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NUCLEAR REGULATORY COMMISSION
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NOTE TO: Fuat Odar

FROM: Ashok Thadani

My recent work on W and CE plants has caused me to be concerned that we may have over emphasized our concerns with overpressure events in PWRs and not given adequate attention to the possibility of core uncovery from ATWS events. The following is a short summary statement of my concerns and recommendations for further audit calculations (I intend to discuss this possible problem with PWR vendors also).

CONCERN IN PWRS

A. ATWS Events With Proper Functioning of Pressurizer Valves

For events like Rod Withdrawal (RW) with Turbine Trip and LOFW* (or LOL**) what is the power profile for long term. Note pressure and L_{przr} may be such that the operator may not actuate HPSI (Borated Water) even after 10 minutes and further the system pressure may be way above HPSI shut off head for some plants (e.g. some HPSI shut off head is 1200 psi). If the power remains high enough and if the pressure remains high enough such that Borated Water is either not injected or injection is delayed because of high system pressure then a potential for core uncovery exists.

Further, if water relief thru safety/relief valves is the major way of removing energy, then the core uncovery could occur because W_{leak} h_f has to match energy produced and since $h_f < h_g$, W_{leak} has to be pretty high.

h_f - Coolant water enthalpy at Pressure P
h_g - Coolant Steam enthalpy at Pressure P
W_{leak} - Flow out of Pressurizer safety/relief valves
L_{przr} - Pressure level

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*LOFW - Loss of Feedwater Flow
**LOL - Loss of Load

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Need for Calculations on PWR

LOFW (or LOL) and RW Event

Analyze event assuming:

Case 1

a) Secondary heat transfer loss at X = 0.9 in Steam Generator
b) All Aux Feed Available
c) 99% and 95% MTC

Case 2

a) heat transfer loss at X = 0.9
b) 1/2 Aux Feed Available
c) Same as 1c

Case 3

a) heat transfer loss at X = 0.95 (or even higher)
b) full Aux Feed Available
c) Same as 1c

Case 4

a) Same as 3a
b) 1/2 Aux Feed Available
c) Same as 1a

Factors: It is important to correctly model heat flux and primary system inventory (HPSI - important).

Carry the calculations far enough (say 20 minutes or longer) to determine if the core can be uncovered.

Note: In these calculations 0.9 X HEM model may be non-conservative.

B. ATWS Events With One or More Valves Stuck Open

Concerns: Are the vendor codes for this scenario adequate? Could the codes used be incapable of estimating void generation in the primary? Do we have audit capability for this scenario?

We need an early discussion of the above concerns. If the concerns are real, we need to perform some calculations soon.

Ashok Thadani

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ATWS Distribution

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