REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR

WCAP-16865-P, REVISION 1,

"WESTINGHOUSE BWR ECCS EVALUATION MODEL UPDATES: SUPPLEMENT 4

TO CODE DESCRIPTION, QUALIFICATION AND APPLICATION"

WESTINGHOUSE ELECTRIC COMPANY

PROJECT NO. 700

1. Please describe the heat transfer equations for the average and hot channel wall temperature calculation for the period during lower plenum flashing up to and including the period of core spray rated flow:

    a. Please define each term in sufficient detail and discuss how those terms are obtained.

    b. Please discuss what information from the average channel calculations feeds the hot channel calculation. Discuss any coupling.

    c. Please provide this information for both the currently approved model and the proposed model.

    d. Please discuss how the core spray flow is accounted for both before and after it reaches rated flow. Before the core spray reaches rated flow, will the core spray flow increase the pressure drop across the core and therefore decrease the steam flow rate through the core? How is this decrease carried through to the hot channel?

    e. The current model uses one definition for the end of lower plenum flashing. Please demonstrate that the proposed model for the end of lower plenum flashing will not overestimate the heat transfer to the hot channel.

2. The spray cooling heat transfer coefficients used, once core spray reaches rated flow, are based on data and are considered conservative, but only by 15 percent. Because spray cooling injection starts some seconds before it reaches rated flow, a gradual transition would be expected where the heat transfer coefficient has a gradual change to meet the spray cooling heat transfer coefficient values which are based on test data. However, the CHACHA-3C calculation does not show a gradual change, but a step change by a factor of **[ ]** Justify CHACHA-3C's calculation of the heat transfer coefficients and explain why CHACHA-3C over predicts the spray cooling heat transfer test data.

ENCLOSURE 1

3. From Figure 3-6 of the topical report (TR), it seems that delaying the time it takes for core spray to reach rated flow (making the time frame longer between core spray initiation and rated flow) will allow higher heat transfer and a lower Peak Cladding Temperature (PCT). Please provide a sensitivity study which demonstrates this is not the case. If this is the case and having core spray reach rated flow earlier results in higher PCTs, justify the core spray time delay.

4. Westinghouse Electric Company's (Westinghouse) new definition of the "end of lower plenum flashing" is defined as the time after initiation of lower plenum flashing when either (1) water inventory in the lower plenum vanishes, OR (2), depressurization in the lower plenum stops. Flashing of initially subcooled lower plenum water begins after the lower plenum pressure drops to the saturation pressure in the region. If the water in the lower plenum region becomes subcooled again, will lower plenum flashing cease? If so, should this be added to the definition of the end of lower plenum flashing?

5. Please provide a graphic which gives the location of the Side Entry Orifice (SEO).

6. Provide ROSA-III data for Lower Plenum Water Temperature and compare to the predictions of GOBLIN presented in figure 5-19 of the submitted TR.

7. The faster depressurization rate in GOBLIN is due to break flow modeling. For safety analysis, the Moody model is prescribed and this would lead to an even faster depressurization than that predicted by the HEM model when comparing to the ROSA-III test. Please provide a discussion addressing this faster depressurization rate and associated increased steam flow rate, specifically verifying that increased heat transfer due to the increased steam flow rate would still result in conservative calculation.

8. By changing the definition of the "end of lower plenum flashing", the proposed Westinghouse model is much more sensitive to the flashing model and the steam cooling heat transfer model. It seems that these models may have had little impact on the core heat transfer with the previous definition of "end of lower plenum flashing" and will have a much greater impact with the change in the definition of "end of lower plenum flashing." Please demonstrate that these models have been adequately validated and demonstrate that any model sensitivities (such as sensitivities to rapid changes in pressure) have been accounted for such that under all anticipated uses the models will result in a conservative estimate of the PCT.

9. What events (accidents/transients) will see the largest impact from the change in the definition of "end of lower plenum flashing" and what is the largest impact expected in terms of PCT?

10. Please provide a plot of Figure 5-28, "Comparison of temperature at the plane of peak power," with the ROSA data, as well as GOBLIN with both the currently approved and proposed definitions of "end of lower plenum flashing."

11. In the ROSA test, GOBLIN is able to match the heat ups during the period of lower plenum flashing, which indicates that the heat transfer coefficients at this time are a best estimate of the actual heat transfer. Is the time in which lower plenum flashing cools the core typical of transients and accidents for boiling-water reactors, or would the steam cooling and steam generation play a larger role in determining the clad PCT in other analysis? In other words, does the ROSA test provide a limiting scenario to determine the impacts of the steam cooling and steam generation models? What assurances are there that use of steam cooling and steam generation models in other transients or accidents will not overpredict the heat transferred from the fuel and result in a non-conservative PCT calculation.

Reference

WCAP-11284-P-A, Addendum 1, “Westinghouse Boiling Water Reactor Emergency Core Cooling System Evaluation Model: Code Description and Qualification”, RPB-90-93-P-A, October 30, 1989.