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Prof. Ivan Catton, Chairman
ACRS Subcommittee on
Thermal Hydraulic Phenomena
48-121 Engr. IV
University of California
at Los Angeles
Los Angeles, CA 90024-1597

Dear Prof. Catton:

Subject: Comments regarding the May 12, 1993 Meeting of the ACRS JOINT THERMAL HYDRAULIC PHENOMENA/CORE PERFORMANCE SUB-COMMITTEE in Bethesda, MD.
(i) BWR Core-power Instability during ATWS,
(ii) Degassing Effects on BWR Water Level Instrumentation.

Here are my comments on, and concerns about, the presentations made at the subject meeting.

(i) <u>BWR Core-power Instability during ATWS</u>

The issue was to determine how far one could lower the coolant level in the Downcomer, thereby reducing the fission power in the reactor core and the heating rate for the Suppression Pool and the Containment, without depriving the fuel at the top of the core of cooling.

I recommend not to lower the level any farther below the Feedwater Spargers than is necessary to saturate the injected coolant. The analyses presented to justify the recommended "Strategy B" of lowering the level to the Minimum Steam Cooling RPV Water Level addresses only static U-tube situations. The analysis leaves these two questions open:

1. Will the water from the Downcomer sweep the heavy boron solution, as expected, out of the Lower Plenum, after the water level in the Downcomer is raised again, or will the lighter water pass under the skirt and over the boron solution below, without entraining significant amounts of boron?

2. Will the top of the core temporarily be uncovered, when the voids in the core collapse partially after fission shutdown? How much fuel damage will occur before decay heat is removed again at the top by contact with two-phase mixture? A simple calculation shows that at least 0.8% of normal full core flow is needed to cover the core at 5% decay heat.

I was favorably impressed by the simple analysis presented by T. Rogers for estimating the pressure rise in the containment. However, the simplifying assumption of thermodynamic equilibrium is not conservative:

During the time of steam condensation in the pool, the analysis
- under-predicts the pool temperature rise, but
- over-predicts the rise of the atmospheric pressure,

because the poor heat transfer between the pool and the atmosphere, and the poor thermal mixing in the atmosphere are too weak to establish thermal equilibrium.

After the time of steam condensation in the pool, the analysis
- over-predicts the pool temperature rise, but
- under-predicts the rise of the atmospheric pressure.

Thus the final containment pressure is under-predicted.

An equally simple, but more conservative approximation would have been to dump all the mass and energy from the RPV into the pool during the first phase, and then into the atmosphere during the second phase. The atmospheric temperature at the end will be above the pool temperature, because the steam emerges from the pool at a temperature above the pool temperature. While the assumptions made by Rogers have little impact on the selection of "Strategy B", their impact on containment loading needs to be quantified.

(ii) <u>Degassing Effects on BWR Water Level Instrumentation</u>

The tests described by BWROG and CDI are very useful to study the phenomena of degassing, but they are not suitable for estimating the error of level elevation measurement in a reactor. The experiments would have to be performed in a full-scale and geometrically similar test facility at reactor conditions, or in a scaled facility under scaled initial and boundary conditions. "Cumulative over Total Heights" and "Cumulative over Total Volumes" were used as, but demonstrated to be inappropriate, scaling groups (see figure after Viewgraph 45 in handout provided by BWROG).

The variations in geometry and piping arrangements now used for level measurements at different plants appear to call for a separate analysis and review for each group of arrangements. Documentation for the Millstone Reactor modification and the acceptance testing is needed, so that the Millstone solution can be reviewed before it is recommended for adoption by other utilities.

I am concerned that BWR plants are being operated which d ot meet a GDC for instrumentation.

I trust that these comments are helpful.

Sincerely yours,

Wolfgang Wulff

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Copy: P. Boehnert, ACRS.