AreveaEPRDCPEm Resource

From: Tesfaye, Getachew
Sent: Wednesday, September 14, 2011 4:12 PM
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Cc: Patel, Amrit; Lu, Shanlai; Donoghue, Joseph; Nolan, Ryan; Segala, John; Lee, Samuel; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: Draft - U.S. EPR Design Certification Application RAI No. 513 (5971,5040), FSAR Ch. 9
Attachments: Draft RAI_513_SRSB_5971_SBPA_6040.doc

Attached please find draft RAI No. 513 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. 513(5971, 6040), Revision 0

9/14/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.01.01 - Criticality Safety of Fresh and Spent Fuel Storage and Handling
SRP Section: 09.01.04 - Light Load Handling System (Related to Refueling)

Application Section: 9.1 and Technical Report TN-Rack.0101, Rev 0

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)
QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

09.01.01-53

OPEN ITEM

Follow-up to RAI 402, Question 402, Question 09.01.01-48 (Issue #8)

The response to Part a) of Issue #8 in the Response to RAI Letter No. 402 dated June 10, 2011 explicitly states that fuel rod pitch uncertainty is considered in the Region 2 evaluation; however, Table 5-26 of the technical report does not include fuel rod pitch uncertainty. Additionally, in Issue #8, justification was also requested for not considering fuel enrichment uncertainty in both Region 1 and Region 2 evaluations. Provide the fuel rod pitch uncertainty for Table 5-26 of the technical report and the fuel enrichment uncertainty for Tables 5-22 and 5-26, or justify not considering these uncertainties in performing the safety analyses.

09.01.01-54

OPEN ITEM

Follow-up to RAI 402, Question 402, Question 09.01.01-33

In RAI Letter No. 402 dated July 26, Question 9.1.1-33 requested a description for capturing the treatment of uncertainty in the burnup records. This uncertainty is typically captured in licensee controlled documentation, such as plant procedures, or it can be addressed in the criticality safety analysis. In the Response to RAI Letter No. 402 dated June 10, 2011, the response to Question 9.1.1-33 explains that the Chapter 16 TS Bases will be updated to indicate that no burnup uncertainty term in the plant records is included in Chapter 16 Figure 3.7.16-1 depicting the spent fuel loading curve. Furthermore, it is specified that it will be up to the COL applicant to determine the uncertainty associated with final assembly burnup values. Justify the uncertainty will be appropriately calculated and will be conservatively applied with respect to assembly loading in the SFP.

09.01.01-55

OPEN ITEM

Follow-up to RAI 402, Question 402, Question 09.01.01-35

A remaining issue related to Question 9.1.1-35 is the potential non-conservative application of burnup-dependent axial burnup profiles. In the response to Question 9.1.1-35, it is stated that four axial burnup profiles are used in the analysis based on the defined ranges. It is explained for the burnup/enrichment point at 18 GWd/MTU in the Region 2 analysis, the profile for burnups less than 15 GWd/MTU is used instead of the profile for the actual corresponding range (which is between 15 and 25 GWd/MTU). This assumption is justifiably conservative. However, for the remaining burnup/enrichment points in the Region 2 analysis, use of burnup profiles corresponding to the upper limits of the defined ranges are used. This is taking credit for a higher relative burnup at the axial ends than is warranted. In one example, staff confirmatory calculations show an almost 700 pcm reactivity increase if the profile corresponding to 25 GWd/MTU (lower limit of the burnup range) is used versus the one assumed by the applicant at 30 GWd/MTU for the burnup/enrichment point at 26 GWd/MTU. Justify the conservatism of the profile selection.

09.01.01-56

OPEN ITEM

Follow-up to RAI 402, Questions 09.01.01-32 and 34 (Issue #4)

In Question 9.1.1-32, staff requested an explanation of a non-physical discontinuity in Table 5-3 burnup profiles; this discontinuity occurs because of the averaging as discussed in Issue #1 Part 4 which is part of Question 9.1.1-34. In the response to Issue #1 Part 4, it is stated that "…the minimum relative burnup for each of the four top and bottom nodes was used to determine the composite axial profile as a function of burnup." However, the top/bottom nodes weren't exclusively used to select the limiting profile. Averaging the top and bottom halves of various profiles to determine the minimum average burnup for these halves does not guarantee that the top and bottom 4 nodes are also at a minimum burnup. Most of the reactivity contribution comes from the fuel ends since they are depleted to a lesser extent during operation and therefore the focus on limiting burnup profile selection should be weighted more toward the ends. Considering the subset of profiles used to determine each limiting composite burnup-dependent profile, show that the average burnup for the top and bottom 4 nodes of each composite profile actually corresponds to the minimum value within each respective subset of profiles.

09.01.01-57

OPEN ITEM

Section 5.4.4 of the technical report presents the abnormal conditions considered in Region 2. The considered configurations include dropped assembly scenarios with the dropped fuel assembly coming to rest both horizontally on top of the rack and vertically in or near the rack and do not include calculational analyses. It is stated that the vertical drop accident would be bounded by the normal condition analysis for all regions and therefore an analysis is not performed. It is not clear to the staff that this case would be bounded by the normal condition. Justify that no significant rack dimensional changes (i.e. plastic deformation) would occur as a result of this accident case. As with the vertical drop accident scenario, justify that no significant rack dimensional changes would occur as a result of the horizontal drop accident.

09.01.01-58

OPEN ITEM

Follow-up to RAI 402, Question 09.01.01-43

Additional cases have been performed by the applicant to determine the minimum separation distance of 5% enriched UO_2 fresh fuel assemblies outside of the storage racks. It appears that the intent of this analysis is to show that fuel assemblies (fresh or spent) can be safely handled outside of the storage racks with respect to criticality safety as long as this minimum distance is maintained. Furthermore, the response to Question 9.1.1-43 does not explicitly state that fuel assemblies are not to be moved next to the storage racks during normal operations, however the response seems to indicate that this will not be allowable. Update the technical report to clarify the intent of this analysis since the design implies that fuel assemblies will not be handled together outside of the storage racks under normal conditions.

09.01.01-59

OPEN ITEM

Follow-up to RAI 402, Question 09.01.01-44 (Issue #7)

In Issue #7 related to abnormal conditions; staff questioned the limiting abnormal condition identified by the applicant. The staff is concerned that it may be possible for an assembly to be in the new fuel elevator during the postulated scenario leading to the mislocation of an assembly outside of the storage racks in the limiting area. Verify that this scenario is not possible or provide an analysis that demonstrates that the minimum soluble boron requirement of 1100 ppm is unaffected by this scenario.

09.01.01-60

OPEN ITEM

For the limiting accident scenario, the spacing between the mislocated assembly and the storage racks was requested for the limiting scenario along with analysis considering spacing optimization that maximizes reactivity. The applicant explains that “the spacing between the mislocated assembly and the storage racks is as close as practicable – within the limitations of the KENO geometry options.” The explanation continues to say that any change in spacing would not affect the soluble boron requirement given in Table 5-28 for this case. However, it appears that the KENO geometry shown in Figure 5-5 does not depict the absolute minimum distance between the storage rack and the mislocated assembly; it appears that there might be a water gap of a few centimeters that remains. Additionally, it is not clear that moving the assembly farther from the racks will not result in an increase in reactivity. However, the 1800 pcm of margin to the USL (Table 5-28) for this case is enough to provide reasonable assurance, that despite an optimum water gap sensitivity study, the 1100 ppm minimum soluble boron limit remains valid. Although 1800 pcm provides substantial margin, additional review has led staff to question if the assumption of 5% initially enriched fuel is limiting for the all-cell portion of Region 2 for this accident. A lower burnup would have a less top peaked fission density which could interact more strongly with the fresh fuel assembly. Provide additional analysis at lower burnups along the spent fuel loading curve to support the claim that the 1100 ppm minimum soluble boron limit remains appropriate.

09.01.01-61

OPEN ITEM

Follow-up to RAI 402, Question 09.01.01-42 (Issue #4)

In Issue #4, the staff had additional questions regarding the various sources of boron available at the plant and the potential for an abnormal condition associated with introduction of natural enrichment soluble boron into the SFP. The applicant was also asked to provide justification for TS SR 3.7.15.2 (verifies the isotopic enrichment of the boron in the SFP on a 24 month basis) with regard to both the expected impact of B-10 depletion in the SFP and the potential for introduction of natural boron.

It was explained that both natural and enriched boron could be available as feed stock and that fresh boric acid is introduced into plant systems via the boric acid mixing tank. It is explained that the boric acid storage tanks will be maintained at an enrichment of 40 ± 1 percent. Two ways that allow for altering of the storage tank boron enrichment are given: (1) highly enriched boron will be added in the RCS water to account for B-10 depletion, and (2) blends of highly enriched boron and natural boron will be added to the storage tanks to replace boric acid that cannot be recycled. It is stated that mixture of the boric acid storage tank water with the SFP water is possible because the storage tank water is injected into the RCS before the refueling cavity is filled for refueling. It is also stated that "because the boric acid storage tank enrichment is maintained above 37% before borating the RCS to refueling concentration, it will not reduce the average enrichment of the spent fuel pool." Provide the procedures and controls that are in place to ensure a minimum of 37% B-10 enrichment is maintained in the boric acid storage tank.

09.01.01-62

OPEN ITEM

The applicant identified two additional ways that the SFP B-10 enrichment could potentially be impacted: (1) impact of makeup batches from the boric acid mixing tank to the SFP and (2) B-10 depletion that occurs as a result of the neutron fluence in the SFP. One reason for a makeup batch to the SFP is to add water lost due to evaporation. This case does not involve boron addition and therefore is not of concern with respect to B-10 enrichment. The other reason for a makeup batch is to add borated water, potentially containing natural boron, to the SFP. Despite the fact that borated water additions are planned to be an infrequent event, the staff is unaware of any limitations on the number of borated makeup operations to the SFP or the quantity of water that is added in a given makeup batch. With this in mind, provide a description of the verification process for ensuring that the proper B-10 enrichment for this operation is verified.

09.01.04-20

OPEN ITEM

Follow Up to RAI 337, Question 09.01.04-14:

The staff requested AREVA to address operating experience considerations associated with refueling cavity seals in Request for Additional Information (RAI) 337, Question 09.01.04-14 dated December 15, 2009. Based on a review of AREVA's response received on August 5, 2011, the staff has determined that the applicant's response does not address all the staff concerns as discussed in Question 09.01.04-14. Therefore, the staff requests the applicant to revise the response to RAI Question 09.01.04-14 to address the following items:

a. Reactor Cavity Level Monitoring: Based on recent operating experience that indicated that inadvertent drain downs of the reactor cavity at relatively rapid rates can occur during refueling, the staff had previously requested AREVA to describe the detection method for indentifying the draindown of the cavity. In the RAI response, AREVA described the cavity seal as a permanently installed welded stainless steel ring and did not propose a dedicated leak detection/collection system. In addition, AREVA indicated that a decrease in reactor cavity level can be detected by level instrumentation installed in the fuel pool or visually in the cavity by an operator. Since the fuel building can be isolated from the reactor building, leaving no instrumentation in the reactor cavity to alert operators of an abnormal condition, it is not clear that visual water level monitoring is adequate to identify a draindown event without having either an alarmed level instrumentation in the reactor cavity or a dedicated ring leak detection/collection system. In addition, Technical Specification (TS) 3.9.6 requires a minimum water level of 23ft above the reactor vessel flange before initiating movement of fuel in the reactor cavity. Based on the proposed design, it is unclear that AREVA intends to meet this TS. Therefore, the staff requests the applicant to justify in the DCD the verification and monitoring of this TS without alarmed level instrumentation in the reactor cavity, and the absence of reactor cavity water level instrumentation that provides level indication and alarm for abnormal conditions (low level and rate of change) both locally and in the main control room.

b. DCD Section 9.1.4.3 states that the COL applicant will develop procedures to handle inadvertent draining of the refueling cavity in accordance with DCD Section 13.5, without making this a COL information item. The staff requests the applicant to include in DCD Section 9.1.4.3 a description of the essential elements of the procedures or to make this a commitment for a COL information item. The essential elements should consider directing the COL applicants to establish and implement procedures responding to pool drain down events, performing periodic maintenance and inspection of the cavity ring and other seals in accordance with vendor recommendations, and monitoring cavity leakage.

c. Proposed Figure 9.1.4-14-1 in the RAI response shows details of the refueling cavity ring. From the information contained in the drawing and the description in the response, it is unclear to the staff the means by which the ring is protected from the movement of core components since parts of the ring are above the reactor vessel flange. The staff requests the applicant to explain in the DCD the protective measures and design features credited to ensure the movement of core components do not damage the reactor cavity ring. In addition, for illustrative purposes, this figured should be added to the DCD.

d. The DCD markup in the RAI response states, "The cavity ring is also designed to withstand the impact of one fuel assembly with resultant leakage less than the capacity of the makeup flow to the refueling cavity." Because there is no cover plate for protection of the cavity ring and no leak detection of the cavity ring, the staff requests the applicant to provide the analysis that demonstrates a dropped fuel assembly will not result in a leak greater than makeup capability.