ArevaEPRDCPEm Resource

From: Tesfaye, Getachew
Sent: Monday, November 30, 2009 12:44 PM
To: 'usepr@areva.com'
Cc: Xu, Jim; Hawkins, Kimberly; Patel, Jay; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: Draft - U.S. EPR Design Certification Application RAI No. 335 (4059, 4061), FSAR Ch. 3
Attachments: Draft RAI_335_SEB2_4059-4061.doc

Attached please find draft RAI No. 335 regarding your application for standard design certification of the U.S. EPR. If you have any question or need clarifications regarding this RAI, please let me know as soon as possible, I will have our technical Staff available to discuss them with you.

Please also review the RAI to ensure that we have not inadvertently included proprietary information. If there are any proprietary information, please let me know within the next ten days. If I do not hear from you within the next ten days, I will assume there are none and will make the draft RAI publicly available.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 994

Mail Envelope Properties (0A64B42AAA8FD4418CE1EB5240A6FED107A3CADA71)

Subject: Draft - U.S. EPR Design Certification Application RAI No. 335 (4059, 4061), FSAR Ch. 3
Sent Date: 11/30/2009 12:44:23 PM
Received Date: 11/30/2009 12:44:24 PM
From: Tesfaye, Getachew

Created By: Getachew.Tesfaye@nrc.gov

Recipients:
"Xu, Jim" <Jim.Xu@nrc.gov>
Tracking Status: None
"Hawkins, Kimberly" <Kimberly.Hawkins@nrc.gov>
Tracking Status: None
"Patel, Jay" <Jay.Patel@nrc.gov>
Tracking Status: None
"Miernicki, Michael" <Michael.Miernicki@nrc.gov>
Tracking Status: None
"Colaccino, Joseph" <Joseph.Colaccino@nrc.gov>
Tracking Status: None
"ArevaEPRDCPEm Resource" <ArevaEPRDCPEm.Resource@nrc.gov>
Tracking Status: None
"'usepr@areva.com'" <usepr@areva.com>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	727	11/30/2009 12:44:24 PM
Draft RAI_335_SEB2_4059-4061.doc	53242	

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

Draft

Request for Additional Information No. 335 (4059, 4061) Revision 0

11/30/2009

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)

03.08.01-44

Follow-up to RAI Question 03.08.01-9

The response to the RAI indicates that a nonlinear FE analysis was performed to show that design forces and moments are not significantly modified by considering cracked section properties for loads other than thermal loads.

In order to resolve this RAI, provide the following information:

a. Further explanation of the loading applied to the nonlinear FE model. The response states that: “First the models are subjected to a structural integrity test, then to an accidental temperature and pressure loading, and lastly to a pressure loading.” In the case of the linear model, the order in which the loads are applied should not change the analysis results. In the case of the nonlinear model, clarify: (a) whether the three series of loads are applied in an incremental manner; (b) whether the “structural integrity test” loads correspond to load cases identified as Pt and Tt in the FSAR; (c) whether the “accidental temperature and pressure loads” correspond to simultaneous application of load cases identified as Pa and Ta in the FSAR; (d) whether load cases Pa and Ta are jointly applied, incrementally, for the four critical time points identified from the temperature and pressure transient analysis; (e) what is the load case that corresponds to the final stage of “pressure loads.”

b. A summary of representative results (including worst case(s)) that show the range of variation in forces and moments obtained from both linear and nonlinear analyses.

c. The RAI response does not address the effects of concrete cracking on the analysis and design of the RCB for seismic loads. The staff notes that SRP Section 3.8.1 Item II.4.D indicates that “based on load combinations that include the design pressure load with earthquake loads, additional concrete cracking would be expected to occur. Concrete cracking can cause redistribution of member forces because of the various loadings applied to the structure. Concrete cracking can also affect the stiffness of the containment and cause shifting of the natural frequency, thereby affecting the response/loads used to design the containment. Accordingly, the analysis used to calculate the dynamic response of the containment resulting from dynamic loads

such as earthquake and hydrodynamic loads (if applicable) needs to consider the potential effects of concrete cracking, if significant. The approach used should include the effect of redistribution of the various loads caused by concrete cracking." Consequently, provide a discussion on how the effects of concrete cracking (if significant) affect the analysis and design of the RCB, for seismic and other loads not considered in the RAI response.

d. The FSAR does not discuss the effects of concrete cracking on the analysis and design of other (non-RCB) Seismic Category I concrete structures. Explain in greater detail how the effects of concrete cracking (if significant) are being considered in the analysis and design of other (non-RCB) Seismic Category I concrete structures, and include this information in FSAR Sections 3.8.3 through 3.8.5.

03.08.01-45

Follow-up to RAI Question 03.08.01-11

In the original RAI, AREVA was requested to provide a Design Summary report consistent with the guidance provided for such reports that is presented in Appendix C of SRP Section 3.8.4. AREVA has instead decided to include relevant design information and calculation results in Sections 2.0, 2.4, 2.5, 3.3, 3.5, 3.8.1 through 3.8.5, and Appendix 3E of the FSAR. The staff has a concern that the design information presented in this manner may not be complete and presents a difficulty in ensuring that it is also technically acceptable in accordance with the guidance provided in Appendix C of SRP 3.8.4. Therefore, AREVA is requested to provide the relevant design information in one of the following forms: (1) separate AREVA Design Report or calculation, (2) include all of the required design information in one area of the FSAR, or (3) provide a detailed cross-reference which identifies the specific FSAR subsections that contain the information corresponding to each item listed in Appendix C of SRP Section 3.8.4, for all Seismic Category I structures.

03.08.01-46

Follow-up to RAI Question 03.08.01-17

AREVA provided the criterion/basis used to include only the equipment hatch, personnel air lock, site access opening (construction opening), and emergency air lock in the overall computer model of the RCB, as well as the methodology for evaluation of more refined submodels for the local design of the regions near these openings. It is not clear from the RAI response if submodels for the remaining smaller openings (i.e. main steam line, feed water line, and smaller) were also created.

To complete the response to this RAI, clarify whether submodels for the smaller openings (i.e. main steam line, feed water line, and smaller) were also created. If they were not, provide the technical basis for not doing so and indicate how the design of the regions near these smaller openings is performed.

03.08.04-8

Follow-up to RAI Question 03.08.04-3

a. The response to Item 2 of the RAI describes a procedure for determining the live load effects on buried items such as pipe, pipe ducts, conduit, and duct banks. This procedure follows the "Guidelines for the Design of Buried Steel Pipe" (American Lifelines Alliance, 2001). Specific live loads described in this guideline document for trucks are based on AASHTO H20 and HS20 loads, and rail loads are based on Cooper E80 loads. Finally, it is noted that loads applied to buried items are considered soil loads (H), which have the same load factors as live loads in all applicable load combinations.

   In this regard, the staff points out that, according to FSAR Section 3.8.4.4.5: "The design of buried conduit and duct banks, and buried pipe and pipe ducts is site-specific." This section adds that "A COL applicant that references the U.S. EPR design certification will describe the design and analysis procedures used for buried conduit and duct banks, and buried pipe and pipe ducts, (...) will use results from site specific investigations to determine the routing of buried pipe and pipe ducts, (...and) will perform geotechnical analyses to determine if the surface load will cause lateral or vertical displacement of bearing soil for the buried pipe and pipe ducts and consider the effect of wide or extra heavy loads." Finally, this section refers to an internal report, ANP-10264NP "U.S. EPR Piping Analysis and Pipe Support Design" (AREVA NP, 2006), for additional guidance on analysis and design procedures applicable to buried piping.

   To complete the response to Item 2 of the RAI, include the information provided in the RAI response in the relevant sections of the FSAR. In addition, if the procedures described in "Guidelines for the Design of Buried Steel Pipe" will be used during the detailed design phase, then this should be clearly stated in the FSAR. The staff will evaluate the adequacy of these procedures on a case-by-case basis during the COL application.

b. The response to Item 3 of the RAI indicates that National Climatic Data Center maps show an average "air temperature" that ranges from approximately 40°F to 70°F for the central and eastern portions of the U.S. Given this range, a ground temperature of 50°F was selected to account for the average temperatures.

c. The staff notes that the mention of "air temperature" in the response appears to be an error since the RAI referred to "ground temperature." Clarify this inconsistency. Furthermore, provide the technical basis for using an average value of 50°F instead of considering the whole range, 40°F to 70°F, in the design.

03.08.04-9

Follow-up to RAI Question 03.08.04-4

The response to Item 1 of the RAI indicates that the separation gaps provided between Seismic Category (SC) I structures and adjacent structures range between 12 inches (gap between Access Bldg. and Safeguard Bldg. 3 shield structure) and 18 inches (gap between Nuclear Auxiliary Bldg. and Fuel Bldg. shield structure, and between Nuclear Auxiliary Bldg. and Safeguard Bldg. 4). It adds that the maximum predicted seismic "interaction distance" between SC I structures and adjacent structures is 11.2 inches, including maximum tilt due to differential

settlement, and that displacements corresponding to all other load cases are enveloped by the seismic load case. Finally, it mentions that displacements corresponding to the special load case of commercial aircraft impact have not been estimated.

Since the maximum interaction distance between SC I structures and adjacent structures is estimated as 11.2 inches, which is relatively close to the 12 inch gap between Access Bldg. and Safeguard Bldg. 3 shield structure, provide the additional information identified below to resolve Item 1 of the RAI.

a. Provide a description of the seismic soil structure interaction analysis used to determine the maximum displacement results for the Access Bldg. and Safeguard Bldg. 3 shield structure used to determine the minimum required interaction distance. This should include a description of the soil representation and building model used in the seismic analysis.
b. Clarify whether the FSAR includes sufficient information (e.g. ITAAC) to assure that the gap sizes assumed in the design are implemented by the COL applicant. These gap sizes should be clearly listed in the FSAR.
c. It is not clear if the term “maximum interaction distance” is used in the sense of an upper bound on all possible interaction distances between all SC I structures and adjacent structures. Provide a more detailed explanation of what is meant by the term “interaction distance,” as well as corresponding results for the four interactions between SC I structures and adjacent structures listed in the RAI response. This information should also be included in the FSAR.
d. The RAI response states that: “Time history analyses predict a maximum interaction distance of 11.2 inches between adjacent structures. This value takes into account maximum tilt due to differential settlement.” It is not clear from this statement if the calculated interaction distances include allowance for out-of-phase seismic-induced motion between adjacent structures. Clarify if out-of-phase motion between adjacent structures has been considered in the calculation of the interaction distances, and if so, indicate whether the absolute sum of the displacements of adjacent structures has been used. If the displacements of adjacent structures have been combined using some other methodology, provide the corresponding technical basis.
e. Compare the gap between the Reactor Shield Building and the Vent Stack (SC II structure) with the corresponding calculated interaction distance (including out-of-phase motion) between these two structures.

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).