UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MEMORANDUM FOR: [redacted]

FROM: Roger J. Mattson, Director
Division of Systems Integration

SUBJECT: BOARD NOTIFICATION REGARDING SEMISCALE S-UT-8 TEST RESULTS


Summary

The purpose of this memorandum is to request that you notify all Westinghouse and Combustion Engineering PWR Licensing boards of the results of an SBLOCA test run at the Semiscale facility. Test S-UT-8 was a 5% cold leg break with 1.5% bypass flow which resulted in a brief complete uncovery of the core prior to loop seal clearing. The same behavior was seen in RELAP-5 calculations for the test and for a full scale PWR.

The significance of this result is that it had previously been thought that the minimum level to which the vessel level could be depressed in Westinghouse and Combustion Engineering designed plants was to the bottom of the loop pump suction piping (approximately 1/3 core uncovery).


Background

During certain cold leg SBLOCA scenarios in Westinghouse and Combustion Engineering designed reactors, core level depression is expected to occur for a brief period of time. The depression occurs because of a water seal in the suction piping of the reactor coolant pumps which prevents steam formed in the core from venting through the break. Consequently, a pressure differential between the hot leg and the cold leg is created and a manometric response is seen in the vessel and downcomer levels.

CONTACT: M. E. Keane
X28957

The minimum level depression expected in the core due to this response is to the elevation of loop pump suction piping. The presence of core barrel vent valves in B&W plants prevents the formation of significant core liquid level depression relative to the downcomer liquid level. Therefore, this concern is not applicable to B&W designed plants.

Semiscale Test Results

The Semiscale test series S-UT investigated the effect of upper head injection (UHI) during SBLOCAs. S-UT-6 and S-UT-8 both were 5% cold leg breaks. For the S-UT-8 test, the facility had been modified to reduce the bypass flow from the downcomer to the upper plenum from 4% to 1.5%. This was done to make the configuration more typical of a non-UHI plant. The S-UT-6 test did not show any unusual level depression while S-UT-8 resulted in complete uncovery of the core for a short time prior to loop seal clearing. High core temperatures were not reached in either case.

The post-test analysis indicates that the increased level depression is due to liquid storage on the upflow side of the U-tube steam generator. This produces a positive hydrostatic head around the loop and can cause depression below the loop pump suction. The timing and extent of this liquid storage appears to be sensitive to several factors including bypass flow and condensation in the U-tubes.

The post-test analysis included RELAP-5 calculations for the Semiscale test and full-scale plants. These calculations show core level depression below the pump loop seals. A previous RELAP-5 calculation for a four-inch cold leg break in a full scale PWR also calculated complete core uncovery prior to loop seal blowout. However, at the time, the results were thought to be unreal.

Conclusions

The significance of these test results is that the phenomena of core level depression and loop seal clearing may be more complex than had been thought. Level depression below the elevation of the pump suction piping before loop seal clearing is a new phenomenon that has not been seen previously. The vendor codes should be reviewed to see if they adequately model liquid storage in the U-tubes. The relevance of this is that the consequences of an SBLOCA may be more severe than had previously been calculated if the codes can not model this phenomenon. However, we do not expect the new phenomena will be shown to result in violations 10 CFR 50.46 limits.

We do not believe sufficient information is available to draw any conclusions from these results. We do believe, however, that the Boards should be made aware of them. We are presently pursuing the issue generically with INEL, Westinghouse and Combustion Engineering. This will lead to a determination of whether or not their codes are adequate to model this phenomenon and, if not, what further action is necessary. We hope to have the issue resolved by January, 1983 and we will provide additional information for updating the Boards with at that time. As

noted, B&W plants have core barrel vent valves which prevent significant level depression due to loop seal formation. Also B&W steam generators do not have primary system upflow through the tubes where additional liquid seals can form due to condensation. Thus, the problem does not apply to B&W plants and those Boards need not be informed.

Roger J. Mattson, Director
Division of Systems Integration

BOARD NOTIFICATION

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