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September 14, 1982

Dr. T. Huang
Core Performance Branch
Division of Systems Integration
Office of Nuclear Reactor Regulation
Washington, DC 20555

Dear Dr. Huang:

The results of LOFT test L2-5 raise some question about the assumptions of all three PWR vendors that the indications of the core-exit thermocouples can be used as an unambiguous indication of approach to ICC, at least during the recovery period from a large break LOCA when there is still a significant amount of residual decay heat in the core.

The EG&G Quick-Look Report (EGG-LOFT-5921, June 1982) states the conclusion: "The temperature information observed by reactor operators for liquid level control (upper plenum) and also coolant temperature information at the core-exit are shown in Fig. 20 (attached). Comparing this information with that in Fig. 19 (also attached), clearly shows that these temperature measurements are not adequate for liquid level control and, hence, maintaining adequate core cooling." From these curves it is apparent that during the second core uncovery the upper plenum temperature did not depart significantly from the saturation temperature and that the core-exit temperature showed superheat only after the cladding temperature started down due to reflooding from reestablished injection flow. Examination of additional temperatures in the L2-5 Data Report (NUREG/CR-2826, EGG-2210, August 1982) shows a close correlation between the rise in core-exit temperature (e.g., Fig. 3R-7) and reestablishment of LPIS flow (Fig. 3R-1). Similar examination of the initial blowdown shows a possible correlation between core-exit temperature rise and the initiation of HPSI flow. A significant amount of top-down quenching was noted to occur during the blowdown phase. It is observed that the central lower end box (assembly 5) coolant temperatures showed superheat during the initial blowdown while the central upper end box temperatures showed virtually no superheat. In the outer assemblies, the superheat was at the top with little or none at the bottom.

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It is speculated that when the vessel level is decreasing in the core region that reverse flow or stagnation may be occurring possibly in conjunction with top quenching, which effectively inhibits superheat indication of the core-exit thermocouples or upper plenum temperatures. When HPIS or LPIS flow is established, then at least the outer fuel assemblies show superheat at the upper end boxes.

It should be pointed out that the analyses of the ICC instrumentation indications including the reactor vessel level and core-exit thermocouple systems have been largely confined to the small break LOCA, whereas the period in question in the LOFT L2-5 test is during the blowdown and recovery from a large break LOCA. The differential pressure reactor vessel level measurement systems would indicate that voiding was occurring in the reactor vessel. The differential pressure indication might, however, be subject to error due to the safety injection. The LOFT dP indication showed boiling noise, but no useful level information. There is insufficient detail about the behavior of the system above the core to speculate about the possible indications of the heated junction thermocouple level system.

It is not clear that the failure of the core-exit thermocouples to show the approach to inadequate core cooling in this large LOCA transient can be extrapolated to the small break case. Some additional testing with slower core uncovery would be in order.

Perhaps the PWR vendors should be asked to analyze LOFT L2-5 with respect to the use of core-exit thermocouples to indicate ICC and show that their emergency guidelines cover situations such as occurred in the LOFT test.

Very truly yours,

Richard L. Anderson

RLA/JLA/r

cc: J. L. Anderson
G. N. Miller
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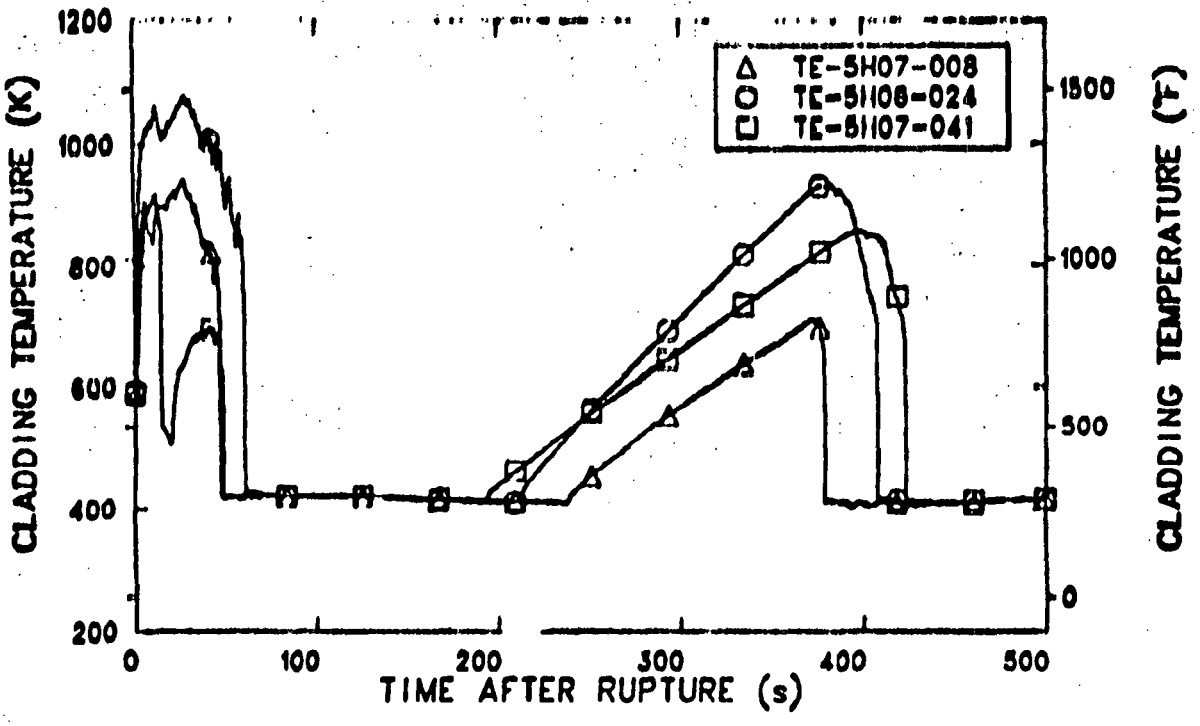

Figure 19. Comparison of cladding temperatures at different elevations during second core heatup for Experiment L2-5.

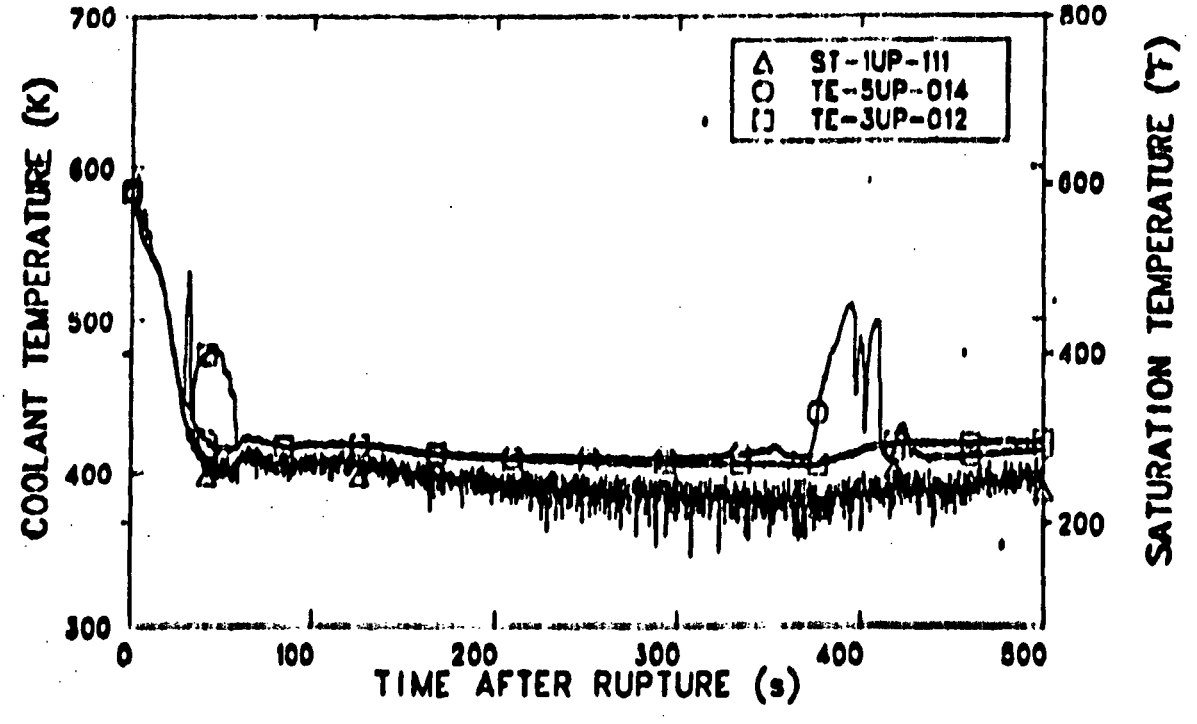

Figure 20. Comparison of core exit and upper plenum fluid temperatures with saturation temperature for Experiment L2-5.