ArevaEPRDCPEm Resource

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Sent: Thursday, January 06, 2011 12:14 AM
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Cc: Reichelt, Eric; Terao, David; Wong, Yuken; Dixon-Herrity, Jennifer; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: Draft - U.S. EPR Design Certification Application RAI No. 467 (5333, 5344), FSAR Ch. 3
Attachments: Draft RAI_467_CIB1_5333_EMB2_5344.doc

Attached please find draft RAI No. 467 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
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Hearing Identifier: AREVA_EPR_DC_RAIs
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Request for Additional Information No. 467(5333, 5344), Revision 0

1/6/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.06.03 - Leak-Before-Break Evaluation Procedures
SRP Section: 03.09.02 - Dynamic Testing and Analysis of Systems Structures and Components
Application Section: FSAR Chapter 3

QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)
QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

03.06.03-28

Follow-up to RAI 265, Question 03.06.03-26

The Allowable Load Limit (ALL) Diagrams are presented in FSAR Tier 2, Section 3.6.3, Figure 3.6.3-12 through Figure 3.6.3-23 for the Main Steam Line (MSL), Main Coolant Line (MCL), and the Surge Line (SL) cases. As a result of the confirmatory calculations performed by the staff and the resulting RAI 265 Question 03.06.03-26, AREVA proposed (i.e., in its Supplemental 5 response to RAI 265 dated September 30, 2010) revising FSAR Tier 2, Figures 3.6.3-18, 3.6.3-19 and 3.6.3-20. Based on a telephone conference call with the applicant on April 7, 2010, the staff understood that AREVA would also revise the remaining ALL diagrams for MCL, MSL, and SL per the same procedure used for the SL. As stated in the telecon dated December 15, 2010, AREVA is requested to provide the NRC staff with revised versions of FSAR Tier 2, Figures 3.6.3-12,-13,-14,-15,-16,-17,-21,-22, and -23.

03.09.02-155

The NRC Standard Review Plan NUREG-0800, Section 3.9.2.III.5 (page 3.9.2-29), Revision 3 recommends that the staff review the detailed information on whether adequate analysis has been made of the reactor internal structures and unbroken loops to withstand dynamic loads from the most severe LOCA in combination with the SSE. The staff reviewed the information presented in U.S. EPR FSAR Section 3.9.2.5 and Appendix 3C. The staff could not find any description of analytical methods or investigations to specifically determine the stability in compression of reactor vessel internals, particularly the core barrel and other elements of reactor internals, subject to combined SSE and LOCA loads. The applicant is requested to provide description of analytical methods or other investigations to determine stability of the core barrel and other compressive elements of reactor internals.

03.09.02-156

The Standard Review Plan, Section 3.9.2.III.5 (page 3.9.2-29) recommends that the staff review the detailed information provided by the applicant on the following subjects:

1. The degree of compliance of the analysis performed with the acceptance criteria listed, and
2. The verification that stresses under the combined loads are within allowable limits of the applicable codes and the deformations are within the limits set to ensure the ability of reactor internal structures to perform the needed safety functions.

The staff reviewed the U.S. EPR FSAR, Section 3.9.2.5 and Appendix 3C. The staff determined that no information was provided to determine the satisfaction of the above SRP criteria. The applicant is requested to provide the necessary information.

03.09.02-157

The applicant states in FSAR, Appendix 3C.1.1, paragraph 2 and Appendix 3C.1.2, paragraph 2 that the “SG model is based on zero percent tube plugging.“ The staff requests the applicant to explain why this is conservative over the life of the plant.

03.09.02-158

In FSAR Appendix 3C.1.1, paragraph 4, the applicant derives the shape factor for a hollow cylinder as follows:

SF = Shape Factor for a hollow cylinder (=4/3)

The commonly accepted value is 4/p = 1.27 (e.g. reference Handbook of Engineering Mechanics, Editor W. Flugge). The staff requests the applicant to explain if the above approximate value derived is correct and conservative.

03.09.02-159

The applicant defines the mass in FSAR, Appendix 3C.1.1, paragraph 4 as follows:

M = (length)(volume)(density)

The applicant is requested to confirm if this is correct and conservative.

03.09.02-160

The applicant states the following in the FSAR, Appendix 3C.1.3 paragraph:

> The initial conditions (pressures, enthalpies and flow) for the RPV internals are calculated by spreadsheet using data obtained from an analysis of the RPV internal flow paths to assess bypass flows and pressure drops inside the RPV.

The applicant is requested to provide details of the methods used in the spreadsheet to verify the technical soundness of the method used as recommended by the NRC SRP 3.9.2.5.III.

03.09.02-161

FSAR Appendix 3C.2.1.1, paragraph 1 states “The RPV internals and fuel mass are lumped at the appropriate center of gravity locations.”

The staff noted the following:

a. The fuel mass consists of a very large number of loose fuel pellets, constituting the active fuel length of 13.78 ft. inside the fuel rod with a total length of 14.93 ft. (they are most probably under pre-compression due to a spring). Due to the high density of the fuel pellets, the fuel pallets contribute the most significant mass to the fuel assembly. The applicant is requested to explain that under combined SSE and LOCA loads, the fuel pellets will behave dynamically like a rigid single lumped mass, instead of multiple masses.

b. The fuel assemblies themselves are supported at the bottom by the bottom nozzle, while the top end is clamped down by the hold down spring. The applicant is requested to explain that with the presence of the hold down spring, the fuel assembly will behave like a rigid single lumped mass, instead of preloaded multiple masses, under combined SSE and LOCA loads.

03.09.02-162

The applicant provided FSAR Appendix 3C, Figure 3C-8 (page 3C-38), “RPV Isolated Structural Model” to illustrate the modeling of the RPV internals. Physically the core barrel is supported in the spigot of the reactor vessel shell at the core barrel flange. The flange is supported at its bottom surface by the reactor vessel spigot, while on the top surface the core barrel flange is loaded by the hold down spring. Further, the flange of the upper support plate rests on the hold down spring.

The staff determined that the applicant has not provided any details of modeling of the hold down spring, This is critical to determine the upward and rotational (roll and pitch) stability about the two horizontal axis for the core barrel and upper support plate assembly under depressurization pressure loads and SSE acceleration loads.

The applicant is requested to provide details of modeling of the hold down spring, particularly related to the possibilities of core barrel flange and the upper support flange partially (due to rotation about the two horizontal axis) or fully separating from their contacting surfaces, or the spring going solid (reaching full compression), such that the stability of the core barrel and the upper support plate assembly is assured under loads due to LOCA, SSE and other applicable loads.

The applicant is also requested to explain how the dynamic effects of any partial or full separation of the flanges from the contacting surfaces, or the hold down spring going solid, if they occur, are accounted for in the determination of the structural integrity of the core barrel and the upper support assembly.

03.09.02-163

FSAR, Appendix 3C.3.3, paragraph 3 states that “The rate of mass transfer from one control volume to another is calculated from a derivation of the one-dimensional conservation of momentum equation.”

The loss of coolant accident due a break in any of the affected pipe lines (10 inch Schedule 160 LHSI, 10 inch Schedule 160 MHSI and 20 inch Schedule 120MFW) is likely to be non symmetric. This will cause 3D pressure (non-axi-symmetric pressure) distributions and consequently non-axi-symmetric fluid flow (i.e. flow in tangential directions) in the down-comers and core barrel thus generating non-axi-symmetric forces on the core barrel and other reactor vessel internals.

The applicant is requested to explain why use of one-dimensional conservation of momentum equations and the modeling are conservative to establish dynamic response of the reactor vessel internals.

03.09.02-164

FSAR, Appendix 3C.2.1.5, paragraph 2 states that “The SL has two dead weight hangers that are represented by vertical forces in the dead weight analysis.” The applicant is requested to describe the type of dead weight hangers used, i.e. rigid hangers, spring hangers etc.

03.09.02-165

The applicant provided the Figure 3C-9 (FSAR Appendix 3C, page 3C-40) to illustrate the variation of the modal damping and the Rayleigh Damping curve applied to the SSE analysis of the reactor vessel internals, with the horizontal axis for frequency and the vertical axis for the percentage damping. It is observed that the two axes have no numerical values associated with them. The staff requests the applicant to provide the numerical values of variables along the ordinate and the abscissa of the damping curve.

03.09.02-166

The applicant in USEPR FSAR Tier 2, Rev. 2, Section 3.9.2.7, page 3.9-35 states the following as Reference 2:

> ANP-10264NP-A, Revision 0, “U.S. EPR Piping Analysis and Pipe Support Design Topical Report,” AREVA NP Inc., November 2008.

Also, the applicant in USEPR FSAR Tier 2, Rev. 2, Section 3.9.2.7. page 3.9-36 states the following as Reference 6:

> ANP-10264NP, Revision 1, “U.S. EPR Piping Analysis and Pipe Support Design Topical Report,” AREVA NP INC., May 2010.

Further, the applicant in USEPR FSAR Tier 2, Rev. 2, Appendix 3C, states the following as Reference 1:

> ANP-10264NP-A, Revision 0, “U.S. EPR Piping Analysis and Pipe Support Design Topical Report,” AREVA NP Inc., November 2008.

The staff requests that the applicant to explain why references have been made to two different revisions of the same Topical Report, particularly reference to an earlier edition of the report.

03.09.02-167

The staff reviewed FSAR Appendix 3C, and did not find any information if and how the applicant has addressed the following critical and relatively fragile components:

1. Adapter Thermal Sleeves
2. Level Monitoring Probe (LMP)
3. Instrument Guide Tube
4. Rod Cluster Control Assembly (RCCA)

5. Irradiation Specimen Basket.

The applicant is requested to explain how the structural integrity of the above components has been investigated.