ArevaEPRDCPEm Resource

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Sent: Tuesday, March 23, 2010 7:57 AM
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Cc: Jeng, David; Kazi, Abdul; Hawkins, Kimberly; Wong, Yuken; Chen, Pei-Ying; Dixon-Herrity, Jennifer; Miernicki, Michael; Patel, Jay; Carneal, Jason; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: Draft - U.S. EPR Design Certification Application RAI No. 384 (4350,4351,4469,4498,4527), FSAR Ch. 3
Attachments: Draft RAI_384_SEB2_4350_4351_4469_EMB2_4498_4527.doc

Attached please find draft RAI No. 384 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,
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Hearing Identifier: AREVA_EPR_DC_RAIs
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Request for Additional Information No. 384(4350, 4351, 4469, 4498, 4527), Revision 0

3/23/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.03.02 - Tornado Loads
SRP Section: 03.04.02 - Analysis Procedures
SRP Section: 03.08.04 - Other Seismic Category I Structures
SRP Section: 03.09.02 - Dynamic Testing and Analysis of Systems Structures and Components
SRP Section: 03.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

Application Section: FSAR Chapter 3

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

03.03.02-5

Follow-up to RAI 211, Question 03.03.02-3

In its response to question 03.03.02-3, the applicant states that due to the proximity of the NAB, TB and ACB to Seismic Category I structures, there is a potential for tornado wind load induced interaction. Therefore, the RG 1.76 tornado wind characteristic guidance is incorporated into the design of these structures. Tornado wind loads are calculated and the results considered in the design in accordance with the approved structural design codes for each structure so that no unanalyzed loads are transferred to the protected Category I SSC. Stating that no unanalyzed loads are transferred to the protected Category I SSC is ambiguous and doesn't preclude an analyzed load from being transferred to the protected Category I structure. The applicant is requested to clearly state in the FSAR whether or not a load will be transferred from the NAB, TB or ACB to the protected Category I structure due to a tornado having RG 1.76 tornado wind characteristics. If it is intended that a load transfer is acceptable the applicant is requested to provide the following information and include it in the FSAR:

a. The failure mechanism of the NAB, TB or ACB that creates the load.

b. The assumptions and methodology used to determine the load transferred to the Category I SSC.

c. The Category I structures which are impacted by the loads and their expected damage.

d. The acceptance criteria for the Category I SSC to ensure it meets its intended safety function under the transferred load.

e. If it is intended under the RG 1.76 tornado wind characteristics that no load will be transferred to a Category I SSC, the applicant should state this in the FSAR and

provide the design criteria for the NAB, TB and ACB to include the following information: The methodology for converting the tornado wind velocity to a load on the structure.

03.04.02-13

Follow-up to RAI 162, Question 03.04.02-1

U.S. EPR FSAR Section 2.5.4.2 identifies the coefficient of friction between concrete and dry soil as 0.7. However in response to RAI 162, Question 03.04.02-1, the applicant stated that to check the upper limit of sliding and uplift (including the effects of maximum water table and dynamic versus static coefficient of friction) the angle of internal friction is reduced to 27 degrees which corresponds to a coefficient of friction of 0.5. As this is a key parameter used in determining the stability of Seismic Category I structures, U.S. EPR FSAR Section 2.5.4.2 should be revised to include this value.

03.04.02-14

Follow-up to RAI 248, Question 03.04.02-12

In its response 03.04.02-2, the applicant states that a flexible elastomeric seal bridges the separation gap between the Access Building and the Tendon Gallery. The seal allows differential movement between the structures while providing protection against water ingress. The design of the Access Building is the responsibility of the COL applicant. However, there is no combined license information item which requires the applicant to design the elastomeric seal to allow differential movement between the tendon gallery and the Access Building. The applicant is requested to add such an item to U.S. EPR FSAR Table 1.8-2. In addition, design of the seal must also account for hydrostatic and lateral earth pressure loads. The applicant should describe how these loads will be accommodated by the flexible elastomeric seal and provide the design load combinations that govern the seal's design.

According to the response to RAI 248, Question 03.07.02-56(h) the Access Building will be designed using conventional seismic codes and standards. As such, the building may be damaged, undergo collapse or a partial collapse during an SSE event. The applicant should describe:

a. How the seismic displacement of the Access Building and the differential settlement with the Tendon Gallery will be determined;

b. The effect of damage, partial collapse, or collapse of the Access Building during an SSE event on maintaining the water tight seal between it and the Tendon Gallery; and

c. The impact of water ingress into the tendon gallery if a water tight seal is not maintained during or after a seismic event.

03.08.04-11

Consistent with SRP Section 3.8.4, the applicant has committed to use ANSI/AISC N690-1994, "Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities," Supplement 2 (S2) based on allowable stress design methodology in the DCD submittal of the debris interceptor design. Regulatory Guide 1.84, Rev. 33, endorses ASME Code Case N-570-2, "Alternative Rules for Linear Piping and Linear Standard Supports

for Class 1, 2, 3, and MC Section III, Division 1, Supplement 7," which approves N690-1994 including S2 as an alternative to ASME Code, Section III, Subsection NF. While the use of ANSI/AISC N-690 is acceptable to the staff, this code does not contain explicit guidance regarding the design of linear type supports, which will be employed in the strainer component design.

In its technical report of February 2008 (ANP-10293-U.S. EPR Design Features to address GSI-191) and in its response to NRC question 06.02.02-32 part (a) and (b), the applicant did not provide information regarding the wall and base mat supports and anchorage types, which will be used in the debris interceptor design.

In order for the staff to complete its review and evaluation of the structural integrity of the supports and anchorages as it relates to the abilities of the trash rack, retaining baskets and sump strainers to perform their intended functions, the staff requests that the applicant provide a description of the industry codes and standards applicable to the design and analysis of the supports and anchorages related to the aforementioned seismic category I structures. In addition, the applicant should describe how the structures would be connected and anchored to the concrete walls or base for the retaining baskets and the sump strainer.

The FSAR should be revised to include the response to this RAI.

03.08.04-12

Follow-up to RAI 259, Question 06.02.02-32, Part (a)

The SRP Section 3.8.4, acceptance criteria II.4 requires that the applicant describe the design and analysis procedures used for Seismic Category I structures, assumptions regarding boundary conditions and the extent of compliance with the ANSI/AISC N690-1994. The description should include the expected behavior under applicable loading conditions and the methods by which vertical and lateral loads and forces are transmitted to and from the various elements to their supports and eventually to the foundation of the structure. The applicant should identify the computer programs that will be used to design the structures in accordance with acceptance criteria II.4D. If proprietary computer programs will be used, the applicant shall describe them to the maximum extent practical to establish the applicability of the programs and the method used to validate them.

Regulatory Guide 1.61 also provides guidance regarding damping values that the NRC staff considers acceptable for use in the seismic response analysis of Seismic Category I nuclear power plant structures, systems, and components (SSCs). Tables 1 and 2 of RG 1.61 provides the damping values for safe shutdown earthquake (SSE) and operating basis earthquake (OBE) levels for welded and bolted structures, respectively, which the NRC staff considers acceptable in these analyses.

The applicant in its technical report of February 2008 (ANP-10293-U.S. EPR Design Features to Address GSI-191) and in its partial response to RAI 259, Question 06.02.02-32 lists the load and load combination based on ANSI/ASCE N690-1994. The applicant, however, does not provides sufficient information regarding their structural analysis methodology, damping values, type of steel structures (e.g., welded or bolted), differential pressure loading parameters, and thermal expansion release mechanisms for the debris interceptor structures. Therefore, in order

for the staff to complete its review, the staff requests that the applicant provide the following additional information:

a. A description of the methods and methodology which will be used for structural analysis of trash racks, retaining baskets and sump strainers;
b. A description of the damping values, which will be used for the specified type of steel structures, used to construct the trash racks, retaining baskets and sump strainers. If these values are not consistent with the guidance provided in RG 1.61 described above, please provide a justification such that the staff can make a conclusion regarding whether the alternative damping values used provide an adequate level of safety such that the structural integrity of the aforementioned structures is not compromised in a way that inhibits their ability to perform their intended safety functions,
c. A description of the structural elements of the debris interceptor components on which the differential pressure loadings are applied including a discussion of whether the differential pressure loadings will consider credit for the perforated screen surfaces; and,
d. A description of the design features, which may be used to accommodate the thermal expansion movements, associated with the maximum design temperature based on the post-LOCA containment environment and pool temperatures. If none of these features are included in the design, please confirm that their absence will be acknowledged in the formulation of the loading combinations with respect to the thermal stresses.

The staff needs this information to ensure that the design of the debris interceptor components perform their intended function so the sump pumps can provide adequate cooling water to the core during a design basis accident in accordance with GDC 35. The FSAR should be revised to include the responses to this RAI.

03.08.04-13

Follow-up to RAI 259, Question 06.02.02-32, Part (b)

In response to part (b) of question 06.02.02-32, the applicant refers to part (a) which does not clearly address the GL 2004-02 (3k) issue. In order to determine whether the design parameters of the trash racks, retaining baskets and sump strainers are assumed adequately, and the structures will perform their intended functions, the staff requests the following information:

a. Summarize the structural qualification results and design margins for the various sump debris interceptors, and
b. Identify structures considered for analysis for structural qualification purposes under the design loads and design temperature.

Alternatively, provide a COL information item or an ITAAC that addresses these requirements.

The staff needs this information to make its safety conclusions about whether the design parameters of trash racks, retaining baskets and sump strainers are assumed adequately, and

the structures will perform their intended functions. The FSAR should be revised to include the responses to these RAIs, as appropriate.

03.08.04-14

The SRP Section 3.8.4, I.4 requires that the applicant describe the design and analysis methods, assumptions regarding boundary conditions and the extent of compliance with the AISC specifications for steel structures. The description should include the expected behavior under load and the mechanisms of load transfer from the various elements to their supports and to the foundations. The applicant should reference computer programs to permit identification with available published programs and describe proprietary computer programs to the maximum extent practical to establish the applicability of the programs and the method used to validate them.

The integrity of the containment emergency sump pumps depends on the integrity and strength of the screens attached to the steel structural elements. These screens must withstand the design basis loads and transfer of loads to the vertical and lateral support elements especially during LOCA or SSE events thus avoiding the development of potential gaps between the screen and the steel structures and breaches in the screens.

The applicant in its technical report of February 2008 (ANP-10293-U.S. EPR-Design Features to Address GSI-191) does not address the design of joints and attachment of the screens to the structural steel members. Therefore, the staff requests that the applicant:

a. Describe the design of the joint and attachments of the screen, and how the screens are attached to the sump strainer to preclude the possibility of debris bypassing the screening, and

b. Provide a justification for assuming that the screens will remain undamaged and there will be no gaps and breaches between the screens and the structural members of the debris interceptor components, such that the operability of the recirculation core-cooling sump pump is not affected during LOCA or SSE events.

The staff needs this information to make its safety conclusions about whether the design of the joints and attachments of the screens to the debris interceptor structural components is adequate to ensure sufficient cooling of the core during design basis accidents. The FSAR should be revised to include the responses to this RAI.

03.09.02-68

Additional information needed regarding FSAR Section 5.4.2.3.1:

a. In FSAR Section 5.4.2.3.1, it is stated that the evaluation included analysis of the tube support system, research with tube vibration model tests and operating experience of similar SG designs in France.

Provide the applicable details or reference documents relating to the vibration model tests and operating experience of similar SG designs in France, for staff review.

b. In FSAR Section 5.4.2.3.1, it is stated that the tube bundle was evaluated for fluid-elastic instability over the first 60 vibration modes by evaluating the ratio of the critical velocity to the effective cross-flow velocity to an allowable fluid-elastic stability margin of 1.3. The evaluation was performed using parameters including "Connors' constants" and damping for the straight and U-bend sections which were assessed through testing. The results indicated that fluid-elastic instability will not occur during full-power, steady-state, normal operating conditions.

   Provide the applicable details or reference documents to support the results indicating that fluid-elastic instability will not occur during full-power, steady-state and normal operating conditions for staff review.

c. In FSAR Section 5.4.2.3.1, it is stated that for flow-induced vibration resulting from random turbulence and vortex-shedding excitations, the resulting amplitudes and stresses were computed considering the cumulative effect of the first 60 vibration modes. The results were compared to allowable limits that would prevent high cycle fatigue failure and tube impacts with adjacent tubes. Both an un-degraded tube and a degraded tube with 40 percent through-wall wear flaws at the tube support locations were evaluated.

   Provide the applicable details or reference documents to support the statement that the allowable limits that would prevent high cycle fatigue failure and tube impacts would not be exceeded for staff review.

d. In FSAR Section 5.4.2.3.1, it is stated that consideration was given to possible excitation from the RCP acoustic pressure fluctuations resulting from the blade passing frequencies. The effects of this excitation mechanism on the tube bundle were shown to be negligible.

   Provide the applicable details or reference documents to support the statement that the effects from acoustic pressure fluctuations resulting from the blade passing frequencies would be negligible for staff review.

03.10-31

Follow-up to Question 03.10-29

In its response to Question 03.10-29 dated February 12th, 2010, AREVA did not properly respond to Items I and II in the question.

a. The applicant is requested to address the potential effect of equipment directional coupling as described in Item I of the Question 03.10-29. As discussed in Question 03.10-29, the applicant is requested to submit the seismic qualification report (by Siemens) including the criteria and descriptions of the test procedures together with the detailed seismic test results, and provide the justification, as required by the criteria delineated in Subsection E.5.1.1 of Appendix 3D, Attachment E of the EPR FSAR Tier 2, for using the single-axis testing one at a time for three times.

b. The applicant stated in the response that the COL applicant/licensee will demonstrate that the generic qualification bounds the plant-specific condition. However, the staff is questioning whether the tested spectrum (from 5 to 35 Hz) would envelop the EPR certified seismic design response spectra (CSDRS). As indicated in SRP 3.10, (1)(A)(iv), the tested response spectrum (TRS) should closely resemble and envelop the required response

spectrum (RRS) over the critical frequency range. In the response to Question 03.07.02-44, AREVA indicated that the EPR CSDRS will be revised to include the Bell Bend Nuclear Power Plant (BBNPP). Figure 03.07.02-44-1 was provided to show the new CSDRS including the higher frequency content of the BBNPP curve. According to Figure 03.07.02-44-1, the staff found this new CSDRS has significant frequency content exceeding 35Hz.. Thus, the staff requests the applicant to address the issue of high frequency input excitation exceedance over the tested limit of 35Hz in the Topical Report, EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System" and accompanying proprietary documents.

The staff considers the resolutions to the above two concerns are necessary to make the safety determination in the staff's Safety Evaluation Report.