TASK CLOSE OUT DOCUMENT

Task Scope Comments about Continued Natural Circulation Operation

File IAG

To: M. Levenson
S. Levy
E. Zebroski

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Reason felt task is complete:

Comments prepared and additional analyses recommended

Members of Committee

S. Levy

S. Levy
Signed
Committee Leader

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SOME COMMENTS ABOUT NATURAL CIRCULATION

With natural circulation established in the A loop, the primary objective should be to keep it going for as long as possible in the A loop while primary water activity decays and additional systems are being added to the auxiliary building. The following are some suggestions to achieve that objective:

1. Because of its low flow and possibly high pressure loss at the exit of the reactor core, the damping in the natural circulation loop is expected to be low. (the hottest in-core thermocouple exhibits poorly damped oscillation of +3°F as makeup is added) It would be worthwhile to establish what the damping ratio and stability of the loop is now and as natural circulation flow decreases with decay of power.

2. Because of its expected low damping characteristics. system perturbations should be made slowly and gently. Addition of cold water makeup has been observed to impact natural circulation in the A loop and is suspected to have stopped the much lower natural circulation rate in the B loop during the transition from forced to natural circulation.

3. There are changes in system parameters which are favorable or unfavorable to natural circulation. The following is not a complete list:

   Favorable:

   adjust makeup water temperature to match coolant water where it is injected;increases percent of decay heat removed in generator by reducing other heat rejection methods such as letdown, pump seal, etc.

   raise position where heat transfer takes place in steam generator and use cold auxiliary feedwater.

   Unfavorable:

   pressure decrease if gas is present in system. This gas volume would increase and would impact natural circulation. Also the colder leg temperature will permit less dissolved than the hot leg which again hurts natural circulation though this temperature effect is believed to be small in the temperature of interest at TMI.

4. It is much more difficult to set up natural circulation from a stand-still condition than a correctly moving condition and it will tend to lead to much larger initial oversnoots and undershoots than in the running case. Also, from a standing condition, "sneaky" circulation paths will be established where heat can be dissipated closest to the point of generation, i.e., it is expected that natural circulation might set in within the core and around the core barrel before it sets in through the steam generator. Such sneaky circulation paths can work against the desired mode and increase the overshoot. Most computer models do not account for such sneaky paths and such modeling should be considered if one wishes to predict the benavior from a standing point.

5. At the low velocities of natural circulation, coolant mixing takes time and distance. All computer codes assume uniform and immediate mixing. By contrast, it is expected that the addition of makeup water may lead to temperature stratification and even counter current flow. A prediction of how natural circulation was stopped in the B loop might enhance confidence in the analytical models.

6. It is possible to operate with both A and B loops in natural circulation and this should lead to increased flow of 10 to 20 percent in the reactor core. However, there is some assymetry in the two loops especially in terms of makeup injection. Makeup is added to the B loop and its introduction will produce a different effect on the B versus the A loop circulation. This might lead to slight oscillations between the two loops and it is suggested that operation with one loop might be preferable until such parallel channel instability has been checked.

7. During any start of natural circulation, provisions should be made in pressurizer level to account for any overshoot or undershoot of flow and level swell and drop in the pressurizer.

8. Temperature distribution along the loop and distances associated with such temperatures can influence greatly the rate of natural circulation. Some assessment of the uncertainties in such temperatures might be valuable.

9. There should be an effort to forecast when natural circulation in the A loop might stop in favor of other present means to remove heat generated in the core. This may be the point in time to transfer to more direct methods to cool the core such as decay heat removal system particularly if the water fission product activity has reached a plateau. Operation in natural circulation beyond this point might lead to a burping type of system which might be more difficult to control.