## ArevaEPRDCPEm Resource

**From:** Tesfaye, Getachew
**Sent:** Wednesday, November 04, 2009 12:14 PM
**To:** 'usepr@areva.com'
**Cc:** Patel, Jay; Xu, Jim; Hawkins, Kimberly; Hsu, Kaihwa; Dixon-Herrity, Jennifer; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
**Subject:** U.S. EPR Design Certification Application RAI No. 306 (3642,3787,3755), FSAR Ch. 3
**Attachments:** RAI_306_NARP_3642_SEB2_3787_EMB1_3755.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 9, 2009, and discussed with your staff on November 4, 2009. No changes were made to the draft RAI as a result of that discussion. 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,
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Request for Additional Information No. 306 (3642, 3787, 3755), Revision 1

11/04/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.03.01 - Wind Loading
SRP Section: 03.08.01 - Concrete Containment
SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports

Application Section: FSAR Ch 3

QUESTIONS for EPR Projects Branch (NARP)
QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

03.03.01-4

The staff has determined that COL Information Item 3.3-1 in FSAR Tier 2, Table 1.8-2 does not distinguish between site parameters and site characteristics as defined in 10 CFR 52.1(a). Please revise COL infromation Item 3.3-1 in FSAR Tier 2, Table 1.8-2, accordingly, or as suggested below:

> A COL applicant that references the U.S. EPR DC will determine site-specific wind and tornado ~~design parameters~~ characteristics and compare these to the standard plant criteria. If the site-specific wind and tornado ~~parameters~~characteristics are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

The staff also requests the applicant to review and revise any addtional COL Information Items in FSAR Tier 2, Table 1.8-2, and throughout the all necessary sections of the FSAR, that clearly do not use the terms "site parameters" and "site characteristics" in accordance with 10 CFR 52.1 (a), as necessary.

03.08.01-39

Follow-up to RAI Question No. 3.8.1-16

The RAI response provided information regarding a parametric study performed to address the issue of the variation of material properties and the use of best estimate values for material properties in the design of the Reactor Containment Building (RCB). The following information is needed to resolve this RAI:

1. Provide the range of values used in the parametric study and demonstrate that these range of values are appropriate by comparing them to the properties (or range of properties) used in the design of the RCB. This comparison of properties between the study and design values should consider the variation of properties corresponding to the range of temperatures for the containment under the different loading conditions.

2. Confirm whether the values in FSAR Tables 3.8-1 through 3.8-4 are best-estimate values used for the analysis and design of the RCB, because it appears that some of these values (e.g., modulus of elasticity for concrete) may be based on code specified values instead. As requested in the RAI, provide the technical basis for using the properties listed in the FSAR Tables 3.8-1 through 3.8-4 (i.e., identify the source for the values). Where a reference to an industry code, standard, guide, or textbook is not available, provide the technical basis for using the listed values. Also, explain why the best-estimate values are used for design purposes and not a conservative value which would account for potential uncertainties inherent in the parameters, as is done in design codes.

3. Provide the same information in Item 2 above for FSAR Sections 3.8.2 through 3.8.5.

4. Explain how the detrimental effects of radiation were considered for the concrete and steel structures in and within the primary and secondary shield walls.

5. The response to RAI Number 3.8.1-14 states that the axisymmetric model of the RCB was also used to study the effect of the variations in the temperature of the annulus relative to the 79F value used to date, and that the results of this study would be given in the response to this RAI. Since the RAI response only marginally mentions this issue, provide a complete discussion on the results of this study.

03.08.01-40

Follow-up to RAI Question No. 3.8.3-8

The first part of the response to RAI Number 3.8.3-8 lists the abnormal loads generated by a postulated high-energy pipe break accident, as described in the FSAR. In addition, the response indicates that the nuclear steam supply system is the only high-energy line considered in developing abnormal loads Ra and Rr, and that pipe break loads Rrj and Rrm were not considered in the global analysis of the RBIS. Finally, the response also mentions the methodology for evaluating thermal stresses per ACI 349 Appendix A.

The staff considers that the RAI response does not address the question raised in the RAI. To resolve the first part of this RAI, provide the method and basis for performing the localized analysis for each type of abnormal load, including the potential effects of concrete cracking due to accident thermal loads and redistribution of member forces due to cracking of concrete if significant. In other words, provide further elaboration on: (1) why certain abnormal loads are considered “localized” loads and “not included in the formation of load combinations for the global system”; simply stating that the localized loads “are not considered significant” is not sufficient; (2) how the member forces and stresses due to these localized loads were determined, e.g. describe the more refined finite element sub-models mentioned in FSAR Section 3.8.3.4.2 (first paragraph) and elaborate on the analysis approach; and (3) how the potential effects of concrete cracking due to accident thermal loads were considered in the finite element models or sub-models.

The staff further notes that the response states that pipe break reaction load “Rrr is the only component of Rr considered in the global analysis of the NIS.” This statement appears to contradict FSAR Section 3.8.3.4.1, which identifies pipe break reaction, jet impingement and missile loads (Rrr, Rrj, and Rrm) as localized abnormal loads that are not included in the overall analysis. Explain this inconsistency.

In response to the second part of RAI Number 3.8.3-8, the RAI response summarizes the design conditions and number of load combinations corresponding to normal plus abnormal loads, as well as to normal plus extreme environmental plus abnormal loads.

The staff considers that the response does not address the question raised in the RAI. To resolve the second part of this RAI, describe how the results (e.g., member forces and stresses from the differing global and localized finite element models and sub-models) of the localized analyses are combined with the results of the global structural analyses for other loads, since location of these element forces from the two models do not necessarily match.

03.08.01-41

Follow-up to RAI Question No. 3.8.3-11

The response to item (1) of this RAI explains that the jurisdictional boundary between the polar crane assembly and the RCB is the location at which the crane runway system (girders) attaches to the crane runway support brackets. The crane support brackets are included in the design of the RCB. The RAI response provides a detail showing the jurisdictional boundary. The description of the jurisdictional boundary between the polar crane assembly and the RCB, which is discussed in the RAI response, needs to be included in the appropriate locations of the FSAR Section 3.8.

The response to item (3) of this RAI indicates that the crane girder and intervening structural steel members will be designed in accordance with the requirements for design and materials specified in AISC N690. Since the RAI response indicates that the intervening structural steel members (i.e., crane support brackets) are within the jurisdictional boundary of the RCB, explain why AISC N690 is utilized rather than the applicable ASME Code for containment. It should be noted that ASME Code, Section III, Division 2, Subsection CC, indicates that the design of steel members not backed by concrete shall meet the requirements of NE-3000 and Subsection NCA. Also, Article NE-1000 of ASME Code, Section III, Division 1, explains the jurisdictional boundary for the containment and any attachments to the containment, and provides a figure with typical examples. The jurisdictional boundaries identified in the RAI response do not appear to be consistent with the jurisdictional boundaries given in the ASME Code. Therefore, explain the basis for the ASME Code jurisdictional boundaries described in the RAI response with respect to the crane support brackets.

03.08.01-42

Follow-up to RAI Question No. 3.8.3-12

The response to item (1) of this RAI states that steel materials ASTM A333, A537 and A633 are listed as acceptable in ASME NOG-1-2004, ASME NUM-1-2004, and by extension, in NUREG-

0554, when used in the construction of the polar crane and its support system. Nevertheless, the staff notes that: (1) the response to RAI 3.8.3-11 indicates that the crane runway support brackets are within the jurisdictional boundary of the RCB and (2) the response to RAI 3.8.3-11 also indicates that the crane and crane runway system are vendor supplied items that lie outside the jurisdictional boundary of the RCB. In light of this information, the applicant should confirm whether the polar crane assembly (minus the support brackets) is considered separately as a vendor supplied and qualified piece of equipment (i.e., not Seismic Category I structure), in which case the information related to the crane assembly should be removed from Table 3.8-8. In addition, if the resolution of RAI 3.8-11 determines that the crane brackets are within the jurisdictional boundary of the containment, as currently described in the RAI, then confirm that the listed materials are in conformance with the applicable ASME Code for containment.

The response to item (2) of this RAI states that material specifications, procurement and supplemental requirements for structural steel materials will be developed later in the design process. However, the structural design calculations described in the FSAR are based on allowable stresses that depend on specific material specifications, grades, and associated/supplemental requirements. Consequently, these specific material designations should be reflected in the FSAR (Table 3.8-8) at this time. To resolve item (2) of this RAI, the applicant is again requested to provide the materials specifications, along with procurement and supplemental requirements, for the actual steel structural materials to be used.

03.08.01-43

Follow-up to RAI Question No. 3.8.5-17

The response to RAI Number 3.8.5-17 provided additional information about the reinforcement in the EPGB and ESWB foundations. To complete the evaluation of this RAI response, provide the following information:

1. The U.S. EPR FSAR should be changed to include Figures 03.08.05-17-1 through 03.08.05-17-4 provided with the RAI response since these figures provide more complete information on the reinforcement design for the EPGB and ESWB foundations than the current figures in the FSAR.

2. Explain the following statement in the response: “The vertical (shear) reinforcement is not required for the revised Essential Service Water Building (ESWB) foundation configuration.” Figures 3.8.5-17-3 and 4 are not consistent with this statement since both figures show shear reinforcement in the ESWB foundation.

3. Explain what additional information regarding the ESWB requested by this RAI will be addressed in the response to RAI Batch 130 Question 03.07.02-27, which will be provided as committed by the AREVA NP response to RAI 130. Clarify if this response has been submitted to the NRC.

4. As requested in the original RAI, provide information that reconciles the difference in the reinforcement for the NI foundation specified in FSAR Table 3E.1-37 and shown in FSAR Figure 3E.1-75.

03.12-18

In FSAR Section 3.12.5.19, AREVA stated that alternative methods for addressing environmental fatigue will be applied and presented examples of alternative methods as follows:

- Redefinition of the normal and upset transients and number of cycles
- Redefinition of the in-air design fatigue curves and/or Fen environmental penalty factors using data obtained from testing of samples representative of U.S.EPR materials, configurations, and environment.
- Fatigue monitoring
- Augmented inspection

The staff noted that redefinition of the normal and upset transient affecting the location in question to reduce the severity of the transients or to reduce the number of cycles associated with the transient requires license amendment. The redefinition of the in-air design fatigue curves and/or Fen penalty factors also requires license amendment. The staff asks the applicant to clarify that the applicant will submit license amendment for NRC review and approval for taking these two alternative methods.

The staff also noted that fatigue monitoring and augmented inspections are for operating plants. The staff does not agree that design requirement for fatigue and cumulative fatigue usage factors for piping and components can be changed. The staff requests the applicant to provide other alternatives or to follow the staff approved methods.

03.12-19

Follow-up to RAI Question No. 03.12-17

In response to Question 03.12-17, AREVA indicated that heatup/cooldown procedures are plant-specific. In order to use the first US EPR initial plant operation to verify the design transients for the surge line are representative, AREVA has to assure that all U.S. EPR plants will use the same heatup/cooldown methods. The staff asks AREVA to address this item and explain why only first plant surge line transients are monitored without standard heatup/cooldown procedures.

03.12-20

In FSAR Section 3.12.5.9, AREVA stated that the EPRI generic methodology indicated that thermal stratification will occur in RHR/SIS/EBS injection, RHR/SIS suction piping. AREVA also stated that specific measurements taken at AREVA NP designed foreign plants on piping configurations that are representative of U.S.EPR piping system indicate small range and shorter vortex penetration than the EPRI methodology. Thus, testing information shows that thermal stratification does not occur in any horizontal segment of the aforementioned (RHR/SIS/EBS injection, RHR/SIS suction) RCS attached piping.

The staff noted that the cyclic thermal stratification occurring within such RCS attached piping is affected by the line orientation and geometry. The staff requests AREVA to provide detailed line geometry information (e.g. L/Di, DH/H/LH configuration) for each of the above mentioned lines in order to determine that the thermal stratification does not occur in any horizontal segment of the RCS attached piping.

If AREVA uses its specific test information to justify that thermal stratification does not occur in any RCS attached piping for EPR design. The staff requests AREVA to provide detailed test information for review and approval.

AREVA stated that the U.S. EPR design incorporates lessons learned from operating experience in that the injection line (SIS/RHRS) continually rises in elevation from the check valve; therefore, it is not susceptible to valve leakage-induced cyclic thermal stratification. The staff requests AREVA to explain why the piping is not susceptible to valve leakage-induced cyclic thermal stratification with continual rises in elevation from the check valve and rise to what kind of level/elevation will not be susceptible to cyclic thermal stratification.

03.12-21

In FSAR 3.12.5.9, AREVA stated that a COL applicant that references the U.S. EPR design certification will monitor the RCS attached piping during the first U.S. EPR initial plant operation to verify that operating conditions have been considered in the design. However, the up-horizontal and horizontal (UH/H) configuration thermal cycling model is based on valve in-leakage establishing a cold stratified layer in horizontal pipe run which interacts with branch line swirl resulting in cyclic thermal loads applied to a region of the horizontal pipe segment.

The staff does not expect valve in-leakage during initial plant operation. The staff requests AREVA to explain how to simulate valve in-leakage during the first initial plant operation to verify that operating conditions have been considered in the design.