NRR-PMDAPEm Resource

From: Harrison Albon <awharrison@STPEGS.COM>
Sent: Thursday, August 25, 2016 6:18 PM
To: Regner, Lisa
Subject: [External_Sender] SNPB Drafts for Monday STP Call
Attachments: SNPB Round 3 followup 3-1 3-2 3-19 8-25-16.pdf

Lisa,

Here are a few draft SNPB responses for Monday's call. Please call me if you have any questions.

I assume we will use the APLA RAI responses as our common talking reference for their part of the call.

Wayne

Hearing Identifier: NRR_PMDA
Email Number: 3014

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Subject: [External_Sender] SNPB Drafts for Monday STP Call
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From: Harrison Albon

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Recipients:
"Regner, Lisa" <Lisa.Regner@nrc.gov>
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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.

STP Response

The thickness of the cladding oxide and the deposits of material on STP fuel do not exceed 0.050 inches in any fuel region as demonstrated in the STP-specific LOCA DM calculation (STI 32408432 and 32408433, CN-SEE-1-08-66) and in the generic analysis documented in WCAP 16793 (see also starting on page 74 of 77 of ML083520326, STP RAI #31 and 36). The deposit layer thickness for STP fuel is 13.64 mils. The STP-specific analysis conservatively assumed 38.832 lbm of fiber (approximately 91 gm/FA) bypassed the strainers into the RCS however, less than half that amount bypasses the STP strainers in a HLB that is success at the strainer. In both of these analyses it was shown that STP cladding material would have less than 50 mil of deposits.

Additional information

STP further applies the results and assumptions used in the Westinghouse LOCA-DM calculation for assessing PCT under full core and core bypass blockage by assuming the same amount of impedance to heat transfer as assumed in the LOCA-DM analyses. That is, Westinghouse assumes sufficient upward flow through the core and core bypass with heat transfer impeded by the deposits whereas STP assumes the core and core bypass are fully blocked and the core has the same impediment to heat transfer due to deposits. As mentioned above, the level of deposition (and therefore impediment to heat transfer) is conservatively assessed compared to STP RCS fiber quantities. Note that HLB is limiting for core fiber accumulation.

Summary

Both the STP and Westinghouse TH analyses assume a clad thermal resistance due to deposits accumulated on the cladding that is independent on the flow condition. Flow assumptions through the core must be adopted in order to obtain a PCT consistent with the clad thermal conductivity and deposits on the clad (impedance to heat transfer). Westinghouse assumes continued flow up through the core and core bypass. STP assumes the core and core bypass (a more restrictive flow condition) are fully blocked.

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)*

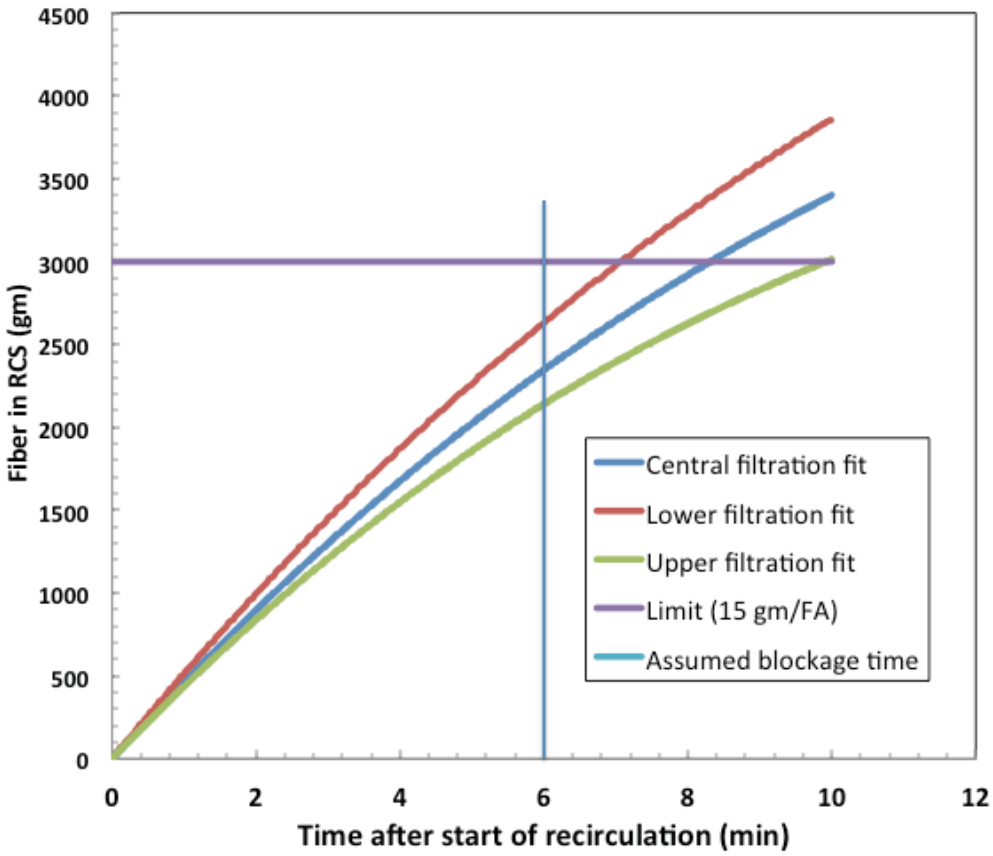
Follow-up question:

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.

STP Response

STP assumes the time to complete blockage of the core and core bypass is when the amount of debris that enters the RCS is equivalent to 15 gm/FA. This is a conservative assumption because, in order to have blocked both the core and the



core bypass, much more than 15 gm/FA is required. That is, additional fiber beyond 15 gm/FA would be needed to block the BB bypass, for example. In addition, any fiber not caught in the core or BB bypass would go out the HLB which would result in further reduction in the amount entering the RCS; FiDOE assumes all debris entering the RCS from a HLB is trapped on the core.

The amount of debris entering the RCS required to just reach 15 gm/FA is approximately 2900 gm (15gm/FA X 193FA). FiDOE time histories for design debris amount (approximately 192 lbm) and design train configuration (two trains) for different measured filtration fits (lower, central, and upper) is shown in the figure. As can be seen, 360 seconds (6 min) is a conservatively short time to assume that core and core bypass blockage has occurred due to 15 gm/FA, especially since there would be negligible chemical head loss this early.

- The LTCC EM has a conservation equation for boron density, but STPNOC did not specify whether boron density effects were modeled in the simulation.

  STP Response
  The STP LTCC EM includes a (mass) conservation equation for boron density however, by use of input, the mass of boron in the system is 0.0. That is, there is no boron assumed in the RCS sources (ECCS flows, CS flows, RWST water, or ECCS Accumulators). Also, no boron mass is entered as an initial condition in the

RCS. Therefore, although a mass conservation equation is present, no boron is present, accumulated, or depleted in the STP LTCC EM. Effects of the boron density are not 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)?

  LATER

- 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.

  LATER

- 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).

  LATER

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.

STP Answer:

The RELAP5-3D software has been installed and currently in use in compliance with the South Texas Project Electric Generating Station Software Quality Assurance Program 0PGP07-ZA-0014 revision 10 [1].

Fifty-nine (59) run-time environment (RTE) test cases are included in the RELAP5-3D installation CD. Each of the cases are is reviewed for applicability and scope of the GSI-191 thermal-hydraulic analyses. Of the 59 cases, eleven (11) cases are relevant to the GSI-191 simulations and are include in the RTE test matrix.

The selected cases are executed and the simulation results (output) are compared with the outputs included in the RELAP5-3D installation CD.

The acceptance criterion applied is that there should be reasonable agreement in the results between the local version of the code and the outputs included in the RELAP5-3D installation CD. The comparison is performed considering that output variations due to running the code with different computer name and precision, CPU time, file paths, dates, times, operative system, and hardware are expected. Nevertheless, no significant variations in the calculated results are expected.

The table below summarizes the results of the output comparison performed [1]. The RTE testing show that the test cases have verified the software functionality by successfully comparing the test case outputs (results) with the reference outputs provided by INL in the installation CD.

Software Name:	**RELAP5-3D**	Software Rev.:	**4.1.3**	
Tester:	Timothy Crook	Test Date:	11/20/2015	
Test Plan No.:	See Section 4.0	Test Case No.:	See Table 3-1	
Case #	**Test Requirement**	**Test Results**		**Pass/Fail**
2	Acceptance criterion: Reasonable agreement of the test results between the installed version and the INL supplied outputs (Comparison of output files)	There were no technical differences in the results between the outputs generated with the installed version and the INL supplied outputs.		Pass
4	Same as above	Same as above		Pass
5	Same as above	Same as above		Pass
17	Same as above	Same as above		Pass
19	Same as above	Same as above		Pass
20	Same as above	Same as above		Pass
21	Same as above	Same as above		Pass
25	Same as above	Same as above		Pass
42	Same as above	Same as above		Pass
50	Same as above	Same as above		Pass
52	Same as above	Same as above		Pass

[1]. 0PGP07-ZA-0014 “Software Quality Assurance Program” STI 33856275 rev.10, 04/17/2014.