ArevaEPRDCPEm Resource

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Sent: Thursday, September 10, 2009 12:20 PM
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Subject: Draft - U.S. EPR Design Certification Application RAI No. 291 (3616,3691,3706,3707,3685,3703), FSAR Ch. 3
Attachments: Draft RAI_291_EMB2_3616_SEB2_3691_3706_3707_EMB2_3685_3703.doc

Attached please find draft RAI No. 291 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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Request for Additional Information No. 291 (3616, 3691, 3706, 3707, 3685, 3703), Revision 1

9/10/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.02.01 - Seismic Classification
SRP Section: 03.07.01 - Seismic Design Parameters
SRP Section: 03.07.02 - Seismic System Analysis
SRP Section: 03.07.03 - Seismic Subsystem Analysis
SRP Section: 03.09.05 - Reactor Pressure Vessel Internals
SRP Section: 03.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
Application Section: EPR FSAR Section 3.10

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

03.02.01-11

Follow-up to Question 03.02.01-9

In its response to RAI 03.02.01-9, the applicant stated that in its interpretation of the statement of consideration from 10 CFR 50 Appendix S (61FR65165 dated December 11, 1996), only those applicants who specify an OBE greater than one-third SSE are required to determine and justify the subset of SSC necessary for continued operation that must remain functional without undue risk of the health and safety of the public and within applicable stress, strain and deformation, during and following the OBE. 10 CFR 50, Appendix S states that if vibratory ground motion exceeding that of the OBE ground motion or if significant plant damage occurs, the licensee must shut down the nuclear power plant, and that prior to resuming operations, the licensee must demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public. The requirement for the SSCs necessary for continued operation to be functional without undue risk to the health and safety of the public during or after an OBE, is regardless of whether the OBE ground motion is 1/3 less or greater than SSE ground motion.

RG 1.166 provides guidance for pre-earthquake planning such as inspection of pre-selected equipment and structures for damages after an earthquake. The list of SSCs necessary for continued operation that must remain functional without undue risk of the health and safety of the public during and following the OBE, can be used to prepare the pre-selected sample of representative equipment and structures.

This list of SSCs necessary for continued operation can be provided by a COL applicant. However, it is not clear from the application whether the DC applicant or the COL applicant has the responsibility for the pre-earthquake planning. If it is the responsibility of the COL applicant to prepare the pre-earthquake planning, clarify that in the U.S. EPR FSAR, and add a COL information item if necessary.

03.07.01-26

Follow-up Question 03.07.01-19 (Audit follow-up)

The commentary for Section 3.3.1.9 of ASCE 4-98 states that effect of embedment on structure behavior is to increase resonant frequencies and *usually* decrease structure response when compared with the same structure founded on the surface of the soil. The applicant is requested to provide the details of the parametric analyses that were performed including the definition of the input motion and how it was derived for the embedded model. The applicant is also requested to provide the results from the parametric studies and compare these with the results for the surface founded NI common basemat structures.

03.07.02-59

Follow-up to Question 03.07.02-36

In Section 3.7.2 of the FSAR, the applicant states that 25 percent of the floor design live load should be included in the dynamic model. Since the System Design Requirements Document cites the floor design load as 400 psf, a value of 100 psf should have been used in the two seismic models to represent the live load mass. The applicant is requested to clarify and justify the value that was used in the seismic model to represent the live load mass, if different from 100 psf, and provide the impact of this choice on the analysis .

03.07.02-60

Follow-up to Question to 03.07.02-37:

The staff has reviewed the applicant's response to the question and has the following comments:

1. Regarding the applicant's response to item (a), the staff finds this acceptable.

2. The possible need for structural backfill and how this is to be considered when comparing site specific soil properties to the U.S EPR soil properties was not answered in the applicant's response. For the NI, EPGB, and ESWB The applicant is requested to address and include in FSAR Section 2.5.2.6 how structural backfill is to be considered when comparing site specific soil properties with the soil properties assumed in the U.S. EPR FSAR for these structures.

3. The applicant basically states that as long as the FIRS2 for the EPGB and the FIRS3 for the ESWB are less than the CSDRS, a site specific analysis is not required. (This assumes soil column properties under these structures are enveloped by the U.S. EPR FSAR soil column properties.) Since the analysis performed by the applicant to determine the SSSI effect assumed all three structures (NI, EPGB, and ESWB) are at

the same elevation it does not properly account for the fact that the three structures are all at different elevations and therefore the equations shown by the applicant in response to item (c) above may not be true in all cases. Specifically it is not necessarily true that the modified FIRS2 = (FIRS2/FIRS1) (SSSI motion). The applicant is requested to modify the acceptance criteria of item 3 in U.S. EPR FSAR Section 2.5.2.6 to require the COLA applicant to confirm that the input motion to the EPGB and ESWB (accounting for the difference in elevation between each of these structures and the NI structures; the embedment of the ESWB; and the SSSI effect of the NI) is less than the modified CSDRS which was used as the design basis for these structures in the U.S EPR FSAR certified design.

03.07.02-61

Follow-up RAI to Question 03.07.02-41

In its response, the applicant states that seismic acceleration modification factors are used to normalize equivalent forces and moments with soil-structure interaction (SSI) model results and provides a reference to U.S. EPR FSAR Tier 2, Section 3.8.3.4.4. The staff was unable to find any discussion regarding the normalization of equivalent forces and moments with the results from the SSI model in this section of the FSAR. The applicant is requested to provide an explanation of what the normalization consists of and include this in the FSAR.

03.07.02-62

Follow-up RAI to Question 03.07.02-55

The applicant in its response has explained that only the 100-40-40 rule is used to determine the seismic loads on the NI Common Basemat Structures and will delete the reference to the SRSS in U.S. EPR FSAR Section 3.8.4.4.1. The staff finds this to be acceptable; however the applicant is requested to provide additional clarification on portions of the response and the FSAR markup, as shown below in the following questions:

1. What is the purpose of Tables 3.7.2-18 through 3.7.2-25 which contains maximum force profiles calculated by the SRSS? An explanation of their use and purpose should be included in the FSAR.

2. The markup on page 3.8-104 states the ZPA_x, ZPA_y, and ZPA_z are the maximum zero period accelerations in each of three directions. As there are a number of soil cases and input time histories used in the analysis, the applicant should describe how the maximum ZPAs used in the 100-40-40 rule shown on revised FSAR page 3.8-104 are selected. This information should be included in the FSAR.

3. On revised FSAR page 3.8-103, there is a sentence which states that seismic acceleration modification factors are used to adjust the equivalent static forces and moments to be consistent with the SSI model results. The applicant should describe how this adjustment is accomplished and provide an example of its application. The FSAR should be revised to include a description of this process.

03.07.03-36

Follow-up to Question 03.07.03-35

The staff has reviewed the response to Question 03.07.03-35 and has the following additional questions regarding the FSAR markup.

1. In the first sentence of the markup to the FSAR on page 3.7-309 it states that Seismic Category I subsystem design requirements extend to the first seismic restraint beyond the system boundary with non-seismic subsystems. According to the referenced Topical Report on page 5-10, a series of pipe restraints may be utilized to isolate the seismic response of non-seismically designed piping from seismically designed piping, in which case four seismic restraints in each of three orthogonal directions beyond the Seismic Category I design boundary are provided. In the Topical Report on page 5-10 it states that non-seismic piping and supports beyond this location (the first seismic restraint) that impact the dynamic analysis of the seismic Category I piping are reclassified as Seismic Category II and included in the model. On page 3-1 of the Topical Report, last sentence of second bullet, it states that to prevent adverse impact to Seismic Category I SSCs, Seismic Category II piping will be designed to the same requirements as Seismic Category I piping. From these last two sentences it would appear that all piping in the dynamic model is designed to Seismic Category I requirements, i.e. piping up to the last seismic restraint in the dynamic model. The applicant is requested to provide a correction to the first sentence of the markup on page 3.7-309 to remove the inconsistency with the statements in the Topical Report.

2. In Section 3.2.1.2 of the U.S EPR FSAR describing the definition of Seismic Category II, it states the U.S. EPR SSC classified as Seismic Category II are designed to withstand SSE seismic loads without incurring a structural failure that permits deleterious interaction with any Seismic Category I SSC or that could result in injury to main control room occupants. In FSAR Section 3.7.3.8 where it discusses non-seismic subsystems attached to seismic subsystems, it states that 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. On page 3-1 of the Topical Report it states that Seismic Category II piping will be designed to the same requirements as Seismic Category I piping. It is not clear that the FSAR and the Topical Report are imposing the same requirements for the design of Seismic Category II piping subsystems for an SSE event. As such, the applicant is requested to:

    a. Provide the design requirements (design code, load combinations, stress allowables and any other acceptance criteria) that are used for the design of Seismic Category II piping subsystems that are attached to Seismic Category I piping subsystems.

    b. Demonstrate that these design requirements are the same as those that apply to the Seismic Category I piping subsystem or if not; provide the basis and justification for the use of these requirements in the design of Seismic Category II piping subsystems.

    c. Revise the FSAR and/or the Topical Report such that consistent requirements for the design of Seismic Category II piping subsystems are provided.

03.09.05-23

Follow-up to Question 03.09.05-7

In RAI 03.09.05-7, the staff requested the applicant to characterize in the FSAR the volume and velocity of the core bypass flow, and discuss whether the bypass flow is sufficient to cause vortex shedding and flow-induced vibration in the internals component located in the RPV upper dome above the upper support plate. In the response, the applicant stated that SRP 3.9.5 does not request providing the flow volume and velocity, and provided no information on the core bypass flow volume or velocity.

Flow volume and velocity are contributors to flow-induced vibration and vortex shedding. Please provide in the FSAR a qualitative assessment of whether the bypass flow is sufficient to cause vortex shedding and flow-induced vibration in the internals components located in the RPV upper dome above the upper support plate.

03.09.05-24

10 CFR 52.47 states that the application must maintain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design. Please provide plan views of the reactor internals in the FSAR to show the flow hole layout of the flow distribution plate, upper core plate, and upper support plate.

03.09.05-25

In FSAR Tier 2, Table 3.2.2-1, the radial keys are not listed (the radial key inserts are listed twice). Please correct this apparent omission.

03.09.05-26

Follow-up to Question 03.09.05-11

In RAI 03.09.05-11, the staff requested the applicant to provide a tabular summary in the FSAR, including each component of the reactor internals and core support structures, listing the maximum calculated total stress, deformation, and cumulative usage factor for each designated design and service limit defined in ASME Section III, Subsection NG. In the response, the applicant stated that providing a summary of maximum total stress, deformation, and cumulative usage fact values is the responsibility of the COL Applicant. However, FSAR Tier 2, Table 1.8-2, COL Item 3.9-11 is only for ASME Code Class 1 components. The calculated total stress, deformation, cumulative usage factor values for reactor internals have not been addressed by the applicant.

Please provide the requested information, revise COL Item 3.9-11 to include reactor internal structures and core support structures, or add a separate COL item.

03.09.05-27

Follow-up to Question 03.09.05-16

In RAI 03.09.05-16, the staff requested the applicant to revise the FSAR to include discussion of the environmental effect of fatigue on the reactor internals. The applicant responded that the heavy reflector analyses consider the irradiation-assisted stress-corrosion cracking, and the stress analyses of the tie rods and bolted joints take into account the preload relaxation of the fasteners. However, the applicant did not revise the FSAR. Revision 1 of FSAR Tier 2, Section 3.9.5.3 incorrectly references Sections 3.9.3.1.1 and 3.12 which do not address the environmental fatigue effects on the reactor internals. Please revise the FSAR. Additionally, the applicant stated in the response that the assessment of the fatigue on the reactor pressure vessel internals including relaxation and loss of preload is performed and verified through ITAAC. However, FSAR Tier 1, Table 2.2.1-5, Item 3.11 is only for ASME Class 1 components. Please revised Item 3.11 to include reactor internals or add a separate ITAAC.

03.10-24

Follow-up to Question 03.10-02

In its letter dated February 27th, 2009, the applicant's response to Question 03.10-02 is partially acceptable. The information provided in Section 3.9.3 of the applicant's submittal related only to pressure-retaining components, their supports, and the core-support structures (i.e., components in the ASME B&PV Code), whereas SRP 3.10 requires that full load combinations be considered in seismic qualification testing and analysis for all mechanical and electrical equipment. Consequently, the applicant is requested to provide supplemental information that describes explicitly the load combinations to be considered for all Seismic Category I, mechanical (non-pressure-retaining components), electrical, and I&C equipment not covered by ASME B&PV Code and IEEE Std. 344.

03.10-25

Follow-up to Question 03.10-03

In its letter dated February 27th, 2009, AREVA responded to Question 03.10-03 indicating that there are no in-plant tests such as in-situ impedance testing. The applicant identified that after installation, active components are subjected to hydrostatic tests, construction acceptance tests, and preoperational tests and, if applicable, periodic in-service inspections and operations to verify the functionality and reliability of the components. The staff found the response not completely acceptable because none of identified tests pertained to the seismic qualification of the equipment. However, the staff found that, as an example for verification of the adequacy of seismic qualification of equipment, there is ITAAC item 3.3 in Tier 1 Table 2.2.2-3 of the EPR FSAR related to Seismic Category I equipment of the In-Containment Refueling Water Storage Tank System (IRWSTS). Furthermore, Tier 1 Table 2.2.2-3 identified all the Seismic Category I equipment for the IRWSTS.

The staff requests the applicant to confirm that: (1) the scope of the ITAAC item 3.3 in Table 2.2.2-3 and other similar ITAAC in Tier 1 encompasses the verification of the seismic qualification of the equipment, and (2) all the equipment listed in Tier 2 Table 3.10-1 are included in Tier 1 ITAAC program.

03.10-26

Follow-up to Question 03.10-04

In its letter dated February 27th, 2009, AREVA's response cited NUREG-1030 and European Utility Requirements for excluding consideration of the simultaneous occurrence of a LOCA with the SSE. NUREG-1030 is for operating plants only. Both NUREG-1030 and European Utility Requirements are not applicable to new nuclear power plants. In additional, the applicant cited several occasions where NRC had accepted the conditions that simultaneous occurrence of a LOCA and a seismic event was not required. However, the staff deems those are all for operating plants and a result of special considerations, and are not applicable to new reactors.

For new reactor applications, SRP Section 3.10 Acceptance Criteria (1)(B), Design Adequacy of Supports, Item (ii) indicates that the combined stresses of the support structures should be in accordance with the criteria specified in SRP Section 3.9.3, and Item 7 in Table I of SRP Section 3.9.3 clearly shows that the Faulted Condition (LOCA+SSE) must be satisfied.

Therefore, the applicant is requested, to commit to the SRP acceptance criteria mentioned above.

03.10-27

Follow-up to Question 03.10-09(a)

SRP 3.10(A)(i) indicates that analyses alone, without testing, are acceptable as a basis for qualification only if the necessary function of the equipment can be ensured by its structural integrity alone. The applicant stated in the submittal that for check valves, once the structural integrity of the valve is demonstrated by analysis, its operability is confirmed. The staff requests the applicant to explain how the operability of the check valve can be ensured by the structural integrity alone.

03.10-28

Follow-up to Question 03.10-11

In its letter dated February 27th, 2009, AREVA responded to Question 03.10-11 by re-stating information in IEEE standards and in the existing submittal that had already been reviewed by the staff. It should be noted that SRP 3.10 Acceptance Criteria (1)(A)(vi) indicated that the use of single axial test should be justified. The staff requestes the applicant to (i) revise FSAR Appendix 3D, Attachment E, Section E.5.1.1 indicating that justification of using single axial test will be provided in the SQDP and (ii) modify Tab H

of the SQDP in Appendix 3D attachment F to include a note showing that justification will be provided if Single Axis is selected.

03.10-29

Follow-up to Question 03.10-13

In its letter dated February 27th, 2009, AREVA responded to Question 03.10-13 by identifying Section 2.1.2.2 in the NRC Safety Evaluation Report (SER) of Topical Report, EMF-2110(NP)(A), Revision 1. This safety evaluation provided the results of the NRC staff's review of topical report EMF-2110 (NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System" and accompanying proprietary documents. The Siemens Power Corporation submitted this topical report by letter dated September 1, 1999.

I. The SER identified that the input excitation for testing the TSX equipment was multiple frequency ranging from 5 to 35 Hz, 3 axes and each staggered by 90 degrees. However, by testing one axis at a time, the results may not be the same as multi-axis testing at the same time due to the potential effect of equipment directional coupling. Thus, 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 for using the single axis testing one at a time for three times.

II. The SER stated that "A US licensee that use the TXS system for a safety system application should compare its required seismic qualification level to the Siemens' qualified level, and identify areas requiring further action." The applicant is requested to address the issue of high frequency input excitation exceedance over the tested limit of 35Hz in the Topical Report.

03.10-30

Follow-up to Question 03.10-21

In its letter dated February 27th, 2009, AREVA responded to Question 03.10-21 claiming that equipment supports for seismic qualification testing are rigid, where flexibility of the supports can be eliminated. The staff found that this claim is not realistically possible and cannot even be approximately achieved for many cases (e.g. electrical cabinets and racks). Accordingly, the staff found that the applicant's response is not acceptable. SRP 3.10 identified that for establishing design adequacy of supports, analyses or tests should be performed for all supports of mechanical and electrical equipment to ensure their structural capability. While the applicant provided some information about qualification by analysis and testing in Section 3.10.3 the section neither reflected the guidance provided in SRP 3.10, Acceptance Criteria (1)(B)(ii) and (iii) nor provide alternative to demonstrate design adequacy of supports. Therefore, the applicant is requested to revise Section 3.10.3 of the submittal to properly address requirements for design adequacy of supports, in a manner consistent with SRP 3.10.