Franklin Research Center
A Division of The Franklin Institute

March 28, 1980

Mr. Sam Duraiswamy
ACRS
USNRC
Washington, DC 20555

Re: ECCS Subcommittee Meeting, March 25, 1980

Dear Sam:

This meeting was devoted to discussion of Small Break Transient Behavior of W plants equipped with UHI.

Discussion concentrated on justification of WCAP-9639 as a basis for accepting the SBA findings of WCAP-9600 for SBA of UHI equipped power plants.

Validity of one dimensional drift flux model to analyze the discharge of UHI water from the upper head volume into the reactor (a strictly three-dimensional behavior expected) was questioned. This was resolved by noting that experimental evidence supports the conclusion that any 3-D effects (channelling) cause more water to be delivered to the core.

Arguments relative to the justification of the Evaluation Model type of analysis used for developing emergence procedure guidelines for operators were presented (Theo). While it is desirable to use the best available codes for this purpose (and any other reactor coolant system behavior for that matter), the resulting guidelines call only for RC system status verification and very few actions on the operator part. As shown by more detailed studies by W (using NOTRUMP code), the primary system state variables are not greatly affected by the UHI water presence. I believe W approach is acceptable for this purpose. W and others should be as encouraged, however, to continue development of better codes.

More concern was expressed over the possibility of UHI nitrogen discharging into the primary coolant system. W explained that depressurization transients without a break do not vacate enough volume in RCS to discharge any of the UHI nitrogen. They also showed that 2" break would depressurize to about 990 psia with no nitrogen discharged into the RCS. 2" breaks (and smaller breaks) depend on steam generator, for decay heat removal. Since there is no mechanism for UHI nitrogen discharge into RCS for such breaks, there should be little concern about losing SG heat sink due to UHI. For larger breaks decay heat can be removed through the break.

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Discussion of UHI discharge dynamics details indicated that the physics of the process are not well known. It is assumed (and supported by W and KANSAI tests, proprietary) that rapid local condensation in void upper head (due to cold UHI water injection) reduces pressure in upper head and two phase mixture is drawn from core into upper head. After the upper head is filled with subcooled UHI water (initially injected), the system pressure stabilizes at a secondary pressure and for some period no UHI water is delivered. When upper head reached saturated state, guide tubes and supports will pass water to upper plenum in exchange for vapor. This process may be associated with some oscillatory behavior (Schrock).

When pressure is reduced further, additional UHI water is delivered. W proprietary research indicates that calculations underpredict water delivery from upper head to upper plenum.

W calculations indicate that adequate SG heat transfer surface remains available even if the entire UHI nitrogen is discharged into RCS (400 ft^3 of Nitrogen vs. 3100 ft^3 of SG tube volumes). Degradation of the heat transfer on the remaining SG tube surface is expected but not likely large enough to preclude SG as a viable heat sink. It is also noted that SG is not required as heat sink for such a case.

In view of the presentations and discussions at this meeting, I believe W analysis of small breaks for UHI plants is acceptable for the purpose of definition of emergency procedure guidelines for power plant operators. The redundancy of UHI block valves and sources of operating energy also appear to be adequate to provide high probability assurance that the block valves will be closed to prevent UHI nitrogen injection into RCS.

It is not clear how exactly UHI injection would affect the natural circulation; injection of cold water may slow down, stop or even reverse the flow of the natural circulation. The question remains: will the system recover and restart the natural circulation and if so what is the time scale. NRC plans to conduct some tests to gain more insight in this matter. The natural circulation tests planned at TVA will be conducted with UHI valves blocked out (no desire to inject borated water.

All W plants have high pressure SI pumps (at very low flow rate for high pressure). However, each of the two PORVs can only discharge 30 lb/sec (at 2200 psia), which when compared to 125 lb/sec of decay heat boiloff, indicates that no feed and bleed cooling mode available for these plants.

Very truly yours,

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ZZ/mmf