August 24, 2006

MEMORANDUM TO: James W. Clifford, Deputy Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: Jennifer Uhle, Deputy Director ***/RA/***
Materials Engineering
Division of Fuel, Engineering and Radiological Research
Office of Nuclear Regulatory Research

SUBJECT: DRAFT REPORT SUMMARIZING ANALYSES OF UNFLAWED STEAM GENERATOR TUBES DURING A SEVERE ACCIDENT TRANSIENT

The purpose of this memorandum is to update the Office of Nuclear Reactor Regulation (NRR) on the efforts of the Office of Nuclear Regulatory Research (RES) to model the behavior of steam generator (SG) tubes in a generic pressurized water reactor during postulated station blackout induced severe accident scenarios. A description of the analysis of unflawed SG tubes using the latest thermal-hydraulic boundary conditions is included in the enclosed report from Argonne National Laboratory (ANL). This work has been completed in close coordination with NRR staff. This report is being sent at this time in order to facilitate a peer review of the modeling assumptions by NRR staff and other experts. RES would like to verify the technical accuracy of the modeling before conducting further studies to refine the estimate of the frequency of occurrence, approximately 5E-6 per reactor year using conservative assumptions on a number of mitigating factors.

The two models used to predict rupture of unflawed and flawed SG tubes are the flow stress model and the creep rupture model. These two models are reported in NUREG/CR-6575. The flow stress model assumes that rupture of the unflawed tube would occur when the hoop stress in the tubes equals the flow stress of the tube material. The creep rupture model predicts tube rupture when the integrated degradation of the unflawed tube over the entire accident equals one. Tests were conducted to evaluate the use of both models. The flow stress model, which assumes that the failure temperatures are independent of ramp rates, predicted SG tube failure at a constant failure temperature. The creep rupture model, which incorporates rate effects, predicted the failure temperatures more accurately.

Therefore, the creep rupture model was utilized to predict the failure times of unflawed SG tubes. The temperature ramps for the average tube and the hottest tube were utilized to evaluate SG tube failure for the current base case. The best estimate failure times for the average and the hottest unflawed tubes are 14,438 and 13,460 seconds, respectively. For comparison, the current best estimate failure time for the hot leg, based on finite element analyses of the same transient, is 13,430 seconds.

CONTACT: Todd S. Mintz, DFERR/RES
301-415-6778

A peer review meeting is being planned which will include a discussion of the assumptions and limitations related to this work. It is requested that NRR staff be available to support this review. Meeting dates for September or October of 2006 are being considered and the meeting will be coordinated with NRR staff. If you have any questions related to this analysis, please contact Dr. Todd Mintz (415-6778, tsm4@nrc.gov, MS: T10E10) of my staff.

Enclosure:
As stated

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