR DC.pdf" provides technically correct and complete responses to 1 of the 5 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 370 Question 03.07.03-39.

The following table indicates the respective pages in the response document, "RAI 370 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 370 - 03.07.01-27	2	2
RAI 370 -03.07.02-64	3	3
RAI 370 -03.07.02-65	4	5
RAI 370 -03.07.03-38	6	6
RAI 370 -03.07.03-39	7	8

A complete answer is not provided for 4 of the 5 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 370 - 03.07.01-27	August 3, 2010

RAI 370 -03.07.02-64	June 10, 2010
RAI 370 -03.07.02-65	June 10, 2010
RAI 370 -03.07.03-38	June 10, 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: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, March 25, 2010 2:00 PM
To: ZZ-DL-A-USEPR-DL
Cc: Chakravorty, Manas; Hawkins, Kimberly; Miernicki, Michael; Patel, Jay; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 370 (4292,4272,4275), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on February 18, 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: 1816

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71072B479A)

Subject: Response to U.S. EPR Design Certification Application RAI No. 370, FSAR Ch. 3, Supplement 3
Sent Date: 8/10/2010 6:43:36 PM
Received Date: 8/10/2010 6:43:40 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	7748	8/10/2010 6:43:40 PM
RAI 370 Supplement 3 Response US EPR DC - PUBLIC.pdf	113818	

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

Response to

Request for Additional Information No. 370, Supplement 3

3/25/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.07.01 - Seismic Design Parameters
SRP Section: 03.07.02 - Seismic System Analysis
SRP Section: 03.07.03 - Seismic Subsystem Analysis

Application Section: 03.07

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

Question 03.07.02-64:

Follow Up to RAI 248, Question 03.07.02-53:

The applicant has proposed utilizing a lateral-force resisting system (LFRS) with a controlled collapse zone as the design basis for the NAB under an SSE event. In order for the staff to evaluate the acceptability of this design feature and whether it meets Acceptance Criteria 8 of SRP 3.7.2, the staff is requesting the following additional information:

1. The design codes applicable to the LFRS and the controlled collapse zone.
2. A detailed description of the LRFS and the controlled collapse zone.
3. Figures that depict the physical dimensions of the LFRS and the collapse zone of the NAB.
4. A description of the loads and the loading combinations applicable to each portion of the building.
5. A description of the methods used to control the collapse of the non-seismic portion of the NAB in such a way that the collapse zone does not impact a Category I structure or reduce the structural integrity of the LFRS.
6. A description of the seismic analysis method including assumptions, description of the model, description and point of application of the seismic input, and a description of how the seismic loads are determined and applied to the NAB structure.
7. A description of the method used to calculate the seismic displacement of the NAB from which it is concluded that the gap between the NAB and Safeguard building (SB4) and the gap between the NAB and Fuel Building is sufficient to prevent an interaction with these adjacent Category I structures.
8. The results of an analysis that demonstrates that the NAB does not slide or overturn into adjacent Category I structures.
9. The interaction between the LFRS and the controlled collapse zone including the collapse or impact loads that are expected to be applied to the LFRS by the collapse zone.
10. The interaction between the NAB and the RWB including a detailed description of how the NAB prevents an indirect transfer of load from the RWB to Seismic Category I structures. Include in your response a description of the loads that will be transmitted to the NAB by a failure of the RWB and describe how these loads will be accounted for in the design of the LFRS.
11. Examples of a LFRS and collapse zone design concept used in the seismic design of structures that have been built especially structures at nuclear power plants.

Response to Question 03.07.02-64:

AREVA NP will not use a lateral-force resisting system (LFRS) with a controlled collapse zone for the Nuclear Auxiliary Building (NAB). Instead, the NAB is analyzed to safe shutdown earthquake (SSE) load conditions and designed to Seismic Category I codes and standards so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria. Because the NAB does not have a safety function, it may slide or uplift provided that the gap between the NAB and any Category I structure is adequate to prevent interaction. Consequently, no answer is provided for items 1, 2, 3, 5, 9, and 11 of the question.

In addition, AREVA will address Items 7 and 8, interaction between the NAB and Seismic Category I structures, in the response to RAI 335 Question 03.08.04-09.

For the remaining items:

4. The NAB is analyzed and designed using the independent loads and load combinations found in the design codes applicable to Category I structures.

6. NAB seismic analysis is performed in accordance with U.S. EPR FSAR Tier 2, Section 3.7.2. U.S. EPR FSAR Tier 2, Section 3.7.1 includes seismic inputs for Category I structural design. The NAB is analyzed and designed for the same seismic inputs as Category I structures.

   U.S. EPR FSAR Tier 2, Sections 3.3.2.3 and 3.7.2.3.3 will be revised to clarify and distinguished between U.S. EPR design and site-specific conceptual design (i.e., use of [[brackets]].

10. Postulation of the Radioactive Waste Processing Building (RWPB) (a Non-Seismic, Category I structure) collapse and load transfer through the NAB (a Category II structure) to a Category I structure is not required by NRC regulation or guidance. Nevertheless, a qualitative discussion on this postulated interaction is presented:

    The RWPB is a reinforced concrete shear wall structure with a low height to width ratio. It is designed in accordance with RW-IIa criteria as set forth by RG 1.143 and is not adjacent to a Seismic Category I structure. It is designed using the codes and load combinations associated with Category I structures (i.e., ACI-349, AISC N-690) and analyzed for one half SSE. This provides significant lateral force resistance capacity, thus catastrophic collapse of the RWPB during an SSE event is improbable. The NAB is a reinforced concrete structure located adjacent to the RWPB. The NAB is designed using Seismic Category I structural design codes and analyzed to full SSE, which yields an inherently robust design. In the event that the RWPB collapsed and impacted the NAB, damage to the NAB would be limited to local areas. Thus, there is no potential for the RWPB to interact with NI structures.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 3.2.2-1 and Sections 3.3.2.3, 3.7.2.8 and 3.7.2.3.3 will be revised as described in the response and indicated on the enclosed markup.

Question 03.07.02-65:

Follow Up to RAI 248, Question 03.07.02-56:

a) The markup of the U.S. EPR FSAR states on page 3.7-81 that "Category II structures are to be seismically analyzed and supported to prevent transfer of unanalyzed loads to a Category I structure." This implies that an analyzed load could be transferred to a Category I structure from a Seismic Category II structure and is at odds with the applicant's response which states that their collapse does not cause them to strike adjacent Seismic Category I structures. In addition the markup of Table 3.7.2-29 states in column 5 that there is no interaction potential for the TB and AB structures. The applicant is requested to revise the FSAR to resolve this conflict in design requirements for these structures as it relates to their interaction with a Seismic Category I structure.

b) The markup of the U.S.EPR FSAR in describing the interaction of Category I and non-Category I structures states on page 3.7-95 that "The non-Category I structure will be analyzed and designed such that the margin of safety is equivalent to that of a Category I structure." In light of the applicant's proposal to allow the collapse or partial collapse of the NAB, TB and AB, the applicant is requested to explain how the non-Category I structure with potential of seismic interaction has a margin of safety that is equivalent to that of a Category I structure.

c) The markup of Table 1.8-2, COL item 3.7-7 does not require the applicant to verify the separation gap adequacy as reported in the applicant's response. The applicant is requested to correct the wording in item 3.7-7 to include this requirement. In addition, since sliding and overturning could be potential modes of failure that could cause an interaction with a Category I structure, the COL applicant should also be required to verify the sliding and overturning stability of these structures. The applicant is requested to add this requirement to Table 1.8-2.

d) Even if the AB and the TB are the design responsibility of the COL applicant, without additional information, the staff cannot conclude that the design concepts proposed by the applicant are acceptable, i.e. these buildings are designed in such a way that the deformation, collapse, or partial collapse due to SSE loads is controlled by introducing an eccentrically braced frame in steel structures and a "crumple zone" in concrete structures. Specific to the design of the TB and AB, the applicant is requested to provide the following additional information:

For the AB:

1. Describe the design process including the method of analysis that will be applied to this structure and how it will be analyzed for SSE load conditions.
2. Describe whether the whole structure will collapse or only a portion of the structure.
3. Describe the collapse sequence and how the collapse will be controlled under an SSE event such that failure occurs in a direction away from a Category I structure.
4. Describe the design features of the AB that ensures collapse of the structure will occur in a controlled manner.
5. Provide figures that depict the failure of the AB under an SSE load including the controlled collapse zone.

6. The markup of the U.S. EPR FSAR on page 3.7-97 states that evaluation to SSE load confirms that separation gaps between the AB and SB 3 or SB 4 are sufficient to preclude interaction in accordance with SRP 3.7.2 criteria SAC-8A. Describe the evaluation that was done and how this conclusion was reached.
7. The U.S. EPR FSAR on page 3.7-97 states that crossover passageways between the SBs and the AB are designed to accommodate differential displacements without importing unacceptable loads to the supporting structure. As a portion of the AB may collapse under an SSE event the applicant needs to describe how the loads transmitted to the SBs as a result of this event are determined.

<u>For the TB:</u>

1. Describe the design process including the method of analysis that will be applied to this structure and how it will be analyzed to SSE load conditions.
2. Describe whether the whole structure will collapse or only a portion of the structure.
3. Provide a figure of the eccentrically braced frame used to control collapse of the TB in a favorable direction and describe how this design will meet its intended function under an SSE event.
4. Describe the other design features of the structure that will ensure collapse of the structure will occur in a controlled manner.
5. The markup of the U.S. EPR FSAR on page 3.7-97 states that evaluation to SSE loads confirms that the separation gap between the TB and SB 2 and SB 3 is sufficient to preclude interaction and is, thus, in accordance with SRP 3.7.2 acceptance criterion. Describe the evaluation that was done and how this conclusion was reached.

Response to Question 03.07.02-65:

a) AREVA NP will no longer use a lateral-force resisting system (LFRS) with a controlled collapse zone for the Access Building (AB) and Turbine Building (TB). Instead, these buildings are analyzed to site-specific safe shutdown earthquake (SSE) load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Seismic Category I structure with the exception of sliding and overturning criteria. Because Seismic Category II structures do not have a safety function, they may slide or uplift provided that the gap between the Seismic Category II structure and any Category I structure is adequate to prevent interaction. Reference to "unanalyzed loads" will be removed from U.S. EPR FSAR Tier 2, Section 3.7.

   The AB and TB are conceptual design structures. A COL applicant that references the conceptual design in the U.S. EPR design certification will demonstrate that the gap distance between the AB and TB and adjacent Seismic Category I structures is sufficient to prevent interaction resulting from sliding, uplift, or other calculated building displacements such as deflection orsettlement during an SSE event. U.S. EPR FSAR Tier 2, Table 3.7.2-29 will be revised to indicate that the COL applicant will demonstrate that the gap distance from the AB and TB to adjacent Seismic Category I structures is sufficient to prevent interaction.

b) Seismic Category II structures are analyzed to SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Seismic Category I structure with the exception of sliding and overturning criteria. Because Seismic Category II structures do not have a safety function, they may slide, uplift or otherwise displace provided that the gap between the Seismic Category II structure and any Seismic Category I structure is adequate to prevent interaction. No additional change is required to U.S. EPR FSAR Tier 2, Section 3.7.2.8.

c) The AB and TB structures are conceptual designs; are not within the scope of the certified design; and will rely on a separation distance and design evaluation equivalent as described in the response to "a" above. In the U.S. EPR FSAR, the conceptual designs of these structures are denoted by [[double brackets]]. The conceptual gap distances are shown in U.S. EPR FSAR Tier 2, Figure 3B-1. Additional text will be added in U.S. EPR FSAR Tier 2, Section 3.7.2.8 to explain the COL information items. This text will require the COL applicant to demonstrate that the respective gap distances between the AB and Seismic Category I structures and TB and Seismic Category I structures are sufficient to prevent seismic interaction during an SSE event. The COL applicant will also consider sliding, overturning and other calculated building displacements such as deflection or settlement when demonstrating the gap adequacy.

   Because the designs of the AB and TB are conceptual, U.S. EPR FSAR Tier 2, Table 1.8-2, COL Item 3.7-7 will not be changed to include a requirement to demonstrate a specific interaction design solution. The COL applicant may choose to pursue licensing of an alternate design for the AB and TB. U.S. EPR FSAR Tier 2, Table 1.8-2, COL Item 3.7-7 will be revised to specifically address the AB and a new COL Item 3.7-8 will be added for the TB.

d) <u>For the AB</u>

   1-5. No design features will be used to confirm that collapse of the AB will occur in a controlled manner. Instead, the AB will be analyzed and designed to not collapse during an SSE event as described in part "a" of this response.

   6. Because the AB is a site-specific building, U.S. EPR FSAR Tier 2, Section 3.7.2.8 will be revised to require the COL applicant to verify the adequacy of the gap distance between the AB and SB3 and between the AB and SB4, as described in part "c" of this response. No figures are provided.

   7. The AB will be analyzed and designed to not collapse during an SSE event as described in part "a" of this response. Loads resulting from collapse of the AB are not transmitted to the SBs through the crossover passageways between the SBs and the AB.

   <u>For the TB</u>

   1-4. No design features will be used to confirm that collapse of the TB will occur in a controlled manner. Instead, the TB will be analyzed and designed to not collapse during an SSE event as described in part "a" of this response. No figures are provided.

5. Because the TB is a site-specific building, U.S. EPR FSAR Tier 2, Section 3.7.2.8 will be revised to require the COL applicant to verify the adequacy of the gap distance between the TB and SB2 and SB3, as described in part "c" of this response.

In addition, U.S. EPR FSAR Tier 2, Section 3.7.2.8 is revised to remove crossover passageways between the Access Building and SBs and Turbine Building and NI Common Basemat Structures. Crossover passageways are not included in the U.S. EPR design.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 1.8-2, Table 3.2.2-1, Sections 3.7.2.3.3 and 3.7.2.8, Table 3.7.2-29, and Figure 3B-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 16 of 55

Item No.	Description	Section	Action Required by COL Applicant	Action Required by COL Holder
3.7-5	A COL applicant that references the U.S. EPR design certification will determine if a suitable location exists for the free-field acceleration sensor. The mounting location must be such that the effects associated with surface features, buildings, and components on the recordings of ground motion are insignificant. The acceleration sensor must be based on material representative of that upon which the Nuclear Island (NI) and other Seismic Category I structures are founded.	3.7.4.2.1	Y	
3.7-6	A COL applicant that references the US EPR design certification will provide the seismic design basis for the sources of fire protection water supply for safe plant shutdown in the event of a SSE.	3.7.2.8	Y	
3.7-7	A COL applicant that references the U.S. EPR design certification will demonstrate that the response of the Access Building to an SSE event will not impair the ability of Seismic Category I systems, structures, or components to perform their design basis safety functions.	3.7.2.8		
3.7-8	A COL applicant that references the U.S. EPR design certification will demonstrate that the response of the TB (including Switchgear Building on the common basemat) to an SSE event will not impair the ability of Seismic Category I systems, structures, or components to perform their design basis safety functions.	3.7.2.8		
3.8-1	A COL applicant that references the U.S. EPR design certification will confirm that site-specific loads lie within the standard plant design envelope for the Reactor Containment Building, or perform additional analyses to verify structural adequacy.	3.8.1.3	Y	
3.8-2	A COL applicant that references the U.S. EPR design certification will describe any differences between the standard plant layout and design of Seismic Category I structures required for site-specific conditions.	3.8.4.1	Y	

03.07.02-65

Table 3.2.2-1—Classification Summary
Sheet 154 of 186

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
PA	**Circulating Water Supply System**	NS	E	NSC	No	UMA, UZT	
STRUCTURES							
UFA, UJA, UJB, UJH, UJK, UJE, JM	**Nuclear Island Structural System (Fuel, Reactor, Safeguard Buildings)**	S	N/A	I	Yes	UFA, UJA, UJB, UJH, UJK, UJE, JM	
JMK	Piping Containment Penetrations	S	B	I	Yes	UJA, UJB	ASME Class 2[2]
JML	Cable Containment Penetrations	S	B	I	Yes	UJA, UJB	ASME Class 2[2]
UBP	**Emergency Power Generating Buildings**	S	N/A	I	Yes	UBP	
URB	**Essential Service Water Cooling Tower Structures**	S	N/A	I	Yes	URB	
UQB	**Essential Service Water Pump Buildings**	S	N/A	I	Yes	UQB	
UKA	**Nuclear Auxiliary Building**	NS-AQ	N/A	RS, ~~CS~~II	~~No~~Yes	UKA	

03.07.02-64

Table 3.2.2-1—Classification Summary
Sheet 155 of 186

03.07.02-65

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
UKS	**Radioactive Waste Processing Building**	NS-AQ	N/A	RS~~, CS~~	No	UKS	
UKH	**Vent Stack**	~~NS-AQ~~S	N/A	~~II~~I	Yes	UKH	
[[UMA, UBA	Turbine Building (Switchgear Building)	NS-AQ	N/A	II	Yes	UMA, UBA]]	
[[UKE	Access Building	NS-AQ	N/A	II	Yes	UKE]]	
SM, SN	**Cranes, Hoists, and Elevators**						
SMJ06	Assembly Crane	NS-AQ	N/A	II	Yes	UJA	ASME NUM-1
SM	Balance of Cranes and Hoists	NS	N/A	NSC	No	All	ASME NOG-1, ASME NUM-1
~~SMK14~~	~~Decontamination Area Crane~~	~~NS~~	~~N/A~~	~~NSC~~	~~No~~	~~UKS~~	~~ASME NUM-1~~
SMB11/12/21/31/41/42	Diesel Hall Cranes	NS-AQ	N/A	II~~NSC~~	Yes~~No~~	UBP	ASME NUM-1
SMK12	Drum Storage Area Crane	NS	N/A	NSC	No	UKS	ASME NOG-1
SN	Elevators	NS	N/A	NSC	No	UJA	ASME A17.1
SMK11	Entrance Area Crane	NS	N/A	NSC	No	UKS	ASME NOG-1
SMF02/03	Equipment Lock Cranes	NS-AQ	N/A	II	Yes	UFA	ASME NOG-1, ASME NUM-1

Table 3.2.2-1—Classification Summary
Sheet 156 of 186

KKS System or Component Code	SSC Description	Safety Classification (Note 15)	Quality Group Classification	Seismic Category (Note 16)	10 CFR 50 Appendix B Program (Note 5)	Location (Note 17)	Comments/ Commercial Code
SMK01	Hot Workshop Crane	NS	N/A	NSC	No	UKA	ASME NOG-1
SMK13	Hot Workshop Crane	NS	N/A	NSC	No	UKS	ASME NOG-1
SMJ02/03/04/05	HVAC Equipment Room Cranes	NS-AQ	N/A	II	Yes	UJA	ASME NUM-1
SMJ32/33/34/35	Main Steam Valve Station Cranes	NS-AQ	N/A	II	Yes	UJH	ASME NUM-1
SMQ05/06/07/08	Pump Room Cranes	NS-AQ	N/A	II	Yes	UQB	ASME NUM-1
SMA01	Manual Hoists	NS	N/A	NSC	No	All	ANSI/ASME B30.11, ANSI/ ASME B30.21
SMZ01	Outdoor Crane	NS-AQ	N/A	II	Yes	UZT	ASME NOG-1
SMJ01	Polar Crane	NS-AQ	N/A	II	Yes	UJA	ASME NOG-1
SMJ07/08/09/10	Steam Generator Cubicle Cranes	NS-AQ	N/A	II	Yes	UJA	ASME NUM-1
~~((UKE~~	~~Access Building~~	~~NS-AQ~~	~~N/A~~	~~CS~~	~~No~~	~~UKE~~	
[[UBZ	**Buried Conduit Duct Bank**	S	N/A	I	Yes	UBZ]]~~))~~	
HVAC SYSTEMS							
SAB	**Main Control Room Air Conditioning System**						
30SAB11/14 AT003	Carbon Adsorbers	S	C	I	Yes	UJK	ASME AG-1[14]

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Effective tornado wind pressure loads (W_w) on exterior surfaces of structural elements and members are determined in conformance with the applicable requirements of Reference 1, Sections 6.5.12 and 6.5.13. Gust factors are taken as unity for tornado wind.

Tornado atmospheric pressure change effect parameters (W_p) and tornado-generated missile impact parameters (W_m) are in conformance with RG 1.76.

The following combinations of the parameters of the total tornado load (W_t) are evaluated in the design of Seismic Category I structures and Seismic Category II structures, where W_w is the load from tornado wind effect, W_p is the load from tornado atmospheric pressure change effect, and W_m is the load from tornado missile impact effect:

$$W_t = W_p$$

$$W_t = W_w + 0.5W_p + W_m$$

Exterior walls and roofs of Seismic Category I structures are designed for the maximum differential pressure of 1.2 psi. When the tornado pressure boundary is not established by exterior walls or roofs, the differential pressure is taken as zero.

3.3.2.3 Interaction of Non-Seismic Category I Structures with Seismic Category I Structures

The non-Seismic Category I structures that are adjacent to the Seismic Category I Nuclear Island Common Basemat Structure, Emergency Power Generation Buildings (EPGB), and Essential Service Water Buildings (ESWB) include the Nuclear Auxiliary Building (NAB), Radioactive Waste Building (RWB), Access Building (ACB), and Turbine Building (TB). Figure 3B-1 provides a site plan of the U.S. EPR standard plant showing the plant layout.

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The NAB is a non-Seismic Category I structure. However, due to the proximity of this structure to Seismic Category I structures, there is potential for tornado wind load induced interaction. Therefore, this structure is analyzed using RG 1.76 tornado wind characteristics and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria. Because the NAB does not have a safety function, the NAB may slide or uplift provided that the gap between the NAB and any Category I structure is adequate to prevent interaction.

The ~~NAB,~~ ACB, and TB are non-Seismic Category 1 structures. However, due to proximity of these structures to Seismic Category 1 structures there is a potential for tornado wind load induced interaction. [[Therefore, these structures are analyzed using RG 1.76 tornado wind characteristics and designed to the codes and standards

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associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria. Because the NAB, ACB, and TB do not have a safety function, they may slide or uplift provided that the gap between them and any Category I structure is adequate to prevent interaction.]]

The RWPB is a reinforced concrete shear wall structure designed for tornado loading per RG 1.143 due to its classification as a RW-IIa structure. The NAB is a reinforced concrete structure located between the RWPB and the NI. Both the RWPB and the NAB are designed using the codes associated with Category I structures, resulting in inherently robust designs. Therefore, there is no potential for indirect interaction between the RWPB and the NI structures. Potential interaction between the RWB and the EPGB is precluded by separation and design. The RWB is embedded over 31.5 ft below grade and has a clear height above grade of 52.5 ft; whereas, the clearance between the two structures is 52.06 ft.

3.3.3 References

1. ASCE/SEI Standard 7-05, “Minimum Design Loads for Buildings and Other Structures,” American Society of Civil Engineers/Structural Engineering Institute, 2005.

2. ASCE paper No. 3269, “Wind Forces on Structures,” Transactions of the American Society of Civil Engineers, Vol. 126, Part II, 1961.

3. Deleted.

4. Deleted.

5. Deleted.

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the EPGB, modifications are made to the slab stiffness at elevation +51 ft, 6 inches to accurately represent the stiffness of composite beams. For the ESWB, two additional modeling features are used:

- Space frame elements are used to simulate the fill support beams and the distribution header supports.
- Rigid water mass, calculated in accordance with the procedure in ASCE 4-98, Reference 1 and ACI 350.3 (Reference 3), is lumped on the appropriate basin walls. Both low water and high water level are separately considered.

Figure 3.7.2-57—Isometric View of GTSTRUDL FEM for Emergency Power Generating Building and Figure 3.7.2-58—Section View of GTSTRUDL FEM for Emergency Power Generating Building illustrate an isometric view and a section view of the 3D FEM of the EPGB. Figure 3.7.2-59—Isometric View of GTSTRUDL FEM for Essential Service Water Building and Figure 3.7.2-60—Section View of GTSTRUDL FEM for Essential Service Water Building, depict the 3D FEM of the ESWB.

For walls and slabs, adjustment is made to account for cracked section properties. Specifically, a value of $0.5E_c$ is typically used to determine out-of-plane stiffness of these concrete walls and floors. There remains the possibility that the wall stiffness may be between the fully cracked and uncracked conditions. To bound the dynamic response in the SSI analysis, SDOF out-of-plane oscillators based on uncracked section properties are included in the SASSI model at the center of selected slabs and walls.

3.7.2.3.3 Seismic Category II Structures

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Non-Seismic Category I structures with potential to impair the design basis safety function of a Seismic Category I SSC will be classified as Seismic Category II in accordance with the criteria identified in Section 3.2.1.2. {{Seismic Category II structures that are included in the U.S. EPR design are analyzed to SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria.}} Because Category II structures do not have a safety function, they may slide or uplift provided that the gap between the Category II structure and any Category I structure is adequate to prevent interaction. Procurement, quality control, and QA requirements for Category II structures will be performed according to the guidance provided in Section 3.2.1.2. Site-specific Seismic Category II structures are addressed in Section 3.2.7-8.

3.7.2.3.4 Conventional Seismic (CS) Structures

The analysis and design of Conventional Seismic building structures will be in accordance with the applicable requirements of the International Building Code (IBC)

Access Building

The Access Building is a non-Seismic Category I structure for which continued operation during an SSE event is not required. The Access Building is classified as Seismic Category II based on its proximity to the NI, a Seismic Category I structure. [[The Access Building is analyzed to site-specific SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria. Because the Access Building does not have a safety function, it may slide or uplift provided that the gap between the Access Building and any Category I structure is adequate to prevent interaction. The effects of sliding, overturning, and any other calculated building displacements (e.g., building deflections, settlement) must be considered when demonstrating the gap adequacy between the Access Building and adjacent Category I structures. The separation gaps between the Access Building and SBs 3 and 4 are 0.98 ft and 1.31 ft, respectively (see Figure 3B-1).]] The walls of the Access Building are not physically connected to the SBs ~~except through crossovers (passageways) providing access to the SBs~~. SB 3 is protected by the aircraft hazard (ACH) shield wall which not only protects the structure, but also isolates control room personnel from adverse impact effects. SB 4 is not protected by the ACH shield wall~~. The crossover passageways are designed to accommodate the differential displacements without imparting unacceptable loads to the supporting structures.~~

A COL applicant that references the U.S. EPR design certification will demonstrate that the response of the Access Building to an SSE event will not impair the ability of Seismic Category I systems, structures, or components to perform their design basis safety functions.

For COL applicants that incorporate the conceptual design for the Access Building presented in the U.S. EPR FSAR (i.e., [[the Access Building is analyzed to site-specific SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria]]), this COL item is addressed by demonstrating that the gap between the Access Building and adjacent Category I structures is sufficient to prevent interaction. The effects of sliding, overturning, and any other calculated building displacements (e.g., building deflections, settlement) must be considered when demonstrating the gap adequacy between the Access Building and adjacent Category I structures.

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Turbine Building

The TB (including Switchgear Building on the common basemat) is a non-Seismic Category I structure for which continued operation during an SSE event is not required. The TB is classified as Seismic Category II based on its proximity to the NI, a

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Seismic Category I structure. [[The TB is analyzed to site-specific SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria. Because the TB does not have a safety function, it may slide or uplift provided that the gap between the TB and any Category I structure is adequate to prevent interaction. The effects of sliding, overturning, and any other calculated building displacements (e.g., building deflections, settlement) must be considered when demonstrating the gap adequacy between the TB and adjacent Category I structures. The separation between the TB and NI Common Basemat Structures is approximately 30 ft (see Figure 3B-1).]] ~~Crossovers from the TB to the NI Common Basemat Structures are supported primarily by the walls or roof of the ACH shield structure. Seismic interaction through the crossover is between the TB and the ACH shield structure rather than with SBs 2 and 3. Design measures limit the interaction forces between the NI Common Basemat Structures and TB transmitted through the crossover structures. The ACH shield structure and design measures isolate control room personnel from adverse effects of the interaction forces generated through the crossover structures.~~

A COL applicant that references the U.S. EPR design certification will demonstrate that the response of the TB (including Switchgear Building on the common basemat) to an SSE event will not impair the ability of Seismic Category I systems, structures, or components to perform their design basis safety functions.

For COL applicants that incorporate the conceptual design for the TB presented in the U.S. EPR FSAR (i.e., [[the TB is analyzed to site-specific SSE load conditions and designed to the codes and standards associated with Seismic Category I structures so that the margin of safety is equivalent to that of a Category I structure with the exception of sliding and overturning criteria]]), this COL item is addressed by demonstrating that the gap between the TB and adjacent Category I structures is sufficient to prevent interaction. The effects of sliding, overturning, and any other calculated building displacements (e.g., building deflections, settlement) must be considered when demonstrating the gap adequacy between the TB and adjacent Category I structures.

Radioactive Waste Building

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The RWB has no significant potential to seismically interact with either the NI Common Basemat Structures or with the nearest Seismic Category I structure not on the common basemat (i.e., the EPGB) therefore, the RWB is not evaluated for SSE. The RWB is a reinforced concrete shear wall structure with a low height-to-width ratio. It is designed according to RW-IIa criteria in RG 1.143; thus it is designed using the codes and standards, and load combinations associated with Category I structures (i.e., ACI-349, AISC N-690) and analyzed for 1/2 SSE. This provides significant lateral force resistance capacity, thus catastrophic collapse of the RWB during an SSE event is

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unlikely. The NAB is a reinforced concrete structure located between the RWB and the NI. The NAB is designed using the codes associated with Category I structures and analyzed to full SSE, resulting in an inherently robust design. If the RWB were to collapse and impact the NAB, the damage to the NAB would be limited to local areas. Therefore, there is no potential for indirect interaction between the RWB and the NI structures.

Potential interaction between the RWB and EPGB is precluded by separation and by design and site selection and foundation design criteria for the RWB. The RWB is embedded a significant distance below grade and has a clear height above grade of +52.5 ft, while the clearance between the RWB and EPGB is at least 49.5 ft (see Figure 3B-1). Therefore, the separation between the two is only a small distance less than the height above grade of the RWB. Failure of the RWB in such a manner as to strike the EPGB is not considered credible due to the separation distance and because of the seismic design for 1/2 SSE loading described above. In addition, site selection and foundation design criteria for the U.S. EPR standard plant ensure that the RWB is founded on competent soils, while the embedded section below grade provides additional stabilization against rotation.

[[Fire Protection Storage Tanks and Buildings]]

[[The Fire Protection Storage Tanks and Buildings are classified as Conventional Seismic Structures.]] RG 1.189 requires that a water supply be provided for manual firefighting in areas containing equipment for safe plant shutdown in the event of a SSE. [[The fire protection storage tanks and building are designed to provide system pressure integrity under SSE loading conditions. Seismic load combinations are developed in accordance with the requirements of ASCE 43-05 using a limiting acceptance condition for the structure characterized as essentially elastic behavior with no damage (i.e., Limit State D) as specified in the Standard.]]

The Fire Protection Storage Tanks and Buildings are site-specific structures. A COL applicant that references the U.S. EPR design certification will provide the seismic design basis for the sources of fire protection water supply for safe plant shutdown in the event of a SSE.

3.7.2.9 Effects of Parameter Variations on Floor Response Spectra

Uncertainties in seismic modeling, due to such items as uncertainties in material properties, mass properties, concrete cracking under normal loading, and structural and soil modeling techniques can affect the accuracy of floor response spectra calculated using any of the approaches for seismic analysis presented in Section 3.7.2.1. To compensate for the effect of these uncertainties, the ISRS for U.S. EPR Seismic Category I structures are broadened by ±15 percent. These broadened ISRS are used in

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Table 3.7.2-29—Seismic Structural Interaction Criteria for Building Structures

Basis: Control Interaction through Prevention of Structure-to-Structure Impact[4]				
Structure	**Seismic Category**	**Design Code**	**Seismic Interaction[1] Criteria**	**Seismic Interaction Evaluation**
Turbine / SBO	CSII	IBC[2] Steel – [[AISC 341N690]] Concrete – [[ACI 318349]]	Site-specific SSE	Collapse Load Evaluation or ASCE 43-05 – Limit State A[[COL applicant will demonstrate that there is not interaction potential]]
Access	CSII	IBC[2] ACI 318[[AISC N690]] [[ACI 349]]	Site-specific SSE	ASCE 43-05 – Limit State A[[COL applicant will demonstrate that there is not interaction potential]]
NAB	CSII RS	IBC[2] ACI 318AISC N690 ACI 349[3]	SSE[1]	ASCE 43-05, Limit State ANo Interaction Potential
RWPB	CS RS	IBC[2] ACI 318AISC N690[3] ACI 349[3]	None[1]	No Interaction Potential

Notes:

1. The NAB and RWPB, as a Rradwaste Sstructures, are alsois designed for the ½ SSE in accordance with the guidance for RW-IIa structures in RG 1.143.
2. Seismic design criteria for IBC-based design to be based on SSE with design forces and moments modified per ASCE 43-05 for design to SDC 5, Limit State ADeleted.
3. ACI 349 and AISC N690 required due to Radwaste Seismic classification.
4. This table is not applicable to equipment and subsystems qualification criteria.

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Figure 3B-1—Dimensional Arrangement Reference Plant Building Location

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