ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Wednesday, August 25, 2010 12:51 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); WILLIFORD Dennis (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 402(4675), FSARCh. 9
Attachments: RAI 402 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 402 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the RAI 402 questions is not provided.

The following table indicates the respective pages in the response document, "RAI 402 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

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A complete answer is not provided for 27 the 27 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 402 — 09.01.01-26	October 14, 2010

Question #	Response Date
RAI 402 — 09.01.01-27	October 14, 2010
RAI 402 — 09.01.01-28	October 14, 2010
RAI 402 — 09.01.01-29	October 14, 2010
RAI 402 — 09.01.01-30	October 14, 2010
RAI 402 — 09.01.01-31	October 14, 2010
RAI 402 — 09.01.01-32	October 14, 2010
RAI 402 — 09.01.01-33	October 14, 2010
RAI 402 — 09.01.01-34	October 14, 2010
RAI 402 — 09.01.01-35	October 14, 2010
RAI 402 — 09.01.01-36	October 14, 2010
RAI 402 — 09.01.01-37	September 24, 2010
RAI 402 — 09.01.01-38	October 14, 2010
RAI 402 — 09.01.01-39	October 14, 2010
RAI 402 — 09.01.01-40	October 14, 2010
RAI 402 — 09.01.01-41	October 14, 2010
RAI 402 — 09.01.01-42	October 14, 2010
RAI 402 — 09.01.01-43	September 24, 2010
RAI 402 — 09.01.01-44	October 14, 2010
RAI 402 — 09.01.01-45	October 14, 2010
RAI 402 — 09.01.01-46	October 14, 2010
RAI 402 — 09.01.01-47	October 14, 2010
RAI 402 — 09.01.01-48	October 14, 2010
RAI 402 — 09.01.01-49	October 14, 2010
RAI 402 — 09.01.01-50	October 14, 2010
RAI 402 — 09.01.01-51	October 14, 2010
RAI 402 — 09.01.01-52	October 14, 2010

Sincerely,

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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Monday, July 26, 2010 12:38 PM
To: ZZ-DL-A-USEPR-DL
Cc: Patel, Amrit; VanWert, Christopher; Lu, Shanlai; Donoghue, Joseph; Hearn, Peter; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 402(4675), FSARCh. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 5, 2010, and discussed with your staff on June 21, 2010. Further discussions took place on July 21, 2010, regarding the proprietary content of the draft RAI. Drat RAI Questions 09.01.01-28, 09.01.01-31, 09.01.01-33, 09.01.01-35, 09.01.01-36, 09.01.01-38, 09.01.01-40, 09.01.01-41, 09.01.01-45, 09.01.01-46, 09.01.01-47, 09.01.01-50, and 09.01.01-51 were modified as a result of those discussions. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
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Hearing Identifier: AREVA_EPR_DC_RAIs
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Response to

Request for Additional Information No. 402(4675), Revision 0

7/26/2010

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
Application Section: 9.1.1 (Technical Report TN-Rack.0101, Rev 0)

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

Question 09.01.01-26:

Most of the benchmarks given are for fresh fuel. The Commercial Reactor Criticals (CRCs) are supposed to contribute to the computational bias based on burned fuel compositions; however, the average burnup of the CRC benchmarks is <16 GWd/MTU with the maximum CRC burnup at ~33 GWd/MTU. The implication is that the computational bias estimates at higher burnups are not appropriate due to the gap in CRC applicability for higher burnups. Describe the process by which the applicability of the CRCs to fuel burned in the EPR (throughout the range of burnup values credited) is determined.

Response to Question 09.01.01-26:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-27:

The origin of the 0.005 Δk administrative margin imposed for the USL determination is ambiguous. It is stated that the basis comes from NUREG/CR-5661, however a value of 0.05 Δk is the recommended administrative margin used in USL determination for transport packages. Clarify the basis of the administrative margin being used.

Response to Question 09.01.01-27:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-28:

The adjustment factors reported in Section 5.5.1.2 of the Technical Report do not include any consideration of k_{eff} biases related to nuclear data errors or the rest of the computational method used to calculate k_{eff}. Consequently, provide an evaluation of trends in k_{eff} bias as a function of plutonium content, and soluble boron concentration. Revise the computational bias and uncertainty assessments as appropriate.

Response to Question 09.01.01-28:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-29:

In the last paragraph of Section 5.5.1.2 of the Technical Report, no evidence is provided that suggests that the listed differences have insignificant impact on the calculation of bias and bias uncertainty. Provide justification for this assertion.

Response to Question 09.01.01-29:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-30:

As is shown in Table 5-14, the CSAS25 validation includes only 11 mixed-oxide (UO2 + PuO2) critical experiments. These MOX critical experiments are documented in evaluations MIXED-COMP-THERM-002 and -003 in the IHECSBE. The uranium and plutonium compositions in these experiments vary significantly from the uranium and plutonium compositions in burned fuel. The fuel compositions in the HTC experiments described in NUREG/CR-6979 were designed to be similar to fuel that had an initial enrichment of 4.5 wt% ^{235}U and was burned to 37.5 GWd/MTU. As is shown in the NUREG, use of these experiments in the EPR validation database would provide a significantly improved validation for burned fuel k_{eff} calculations.

Discuss whether or not the HTC experiments will be used to validate burned fuel k_{eff} calculations. If not, provide justification for not using the HTC experiments.

Response to Question 09.01.01-30:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-31:

In general, safety-related calculations should be validated using the same computational method for both the safety analysis and validation. The computational method is the combination of the following:

a. computing platform and operating system,
b. computing software,
c. nuclear data,
d. if multi-group cross sections are used, the unit cell modeling techniques used to incorporate resonance data into problem-specific cross sections
e. input options affecting k_{eff} (e.g. order of scattering, angular quadrature)
f. modeling approaches that may affect k_{eff} (e.g. homogenization)

Variations in computational method used between safety analysis and validation may significantly affect the applicability of the bias and bias uncertainty to the safety analysis.

In Section 5.2.2 of the Technical Report, provide a complete description of the computational method used in the safety analysis and confirm that the validation was performed using the same computational method as was used in the safety analysis.

Response to Question 09.01.01-31:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-32:

Explain the presence of a non-physical discontinuity in the Table 5-3 burnup profiles between 204.17 and 215.83 cm.

Response to Question 09.01.01-32:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-33:

A potential issue exists for the implementation of burnup credit for the EPR. Burnup credit analyses specify a minimum burnup as a function of assembly initial ^{235}U enrichment that is required for storage in a given configuration. The uncertainty on the assembly average burnup is considered, often either as a reduction in the final assembly burnup or an increase in the burnup limits determined in the analysis. The treatment of this uncertainty, sometimes referred to as an uncertainty in the burnup records, in this way is typically captured in licensee controlled documentation, such as plant procedures. In some instances, the reactivity impact of the final burnup uncertainty is included in the determination of uncertainties within the criticality safety analysis and therefore is already included in the burnup limits. The treatment of this uncertainty in this way must be documented in the technical report for the analysis.

Provide an evaluation of the method that will be used to determine the uncertainty in final assembly burnup values for burnup credit purposes for the EPR. The evaluation should state and justify the use of an uncertainty value based on the intended core operations and instrumentation to be used to assess the assembly average burnup. Furthermore, the intended method of application must be documented for review.

Response to Question 09.01.01-33:

A response to this question will be provided by October 14, 2010.

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Question 09.01.01-34:

Expand the discussion on the use of assembly burnup profiles from EPR design calculations. This discussion should cover the characteristics of the core, cycles, and assemblies modeled and the means of providing margin for future variations in reactor operations and fuel design parameters. Provide justification for considering the burnup profiles in Table 5-3 to be bounding.

Response to Question 09.01.01-34:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-35:

The use of the profiles from NUREG/CR-6801 for burnups below 18 GWd/MTU is questionable. Provide a discussion of the development of the modified profile and justification for its use.

Response to Question 09.01.01-35:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-36:

The SAS2H models used to calculate the burned fuel compositions for the safety analysis did not include gadolinia rods. The EPR design relies on gadolinia present as integral fuel burnable absorbers. Provide information, including bounding ranges, describing the use of gadolinia in EPR.

Provide justification for using the gadolinia rod modeling approximation and quantify the bias and bias uncertainty associated with using the approximation. Depending on the values of the bias and bias uncertainty, conservatively incorporate into the criticality analysis the bias related to the modeling approximation.

Response to Question 09.01.01-36:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-37:

Describe axial blanket usage in more detail. The description should address the range of permitted blanket enrichments, range of blanket dimensions, usage of Gd in blankets, etc.

Response to Question 09.01.01-37:

A response to this question will be provided by September 24, 2010.

Question 09.01.01-38:

NUREG/CR-6665, "Review and Prioritization of Technical Issues Related to Burnup Credit for LWR Fuel" states the following:

Calculations with both actinide and fission product credit show a trend for conservative prediction of fuel reactivity worth when fuel is burned at lower specific power for a longer period of time for a given burnup.

Explain the choice of specific power in depletion calculations.

Response to Question 09.01.01-38:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-39:

SAS2H calculations are central to determining the isotopic vector associated with depleted fuel, which is to be discharged to the spent fuel pool. The depiction of the model in Fig. 5-1 of the submittal shows no fueled zone – presumably only the inner burnable poison is shown. In order to evaluate the validity of the model, a more detailed depiction, including a fuel zone is required. Provide the complete SAS2H model including the fuel zone for a representative burnup calculation.

Response to Question 09.01.01-39:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-40:

A constant soluble boron concentration is assumed, instead of assuming a letdown curve during the burnup cycle. The first cycle letdown curve is given in Figure 4.3-5 in Section 4.3 of the FSAR. Provide the impact of using the actual boron letdown curve (as given in Figure 4.3-5 in Section 4.3 of the FSAR) for the period in the cycle where boron concentration is different from the value assumed in the analysis. Provide the effect of using the actual boron letdown curve on the k_{eff} values reported in the final safety analysis.

Response to Question 09.01.01-40:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-41:

Figure 1-4 shows the Region 1 fuel storage racks. The left hand view shows the structure with the fuel storage tubes removed. The right hand view shows the structure with the tubes present. Figure 1-6 also shows a side view of a Region 1 rack module.

The continued efficacy of the poison panels during various potential accidents (seismic, dropped load, etc.) should be evaluated.

Provide drawings and/or descriptions of the Region 1 rack design to support the review. This information should include all relevant dimensions with tolerances and material descriptions. Confirm that analyses of normal conditions and accident scenarios have shown that the panels will continue to be adequately effective as neutron absorbers in all normal and credible abnormal conditions. If there is a design feature that ensures the flux trap gaps are maintained at the ends of poison panels, describe such features. If there is no design feature ensuring the flux trap gaps are maintained, evaluate the potential effect of flux trap gap reduction on k_{eff}.

Also, confirm the arrangement of poison panels on the outside faces of the Region 1 rack modules and that the analysis correctly models the actual configuration.

Response to Question 09.01.01-41:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-42:

Item 17 on Page 2-3 states that "The potential off-normal condition involving a boron dilution event is outside the scope of this report." From this statement, it would appear a complete boron dilution event (diluted to zero ppm) is credible, and thus the keff should be no greater than 0.95 for zero boron. Provide boron dilution accident analysis results supporting that attainment of the minimum boron concentration required by the criticality analysis is not credible.

Response to Question 09.01.01-42:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-43:

If it is considered permissible for an assembly to be moved next to the spent fuel storage racks during normal operations; therefore this configuration should be evaluated as a normal condition. Confirm that controls are implemented to prevent movement of one or more assemblies next to the spent fuel storage racks. If such control is not intended, amend the criticality analysis to consider this additional normal condition/configuration. Note that such revision may also impact analysis of abnormal conditions.

Response to Question 09.01.01-43:

A response to this question will be provided by September 24, 2010.

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Question 09.01.01-44:

Section 5.2.1 of the Technical Report lists the configurations evaluated for the Region 1 racks. It looks like the accidental drop of an assembly outside of the racks was evaluated for Region 2 but not for Region 1. Explain not providing this scenerio in the evaluation for the Region 1 racks. If the logic is that the spent fuel pool storage layout will not permit placement or dropping of an assembly next to a Region 1 rack, describe the design limitations that is ensure this (e.g. ITACC, COL item, etc.).

Response to Question 09.01.01-44:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-45:

From Section 5.4.4 of the Technical Report, it looks like fresh fuel may be stored in a Region 2 rack in an allowed pattern. This presents the opportunity for another abnormal condition in which a fresh fuel assembly is placed in an unapproved location. This potential abnormal condition should be evaluated or justification for not doing so should be given.

Response to Question 09.01.01-45:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-46:

Evaluate the impact on system k_{eff} related to the “Deep Drop in the Center” accident scenario in Section 3B.5.3 of the Technical Report or justify not doing so.

Response to Question 09.01.01-46:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-47:

Review the supporting calculations to confirm that the soluble boron concentration value is correct in the third and fourth rows of the unnumbered table in Section 5.1.3 of the Technical Report on page 5-3.

Response to Question 09.01.01-47:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-48:

In Table 5-26 of the Technical Report , there is no fuel pellet density sensitivity as claimed in Section 5.3.3.1 Numbered Item 8. Clarify or revise either the statement or the table accordingly.

Response to Question 09.01.01-48:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-49:

Section 5.3.3.4 of the Technical Report contains the statement: “The Region 2 storage cells are identical to those of the Region 1 storage cells.” This statement is incorrect and needs to be qualified or removed.

Response to Question 09.01.01-49:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-50:

Review of Table 5-12 of the Technical Report and the supporting references yielded the following comments:

a. Provide the methods used to obtain the measured to calculated ratios for ^{151}Sm and ^{155}Gd fission products.

b. Describe the validation process more fully, including criteria used for using some data and rejecting other data.

c. On page 5-49 some of the data appears to be shifted up a row. Review and correct accordingly.

d. The calculation methods of the TMI results are not clear. All measurements were reported in terms of gram of nuclide per gram of ^{238}U. However, no ^{238}U measurements were reported. Describe the use of the TMI data.

e. There is likely a typographical error in the measured to calculated ratio for ^{150}Sm for TMI sample nj070go1s3. Review and correct accordingly.

Response to Question 09.01.01-50:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-51:

Review of Table 5-13 of the Technical Report yielded the following comments:

a. The use of the results in the 2nd, 3rd, and 4th columns to create the values in the 5th column are not clear. Describe the selection process in more detail.

b. The values for some of the fission products in the Reference 20 column appear to be switched. Fix all discrepancies accordingly.

Response to Question 09.01.01-51:

A response to this question will be provided by October 14, 2010.

Question 09.01.01-52:

The addition of boron to cases C18 and C19 (Table 5-28) is not mentioned. Provide the concentrations, if any, of boron that is added to the water to ensure that k_{eff} is acceptably lower than the USL?

Response to Question 09.01.01-52:

A response to this question will be provided by October 14, 2010.