January 19, 2006

MEMORANDUM TO: William H. Bateman, Deputy Director
Division of Component Integrity
Office of Nuclear Reactor Regulation

FROM: Michele G. Evans, Chief **/RA/**
Engineering Research Applications Branch
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SUBJECT: TRANSMITTAL OF REPORT ENTITLED "CHEMICAL EFFECT/HEAD-LOSS TESTING QUICK LOOK REPORT, TESTS ICET-3-4 TO 11", DATED JANUARY 20, 2006

The enclosed report entitled "Chemical Effect/Head-Loss Testing Quick Look Report, Tests ICET-3-4 to 11", dated January 20, 2006 is being transmitted to be included as an attachment to IN 2005-26 Supplement 1. The enclosed report describes the continuation of studies conducted at Argonne National Laboratory (ANL) on the potential contributions of chemical effects to head loss across sump screens in environments where trisodium phosphate (TSP) buffering is used to control pH and fibrous and calcium silicate insulation (cal-sil) debris may be present. Head loss testing, settling rate testing of calcium phosphate precipitates and cal-sil dissolution testing in TSP solutions are described.

The objective of the head loss tests was to assess the pressure drop across debris beds created by various mixtures of cal-sil, fibrous (NUKON) insulation, and calcium phosphate precipitates. The effects of both the relative arrival time of the precipitates and insulation debris and the calcium phosphate formation process were specifically evaluated. The debris loadings and test temperature were chosen to be reasonably representative of those expected, based on limiting design basis analyses, in plants with updated sump screen configurations. Other variables were selected with the intent to encompass the variability in head loss due to the effect of TSP dissolution rates, debris residence time in the containment pool prior to accumulation at a sump screen, and other variables that could affect the amounts and homogeneity of calcium phosphate precipitates in the debris bed.

The results of the head loss tests demonstrate that calcium phosphate precipitates associated with TSP-buffered containment environments can significantly contribute to head loss across simulated sump screen debris beds for the debris mixtures tested. Additionally, the head losses associated with pure NUKON and cal-sil debris beds can be much smaller than those that occur across debris beds in which some of the cal-sil has been replaced with a corresponding amount of calcium phosphate precipitates. Greater initial calcium phosphate concentrations within the debris bed led to more rapid head loss accumulation than in tests where the calcium phosphate was formed over longer durations, but the steady state, maximum head loss was most strongly a function of the final calcium phosphate concentration. It was not possible, in these tests, to measure head loss differences between the simultaneous arrival of insulation debris and chemical precipitate and the arrival of insulation debris first followed by chemical precipitate because the measured head loss was high in both conditions for the debris mixtures tested.

The dissolution tests were intended to identify important environmental variables governing both calcium dissolution and subsequent calcium phosphate formation over a range of simulated containment pool conditions. Results of this testing indicate that the cal-sil dissolution rate for concentrations less than 1.5 g/L is not strongly dependent on the TSP dissolution rate over the range of TSP dissolution rates that are likely to be relevant. For cal-sil concentrations as low as 0.5 g/L, the equivalent dissolved Ca could be high enough after a few hours to potentially produce significant head loss increases even for instantaneous TSP dissolution.

Settling tests were performed to determine settling rates for calcium phosphate under conditions with no bulk directional flow. At higher dissolved calcium concentrations (300 ppm), some of the precipitates agglomerated. The agglomerated precipitates settled more quickly (3.8 cm/min), but approximately one half of the total precipitate settles more slowly than the agglomerated precipitate. At a lower dissolved calcium concentration (75 ppm), which is expected to be more representative of plant conditions, the estimated settling velocity was 0.8 cm/min.

Enclosed:
As Stated

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