June 13, 2007

MEMORANDUM TO: Jared S. Wermiel, Deputy Director
Division of Safety Systems
Office of Nuclear Reactor Regulation

FROM: Robert Lewis, Acting Deputy Director ***/RA/***
New Reactors and Computational Analysis
Division of Risk Assessment and Special Projects
Office of Nuclear Regulatory Research

SUBJECT: TECHNICAL ASSISTANCE RELATED TO AUDITING BWR MARK I SHORT-TERM ANALYSIS FOR REVIEW OF WCAP-16608-P ENTITLED WESTINGHOUSE CONTAINMENT ANALYSIS METHODOLOGY

NRR requested technical assistance in performing audit calculations to support the NRR review of Westinghouse topical report WCAP-16608-P, "Westinghouse Containment Analysis Methodology." (ML 062430594). The report describes Westinghouse methods for calculating containment conditions following postulated design basis accidents. Westinghouse proposes to use the GOTHIC computer code for these calculations. To date, Westinghouse has submitted only a proposal for modeling the BWR Mark I containment. Future submittals will address other containment types. To assist in this review, NRR requested that RES perform a containment response calculation of a BWR Mark I short-term LOCA (recirculation line break), which produces the peak drywell pressure. Accordingly, this activity was coordinated with the cognizant NRR reviewer, R. Lobel, and the following summarizes our analysis and, thus, completes the requested activity.

Westinghouse has included a sample problem of the BWR Mark I short-term transient in the topical report, thereby providing the design data used in the GOTHIC input deck along with the calculated results. Similarly, RES developed a CONTAIN input deck using the relevant design details and practices consistent with the CONTAIN BWR User Guide (ML 030700335). RES performed a similar calculation with CONTAIN along with selected code sensitivities; enclosed is a plot of drywell pressures. Three CONTAIN calculations were performed:

1. The reference design basis calculation for the short-term BWR LOCA, which includes the key assumption of retaining the liquid blowdown effluent ("no dropout" assumption) in the drywell gas space thus maximizing the main vent flow resistance;

2. A code sensitivity of the reference calculation where "dropout" is modeled;

3. Another code sensitivity of the reference calculation where the drywell free volume is increased by 10%, investigating the effect of increased initial inventory of the non-condensible gases in the drywell.

When comparing the GOTHIC drywell pressure transient against the CONTAIN results, it was revealed that GOTHIC results were closer to the “dropout” case rather than the “no dropout” calculation, which should not be the case for a design basis analysis. Requests for additional information (RAIs) are being sent to Westinghouse and based on recent discussions, Westinghouse found that GOTHIC condenses the steam in submerged flow paths (such as the downcomer outlet) prior to calculating the flow path pressure drop. After fixing this error so that the loss coefficient is applied to the downcomer inlet instead of the downcomer exit, GOTHIC results are now closer to the “no dropout” case. Westinghouse also made other code adjustments to maximize the peak drywell pressure, e.g., 100% water entrainment, no slip between the water droplets and gas flow. Also, enclosed is a CONTAIN plot of vent flow rates for the reference case. Furthermore, we did not model containment structural heat sinks in the CONTAIN BWR model. It was unclear from the topical report what was modeled in GOTHIC. We did learn that Westinghouse had modeled the heat sinks. But this omission in the CONTAIN model is insignificant, i.e., less than one psi, for the short-term peak drywell pressure transient.

As mentioned above, this completes our technical assistance on this subject. However, we will still follow this evaluation, for example, by reviewing the Westinghouse responses to the relevant RAIs on this targeted analysis, and consult with NRR accordingly. Please contact Allen Notafrancesco (415-6499) for any further discussion on this matter.

Enclosures:
As stated

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