NRR-PMDAPEm Resource

From: Regner, Lisa
Sent: Monday, August 22, 2016 4:31 PM
To: Wayne Harrison
Cc: Blossom, Steven (sdblossom@STPEGS.COM)
Subject: GSI-191 DRAFT SNPB followup RAI
Attachments: draft SNPB followup.docx

Hi Wayne,

Here is the draft follow-up RAI for SNPB.

The APLA question we were talking about is APLA-4-4.

Lisa

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Sent Date: 8/22/2016 4:30:45 PM
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From: Regner, Lisa

Created By: Lisa.Regner@nrc.gov

Recipients:
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Tracking Status: None
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Priority: Standard
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1. **Follow-up SNPB-3-1 Cladding Oxide**

   Initial RAI: *Demonstrate that the thickness of the cladding oxide and the deposits of material on the fuel do not exceed 0.050 inches in any fuel region.*

   Follow-up question:

   In its response, STPNOC referenced an analysis performed by Westinghouse. It is not clear to the NRC staff that the analysis referred to in the RAI response is applicable to STP due to the fiber loading assumed in the analysis. The same referenced analysis also provided a prediction of the peak centerline temperature (PCT) experienced during the long term core cooling phase, but STPNOC determined that the PCT analysis was not applicable due to the amount of debris used in the analysis. If the analysis' prediction of PCT was not applicable to STP, it would follow that the same analysis' prediction of clad oxide thickness would also not be applicable. Explain how the analysis referenced is, in fact, applicable and an appropriate basis to satisfy the initial RAI criteria.

2. **Follow-up SNPB-3-2 Accident Scenario Progression**

   Initial RAI: *Provide a description of the accident progression of the accident scenarios being simulated using the LTCC EM. This description should start at the initiation of the break, define each phase, and the important phenomena occurring in that phase in the various locations of the RCS (e.g., core, reactor vessel, steam generators - both primary and secondary side, loops, pressurizer, pumps, containment)*

   Follow-up question:

   In their response, STPNOC provided a detailed write-up of the accident scenario, along with a number of plots describing key phenomena. However, the following items need to be addressed in the explanation of the accident progression scenario:

   - A basis was not provided for the time delay between sump switchover and full core blockage. STPNOC chose 360 seconds, but did not justify this time period.
   - The LTCC EM has a conservation equation for boron density, but STPNOC did not specify whether boron density effects were modeled in the simulation.
   - The heat stored in the steam generators needs to be appropriately treated to ensure correct flow, as the steam generators become the dominant flow path following full core blockage. Are the levels of auxiliary feedwater used in this analysis consistent with plant procedures following a LOCA? Has all of the secondary metal mass been accounted for the in the simulation? Have the correct material properties been used (e.g., heat capacity of the steam generator tubes)?

- Though only the 16-inch hot leg break analysis was provided, STPNOC did not justify or demonstrate that the 16 inch hot leg break bounds smaller hot leg breaks. Justify that the 16-inch hot leg break analysis bounds the smaller hot leg break scenarios.
- Provide a clear and in-depth description of counter-current flow limit (CCFL) at the core exit (e.g., plots of vapor and liquid flow at the exit, a description of relevance of the provided figure).

3. Follow-up SNPB-3-5 Debris at grid spacers

Initial RAI: *Describe how the LTCC EM accounts for potential blockages at spacer grid in the core above the bottom grid.*

Follow-up question:

In its response, STPNOC referenced a previous submittal. In this previous analysis, STP demonstrated that the amount of CRUD which could be expected to be released would be less than 2 pounds. The NRC staff agrees with STPNOC that this small amount of fine particles would have minimal impact on the flow through the spacer grids. STP also referenced WCAP-16793-NP (Reference 26) to address the ability of fibrous debris to collect at grid spacers. In section 3.4.4 of their Safety Evaluation (Reference 27), the NRC staff concluded that when the quantity of debris is within the acceptance limits specified in the WCAP (e.g., 15 grams per fuel assembly), the effect of fibrous debris accumulation on spacer grids in the core will be minimal. This conclusion was based on the observation made during testing that while fiber was deposited on spacer grids in the core, it did not impede cooling. It was not clear to the NRC staff that the same conclusion made in WCAP-16793-NP-A would be applicable to STP, as the fiber loading analyzed by STP in the long term core cooling analysis is much higher than what was tested in WCAP-16793-NP-A.

4. Follow-up SNPB-3-7 Initial and Boundary Conditions for the Long-Term Phase

Initial RAI: *Demonstrate that the initial and boundary conditions for each accident scenario at the beginning of the long-term phase are consistent with those conditions which are expected. This demonstration should analyze the RELAP5-3D calculations for the conditions at the beginning of reflood and show that those calculations are reasonable compared with known behavior. This analysis should include comparison between the conditions calculated by RELAP5-3D and the current large and small break LOCA safety analyses.*

Follow-up question:

Discuss the initial and boundary conditions at the beginning of the long-term phase (i.e., phase 4), and provide a justification that these initial and boundary conditions are appropriate.

5. Follow-up SNPB-3-13 Validation of closure relationships

Initial RAI: *For the closure relationships identified, provide appropriate validation for the use of this relationship over its expected application domain. This validation should include comparisons to separate effects tests and/or integral test data and appropriately address the model's uncertainty. Where appropriate, discuss any similarity criteria, scaling rationale, assumptions, simplifications, and/or compensating errors.*

Follow-up question:

Provide an analysis of the validation for the closure relationships important for the long-term core cooling (LTCC) evaluation methodology (EV). Analysis of the validation of the closure relationships is recommended with consideration towards similarity criteria, scaling, experimental uncertainty, the potential for compensating errors, and the comparison between predicted and measured results to determine if the closure relationships for the LTCC EM have sufficient validation for their use in the EM.

6. Follow-up SNPB-3-17 Validation of the evaluation model

Initial RAI: *Provide appropriate validation demonstrating that the LTCC EM will result in a reasonable prediction of the important figures of merit for the accident scenarios considered. Demonstrate that the validation covers the range of the accident scenarios used in the LTCC EM. This validation should include comparisons to integral test data and appropriately address the model's uncertainty. Where appropriate, discuss any similarity criteria, scaling rationale, assumptions, simplifications, and/or compensating errors.*

Follow-up question:

In their response, STPNOC provided a summary of the verification of the adequacy of the parameters used in the LTCC EM, a summary verification of the input models, and a summary of the judgment of the simulation results. While the information provided to justify the simulation results discusses various tasks that were performed to ensure the simulation is correct, that information falls more into quality assurance as it demonstrates that the inputs are correct and that the EM is predictable. Provide validation to demonstrate that the results from the EM are a reasonable prediction of the laws of nature.

Provide information to support the trustworthiness of the overall results of the LTCC EM. While such information is usually provided by comparison to an integrated experiment, the NRC staff is aware that such experiments are not available. However, a case can still be made, based on the relative simplicity of the simulation, the well-known phenomena modeled, and details of the numerous conservative assumptions, that the result of the LTCC EM can be trusted as a reasonable prediction.

7. Follow-up SNPB-3-18 Mesh size sensitivity

Initial RAI: *Demonstrate that the LTCC results are independent of mesh size for the accident scenarios under consideration.*

Follow-up question:

In its response, STPNOC provided a mesh sensitivity study on the radial mesh in the core. The base case uses a single set of axial nodes for the core region. In the mesh sensitivity, the licensee created another axial set of nodes to specifically model the hot channel in the core. This sensitivity study was performed to maximize the likelihood for CCFL to occur, as this would reduce the quantity of liquid which could act to cool the core. The results of the sensitivity study confirmed that there was no appreciable difference in the PCT of the two-channel core versus the one-channel core. However, STPNOC did not provide enough information to determine why these results occurred or if the second channel had any impact at all on the analysis. In order for the NRC staff to understand the radial mesh sensitivity study, STPNOC is requested to address:

- Was there a difference in CCFL between the average and hot channel?
- Was the PCT taken from the hot channel, from the average channel, or from both?
- What were the temperature profiles of the different channels?
- Did STPNOC notice any difference in the flow through the hot channel?

Additionally, the only mesh size sensitivity study discussed by STPNOC was a radial mesh size sensitivity study. Depending on the scenario, NRC staff have found varying levels of sensitivity to axial nodalization. Did STPNOC perform an axial nodalization study? If so, provide a discussion of the results.

8. Follow-up SNPB-3-19 Initial Test Cases

Initial RAI: *Provide a summary of the assessment cases performed in order to demonstrate that RELAP5-3D has been installed and is being used appropriately.*

Follow-up question:

In its response, STPNOC provided an explanation of the initial test cases, but it was not clear if these test cases were the complete set recommended by the developers of RELAP5-3D to verify a correct installation, or merely a subset. Additionally, STPNOC did not discuss the success criteria for each of the test cases and did not confirm that the criteria was satisfied. Confirm that the test cases run were the complete set recommended by the RELAP5-3D developers and provide the results of each case.

9. Follow-up SNPB-3-20 Specific sensitivity studies

Initial RAI: *During the audit, the NRC staff identified a number of sensitivity studies that would be important for the review of the proposed long term core cooling evaluation methodology. STP should perform the following sensitivity studies and submit plots of the relevant figures of merit and important timings for long term core cooling analysis:*

a) Appendix K decay heat load with single worst failure and steam generator tube plugging
b) Axial power shape
c) Break sensitivity study with appropriate break size resolution
d) No bypass blockage

Follow-up question:

In its response, STPNOC provided an overall summary of the sensitivity studies. However, this summary did not provide important details such as the plots of the figures of merit and justifications for the selections of certain input parameters. Provide the following:

- Plots of the figures of merit
- Discussion of the values of the important inputs chosen for the sensitivities. Where did those values originate and are they typical values (were the top and bottom peaked power shapes typical of top and bottom power peaking, why are the inputs for sensitivity ‘a’ so much different from the rest and are those values typical of plant or accident conditions, etc.)
- A summary of how the overall accident progression differed from the nominal case in each sensitivity study
- A more detailed discussion of the barrel-bypass sensitivity, including a reference to the PWROG testing performed to show the effect of fiber on flow orifices

10. Follow-up SNPB-3-22 Uncertainty and design margin

Initial RAI: *Provide a discussion on the impact of the uncertainties considered on the important figures of merit (e.g., PCT) for each of the accident scenarios and the margin to the design limit.*

Follow-up question:

In its response, STPNOC provided an overall summary of the uncertainties considered but did not provide sufficient details. Provide additional detail in the following areas:

- STPNOC makes the assertion that the 16-inch hot leg break would bound all smaller hot leg breaks, but does not justify this assertion.
- STPNOC discusses how the ECCS flow rate can impact the analysis, but did not discuss their choice for ECCS flow rate or its justification.
- STPNOC does not discuss its justification for the ECCS injection temperature or sump temperature.
- STPNOC alluded to sensitivity studies regarding the treatment of CCFL parameters but did not discuss them in sufficient detail for the NRC staff to understand how CCFL is treated.