ArevaEPRDCPEm Resource

From:	BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
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
Attachments:	RAI 370 Response US EPR DC.pdf

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.
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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: 1344

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Response to

Request for Additional Information No. 370

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 03.07.01-27:

Follow Up to RAI 248, Question 03.07.01-25

In NUREG/CR6919 "Recommendations for Revision of Seismic Damping Values in Regulatory Guide 1.61" it states on page 6 "If significant stresses due to load combinations that include SSE are less than 80 percent of the applicable code stress limits, then using SSE damping values may under-predict the structure's response to seismic loads. In this case structural evaluation and development of in-structure response spectra should be based on a seismic analysis utilizing the OBE damping values specified in Table 2." The OBE damping value in Table 2 recommended for reinforced concrete is 4 percent. In the tables provided in the applicant's response there are only 14 instances where one of the load components results in a stress that exceeds 80 percent of the allowable stress. In addition the locations in the table are at critical sections of the NI common basemat structures. Other locations may have stress levels lower than those presented in the applicant's response. Thus the staff believes it does not have sufficient information to justify the use of SSE damping for the generation of ISRS. The staff is requesting that the applicant provide additional information on the state of stress within the NI common basemat structures (such as stress contours from the GT STRUDL model) to support its position on the use of SSE structural damping values. Justification for the use of SSE damping values for the generation of ISRS should also be provided in the FSAR.

Response to Question 03.07.01-27:

A response to this question will be provided by August 3, 2010.

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:

A response to this question will be provided by June 10, 2010.

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.

For the TB:

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 response to this question will be provided by June 10, 2010.

Question 03.07.03-38:

Follow Up to RAI 215, Question 03.07.03-32:

In its markup of the FSAR the applicant has identified two approaches for non seismic SSC that could impact a Seismic Category I SSC. In the first approach, if the non seismic SSC can impact a Seismic Category I SSC, an evaluation is performed to determine if the target has significant structural integrity to withstand impact without loss of ability to perform its safety-related function. Since there is a risk that the Seismic Category I SSC may not be able to perform its safety-related function due to the impact of a non seismic SSC, the applicant is requested to provide an example of how such an interaction evaluation will be performed and include this information in the FSAR. In addition, the ability of an SSC to perform its safety related function goes beyond maintaining its structural integrity. If the SSC performs a control function, that function could be impaired by the impact of the non-seismic SSC which could cause an unacceptable acceleration or vibration of the safety-related SSC. The applicant needs to address this condition of interaction and describe how it will be evaluated.

In the second approach, if an unacceptable interaction can occur between a Seismic Category I SSC and non seismic SSC, the non seismic SSC is classified as Seismic Category II. These are then “analyzed and supported so that an SSE event does not cause an unacceptable interaction with the Seismic Category I item, in accordance with the provisions of SRP 3.7.2-SAC II-8.” In this approach the applicant in its response states that the full SSE load is applied to the Seismic Category II SSC. However this is not stated in the FSAR. As it appears that it is acceptable for some type of interaction to occur under this approach, the applicant needs to describe under what types of situations this might be used and give examples of its application. The applicant should include in the FSAR and in its response the following information:

1. How the SSE load acting on the non-seismic SSC is determined.
2. How the impact load is calculated on the Seismic Category I SSC.
3. How it is determined that the Seismic Category I SSC maintains its safety function and that the seismic qualification of the component or piece of equipment is not invalidated.
4. How it is assured that after impact that the non-seismic SSC doesn’t collapse or fall on the Seismic Category I SSC.
5. The code and code allowables that apply to Seismic Category II SSCs subjected to the SSE loads.

Response to Question 03.07.03-38:

A response to this question will be provided by June 10, 2010.

Question 03.07.03-39:

Follow Up to RAI 291, Question 03.07.03-36

A. In its response to Question 03.07.03-36, the applicant provided a markup to page 3.7-309 of the U.S. EPR FSAR. The first bullet of the markup states "If the first seismic restraint beyond the Seismic Category I subsystem boundary is an anchor restraining the Category I subsystem in all six degrees of freedom, the analysis model includes only the Category I subsystem up to the anchor, which is designed to accept loads from both the Category I subsystem and the non-seismic subsystem." The applicant is requested to provide further clarification as follows:

   1. If the Category I system terminates prior to the anchor, the applicant is requested to amend the first bullet to state that the analysis model includes the Category I system and any extended portion of the system which is Category II up to the anchor defining the analysis boundary and provide the design requirements imposed on the included Category II portion of the seismic subsystem model. If not designed to Seismic Category I requirements the applicant is requested to provide the requirements that do apply and provide their technical justification. These should be included in the FSAR.

   2. The applicant states that the anchor is designed to accept subsystem loads from the side containing the Category I subsystem as well as the loads on the other side of the anchor from the non-seismic subsystem. The applicant should provide and include in the FSAR the method for determining the loads from the non seismic side caused by a seismic event.

B. The second bullet of the markup to page 3.7-309 states "If the first seismic restraint cannot be an anchor the non-seismic subsystem and supports beyond this location that affect the seismic Category I subsystem dynamic analysis are classified Seismic Category II, included in the model and designed to the same requirements as Seismic Category I supports." Additional clarifications are needed in this regard as follows:

   1. The last part of the criteria needs to be explained as it is not clear how the included Seismic Category II portion of the seismic subsystem model is designed to the requirements of Seismic Category I supports.

   2. The applicant is requested to provide in the FSAR the design requirements for the Seismic Category II portion of the model and if not designed to Seismic Category I requirements the applicant should provide a technical justification for not doing so.

Response to Question 03.07.03-39:

A.

1. U.S. EPR FSAR Tier 2, Section 3.7.3.8 will be revised to include the following statements: "…the analysis model includes the Seismic Category I system and any extended portion of the system which is Seismic Category II up to the anchor defining the analysis boundary. The subsystem components in the analysis boundary will be designed to Seismic Category I requirements."

2. Topical Report ANP-10264NP-A, Revision 0, "U.S. EPR Piping Analysis and Pipe Support Design," Section 5.5 provides the approved methodology for generating anchor design loads

imposed from the non-seismic side of the boundary. U.S. EPR FSAR Tier 2, Section 3.7.3.8 will be revised to reference Section 5.5 of Topical Report ANP-10264NP-A.

B.

1. U.S. EPR FSAR Tier 2, Section 3.7.3.8, second bullet, will be revised to state: “If the first seismic restraint cannot be an anchor, the non-seismic subsystem and supports beyond this location that affect the Seismic Category I subsystem dynamic analysis are classified Seismic Category II, included in the model and designed to the same requirements as Seismic Category I components.”
2. As stated in the Response to A.1, the Seismic Category II subsystem is designed to Seismic Category I requirements.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.7.3.8 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

These modal results are combined with the low frequency modal results using the methods described in Section 3.7.3.7.1.

For multiply supported systems analyzed using ISM, the rigid range (missing mass) results will be combined with the low frequency modal results by SRSS, per Reference 8, Volume 4. All of the provisions of Reference 8 for the ISM method of analysis will be followed. For ISM, the responses in the rigid range are considered in phase and combined by algebraic summation and the total rigid response will then be combined with the modal results by SRSS.

3.7.3.8 Interaction of Other Systems with Seismic Category I Systems

The U.S. EPR uses state-of-the-art computer modeling tools for design and location of structures, subsystems, equipment, and piping. These same tools are used to minimize interactions of seismic and non-seismic components, making it possible to protect Seismic Category I subsystems from adverse interactions with non-seismic subsystem components. In the design of the U.S. EPR, the primary method of protection for seismic SSC is isolation from each non-seismically analyzed SSC. In cases where it is not possible, or practical to isolate the seismic SSC, adjacent non-seismic SSC are classified as Seismic Category II and analyzed and supported so that an SSE event does not cause an unacceptable interaction with the Seismic Category I items, in accordance with the provisions of SRP 3.7.2-SAC II-8. However, for non-seismic subsystems classified as Seismic Category II, inelastic analytical methods may be used, if necessary. The non-seismic classification of SSC located in the vicinity of safety-related SSC, may be retained if Aan interaction evaluation may be performed to demonstrates that the interaction does not prevent the Seismic Category I distribution subsystem SSC from performing its safety-related function.

For non-seismic subsystems attached to seismic subsystems, the dynamic effects of the non-seismic subsystem are accounted for in the modeling of the seismic subsystem. The attached non-seismic subsystem, classified as Seismic Category II, is designed to preclude the effect of causing failure of the seismic subsystem during a seismic event. Section 3.7.3.3 describes decoupling criteria used to determine if the flexibility of the non-seismic subsystem is included in the subsystem model.

Seismic Category I subsystem design requirements extend to the first seismic restraint beyond the system boundary with non-seismic subsystems. In addition, the following requirements must be met:

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- If the first seismic restraint beyond the Seismic Category I subsystem boundary is an anchor restraining the Category I subsystem in the six degrees of freedom, the analysis model includes the Category I system and any extended portion of the system which is Category II up to the anchor defining the analysis boundary. The subsystem components within the analysis boundary will be designed to Seismic

Category I requirements. Loads from the non-seismic subsystem will be developed as described in Section 5.5 of Reference 1.

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- If the first seismic restraint cannot be an anchor, the non-seismic subsystem and supports beyond this location that affect the Seismic Category I subsystem dynamic analysis are classified Seismic Category II, included in the model, and designed to the same requirements as Seismic Category I components. Loads from the non-seismic subsystem will be developed as described in Section 5.5 of Reference 1.

Boundary conditions of the model at the seismic to non-seismic interface are described in Section 5.5 of Reference 1.

3.7.3.8.1 Isolation of Seismic and Non-Seismic Systems

Isolation of seismic and non-seismic subsystems is provided by either geographical separation or by the use of physical barriers. Isolation minimizes the interaction effects that must be considered for the seismic systems and minimizes the number of non-seismic subsystems requiring more rigorous analysis.

Several routing considerations are used to isolate seismic and non-seismic subsystems. When possible, non-seismic SSC are not routed in rooms containing safety-related SSC. Non-seismic SSC that can not be completely separated from seismic SSC must be shown to have no interaction with the seismic systems based on separation distance or an intermediate barrier, or be classified as Seismic Category II. To the extent possible, non-seismic systems are not routed close to any safety-related components.

3.7.3.8.2 Interaction Evaluation

Non-seismic SSC may be located in the vicinity of safety-related SSC without being qualified as Seismic Category II, provided an impact evaluation is performed to verify that no possible adverse impacts occur. In this evaluation, the non-seismic components are assumed to fall or overturn as a result of a seismic event. Any safety-related subsystem or component which may be impacted by the non-seismic component is identified as an interaction target and is evaluated to establish that there is no loss of ability to perform its safety-related function.

The following assumptions and guidelines are used to evaluate non-seismic and seismic interactions, resulting from an SSE seismic event:

~~As a result of the seismic event:~~

- ~~Every non-seismic hanger on the non-seismic distribution subsystems is assumed to fail instantaneously.~~
- ~~Every connection on the non-seismic distribution subsystem is assumed to fail, thus allowing each section of a subsystem to fall independently.~~