ArevaEPRDCPEm Resource

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Sent: Tuesday, December 23, 2008 7:04 PM
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Subject: Draft - U.S. EPR Design Certification Application RAI No. 162 (914, 938, 1845), FSAR Ch. 3
Attachments: Draft RAI_162_SEB2_914_938_SRSB_1845.doc

Attached please find draft RAI No. 162 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. 162 (914, 938, 1845), Revision 0

12/23/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.04.02 - Analysis Procedures
SRP Section: 03.05.03 - Barrier Design Procedures
SRP Section: 03.06.02 - Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping

Application FSAR Ch. 3

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

03.04.02-1

SRP 3.4.2 Acceptance criteria 2 and 3 states that unless the hydrostatic head associated with the highest flood and groundwater levels is relieved by utilizing a drainage or a pumping system around the foundations of structures, hydrostatic pressure has to be considered as a structural load on basement walls and the foundation slab of a structure. In consideration of any uplifting or floating of a structure, the total buoyancy force may be based on the highest flood level or the highest groundwater level excluding wave action. However, the dynamic loads of wave action should be included in the calculation for lateral and overturning movements of a structure if the flood level is above the proposed plant grade.

In FSAR Section 3.4.2 (External Flood Protection) it states that Seismic Category I SSCs can withstand the effects of ground water pressure and external flooding. There is no discussion in the FASR of how the PMF is utilized in the calculation of loads on basement walls and foundations, or in a stability check. Therefore, the staff requests additional discussion of the following:

a. How has the buoyancy force resulting from PMF has been used in the calculation of uplift?

b. With respect to the load combination required in SRP 3.8.4, what is the maximum hydrostatic pressure being used and how are lateral loads calculated on buried walls and foundations of a structure?

c. If soil friction is used in the calculation of stability, provide the value used for this parameter, and describe the method and basis used in computing the above value including the effects of maximum water table.

03.04.02-2

EPR FSAR Section 3.4.2 states that portions of Seismic Category I structures located below grade elevation are protected from external flooding by water-stops and water-

proofing and below grade exterior construction joints having water-stops to prevent in-leakage. Provide the specified design life for waterproofing, water stops and water seals. If this is less than the operating life of the plant, describe how continued protection will be provided.

03.04.02-3

Identify if there are Seismic Category I buried structures, pipes, conduits and duct banks within the scope of the EPR design certification, and located below the PMF or ground water elevations. If yes, list those items and describe measures taken to protect them from the effects of ground water or PMF.

03.04.02-4

In FSAR Section 3.4.2, it states that no access openings or tunnels penetrate the exterior walls of the Nuclear Island below grade. Protection for other safety-related structures must also be described. Are there access openings or tunnels for other safety-related structures not located on the Nuclear Island? If so, how are these openings protected from the PMF or maximum ground water level?

03.04.02-5

SRP 3.4.3 Acceptance Criteria 3 states that “Where the flood level is above the proposed plant grade, the dynamic loads of wave action should be considered”. In FSAR Section 3.4.2, it states that flood protection measures described in nine bullet items provide protection against flooding from postulated failure of onsite storage tanks. There is no discussion in the FSAR how those nine flood protection measures can provide assurance that the sudden failure of onsite storage tanks may not cause a surge of water above yard grade that could cause temporary flooding and wave action to nearby structures. Therefore, the staff requests the basis be provided for not including the effects of flood or wave action from sudden failure of onsite tanks and to also address the impact on adjacent structures.

03.04.02-6

The staff is requesting that the following changes be made to the EPR FSAR: FSAR Section 3.4.2 entitled “External Flood Protection” is not consistent with the title of SRP 3.4.2 “Analysis Procedures”. Also FSAR Section 3.4.3 entitled “Analysis of Flooding Event” does not correspond to an SRP section. Those portions of FSAR Section 3.4.3 which relate to internal flooding should be included in FSAR Section 3.4.1 and meet the acceptance criteria of SRP 3.4.1. Those portions of FSAR Section 3.4.3 that relate to external flooding should be included under FSAR Section 3.4.2 and meet the acceptance criteria of SRP 3.4.2. In addition, COL items 3.4-1 to 3.4-3 listed in Table 1.8-2, should be revised to reference FSAR Section 3.4.2.

03.05.03-1

The last paragraph of FSAR Section 3.5.3.1.1 (Concrete Barrier Analysis) states that “Table 3.5-2 (Minimum Concrete Barrier Thickness Requirements for Local Damage Prediction Against

Tornado Generated Missiles) shows minimum concrete barrier thicknesses requirement for local damage prediction against tornado generated missiles, which are based on the Region I guidelines in NUREG-0800". FSAR Sections 3.5.3.1.1.1 through 3.5.3.1.1.3 also provide equations endorsed by SRP 3.5.3. Table 3.5-2 is acceptable because it is consistent with SRP 3.5.3 Table 1 and the SRP acceptance criteria. However, SRP 3.5.3 Acceptance Criteria 1.A also states that these equations should be used to determine the required barrier thicknesses. Thicknesses resulting from such calculations should not be less than those listed in SRP 3.5.3 Table 1, which specifies the minimum thicknesses necessary to protect against tornado missiles. Confirm that when the equations shown in FSAR Sections 3.5.3.1.1.1 through 3.5.3.1.1.3 are used to compute concrete barrier thicknesses and the computed barrier thicknesses are greater than those of Table 3.5-2, the larger of the two thicknesses will be used for the EPR barrier design.

03.05.03-2

FSAR Section 3.5.3.1.1.1 (Penetration) provides a formula for calculating the depth of missile penetration. One of the factors in this formula is the missile shape factor which has an important influence on the penetration thickness. For the missiles considered in the AREVA design, describe what type missile shapes are used in the calculation and how they are determined.

03.05.03-3

SRP 3.5.3 1B accepts the use of the SRI equations developed from test data developed in ORNL/NSIC-5, Vol. 1, Chapter 6, by Cottrell and Savolainen for designing steel penetration thickness. The BRL equations may be used provided the results are comparable to those obtained by using the SRI equation or validated by penetration tests. FSAR Section 3.5.3.1.2 permits the use of either formula. If the BRL equation is used to calculate steel penetration thicknesses provide the test data verifying its application or confirm that the larger thickness requirement resulting from the use of either the BRL or SRI equation will be used in the design.

03.05.03-4

FSAR Section 3.5.3.1.3 (Composite Section Barrier Analysis) discusses the evaluation of composite barriers for use as missile protection.SRP 3.5.3 allows the use of composite sections where the first layer is steel provided that the guidance in Reference 6 of the SRP is followed.

a. Identify if and where composite barrier protection will be provided in the AREVA design.

b. Clarify whether any composite barriers are utilized where the first material is concrete and if so what procedures will be used in their analysis.

03.05.03-5

In FSAR Section 3.5.3.2 (Overall Damage Protection), it states that ACI 349-2001 is used to design concrete missile barriers. RG 1.142 references ACI 349-1997. What are the specific differences between these two codes as they relate to barrier design?

03.05.03-6

In FSAR Section 3.5.3.2, it states that ASCE 58 is used for the evaluation of steel barriers. What specific methods are used from this reference and how does their use meet the acceptance criteria of SRP 3.5.3?

03.05.03-7

In FSAR Table 3.5-3, the column entitled “Material” is not consistent with its contents, which are structural member categories. In addition, items c.ii and c.iii under this same column are not consistent with item c which is labeled axial compression and flexure. Also under this column (item c), the column slenderness ratio “l/r 20” appears to be missing a less than or equal sign. Provide the appropriate terms for c.ii and c.iii in column 1 and correct the slenderness ratio typographical error.

03.05.03-8

In FSAR Section 3.5.3.3 which addresses ductility requirements for missile barriers, the second and third paragraphs commit to meeting the code requirements of ACI 349, ASME III Division 2. Provide clarification as to whether meeting the code requirements is only for ductility or for all aspects of these codes as they relate to the design for dynamic impact loads. The method for determining the ductility ratios and the limits for these ductility ratios should be provided as was done for concrete barriers using ACI 349 and for steel barriers using ANSI/AISC N690.

03.05.03-9

In FSAR Section 3.5.2 (pg 3.5-11) it states that safety-related pipes and cables routed outside of missile protected structures are buried at sufficient depth to provide protection for these items from missile impact, or concrete or steel enclosures are provided that are designed to withstand missile impact. No criteria are provided to define how the sufficient depth of burial is determined. In FSAR Section 3.8.4.1.8, it states that the design of buried conduit and duct banks is site specific. It also states that the duct bank depth and encasement methods will also consider effects from external hazards (e.g. tornado missile). In the Acceptance Criteria Requirements of SRP 3.5.3 it states that the design of structures, shields and barriers must meet GDC 2 which requires that SSCs important-to-safety shall be designed to withstand the effects of natural phenomena such as tornados and GDC 4 which requires that SSCs important-to-safety shall be appropriately protected against the dynamic effects of missiles. Provide the criteria and basis of protection for buried safety-related SSCs including minimum depth of burial required for each tornado missile considered, or include in the FSAR a COL item that requires a COL applicant provide this information.

03.06.02-18

The seismic protection of the control rod drive system presented in the FSAR Section 4.6.1 refers to FSAR Section 5.4.14 on component supports. These two sections describe the restricted displacements during seismic events and design-basis accidents. The natural ground motion based seismic events are part of the seismic analysis of the plant. However, large missiles, such as an aircraft crash, can also cause acceleration events inside the containment,

where the direction of the force is different (i.e. from above and the side) than in the natural ground motion seismic events (from below and the side).

How does EPR design demonstrate that the impact direction has been considered in the seismic analysis of the control rod drive mechanism component supports? This information is required to confirm the compliance that SSCs be designed to meet the requirements of GDC 4 as it relates to protection against dynamic effects including external events.