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December 7, 1981

Mr. R. L. Tedesco
Assistant Director of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: LaSalle County Station Unit 1
Core Spray Preoperational Test
NRC Docket No. 373

Reference (a): R. L. Tedesco letter to L. O. DelGeorge dated November 6, 1981.

Dear Mr. Tedesco:

The purpose of this letter is to provide a response to the question presented in Reference (a). The question addressed the spray distribution of the High Pressure Core Spray System during recent preoperational tests.

The response provided on the enclosed attachment also includes the information requested in meetings held with NRC representatives on November 17 and November 20, 1981. During the November 17 meeting with NRR reviewers, the video films, which initiated Region III Inspector concerns, were reviewed and discussed. The staff requested a sensitivity analysis of core spray heat transfer be conducted to demonstrate the peak clad temperature remains below 2200°F. The results of this analysis were presented to the staff on November 20, 1981. During the meeting with NRR Senior management, an additional request was made to visually inspect the High Pressure Core Spray Sparger.

Based upon the validity of the post-installation flow test on the sparger and nozzles and based upon the special sensitivity analysis which confirms that there is no deficiency in the cooling adequacy of the LaSalle design, even with the conservative Appendix K model, it is evident that no corrective action is needed. None-the-less, at the request of the staff, Commonwealth Edison has agreed to perform a visual inspection of the post-installation condition of the nozzles on the core spray spargers.

If there are any questions in this regard, please contact this office.

Very truly yours,

C E Sargent

C. E. Sargent
Nuclear Licensing Administrator

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cc: NRC Resident Inspector - LSCS

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ATTACHMENT

HPCS Preoperational Test

Response to Q231.28

Field Tests

The preoperational core spray tests at LaSalle, PT-HP-101 (FSAR Chapter 14 Table 14.2-36) were conducted to verify the operability of the HPCS equipment including controls, alarms, valves, pumps, test loop, initiation logic, and response timing. To ensure proper water delivery, system total flow was recorded and the spray nozzles were checked for blockage. The final test observation showed that the system was operating as intended. This test was never intended to be a test of spray distribution and is not useful for determining spray distribution because: (1) Only the top guide is in place, channels and handles which have a significant effect of spray distribution are not in place; (2) Camera placement and lighting are intended to view individual nozzle behavior and are not suited to judge distribution; and (3) Experience with full scale water tests in air under ideal lighting conditions shows that observation of light and dark areas in the pattern have no correlation to actual flow into the individual fuel bundles.

The first field test run indicated that flow from the nozzles nearest the water tee-boxes could be improved. Such indications had been observed in other field tests. The water tee-box is a welded configuration where internal surface irregularities can cause nozzle sputtering of the nearest nozzle. At LaSalle, the spargers were disassembled, the inner surface of the tee-boxes were smoothed and the spargers were reassembled. The subsequent field test indicated improvement in flow continuity of the nearest nozzles when at ninety-percent total flow condition and at the fully rated flow condition for the spargers. The performance of the installed spargers was reviewed and judged satisfactory by the NSSS vendor's engineers who specialize in core spray design and who routinely evaluate post-installation video films of sparger and nozzle flows.

Developmental Tests

Quantitative measurements of spray cooling adequacy have been underway for over a decade. Core spray distributions have been measured with liquid catchers under the fuel channels which were occupied with bundle hardware. Spray patterns and nozzle arrangements have been developed and calculational models verified to be conservative on the basis of full scale air tests, core sector tests, and measurements of heat transfer coefficients (Flecht tests). These are reported in NEDO-10846 and NEDO-20566-3 and have been generically reviewed by the NRC Staff. The latest staff evaluation (December 1978) concluded that the GE data "indicates that for the worst size and break locations with the worst attendant single failure, the spray from a single spray sparger is adequate to justify credit for cooling assumed in ECCS analyses." Such tests provide the basis for the spray cooling component of the analytical models used in the Appendix K analyses.

Test results indicate a wide margin between the minimum channel flow requirement and the measured channel flow. It should be remembered that total cooling is dominated by reflood considerations rather than spray cooling considerations for reactors of the LaSalle vintage.

Sensitivity Analysis

To further investigate the safety significance of variations in HPCS core spray patterns, a sensitivity analysis was made of the core spray heat transfer as modeled in the Appendix K calculations to see whether the accepted peak clad temperature limitation was challenged.

The core spray heat transfer is modeled in Appendix K calculations as a constant core spray heat transfer (CSHT) coefficient applied from the time of rated core-spray to reflood time. Heat transfer phenomena during the ECCS period are dependent on thermal-hydraulic system performance. Shortly after the core sprays come on, there is a pool of water in the upper plenum due to counter-current flow limiting (CCFL) at the top of the core. In the presence of the pool of water in upper plenum, the heat transfer in the bundle is governed by the CCFL downflow and is not dependent upon core spray distribution which is applicable only in a steam environment. Sometime later in the transient, the pool in the upper plenum becomes sub-cooled thus causing the breakdown of CCFL and, thereby, an earlier reflood of the core. Only during a short time period, when there is no pool of water in the upper plenum does the heat transfer in the bundle depend upon core spray distribution. A consistent and mechanistic evaluation (Appendix K) bundle heat transfer concludes that a peak cladding temperature (PCT) of 2009^{o}F applies for LaSalle. This includes the typical NRC conservatism of only one sparger and credit for only partial heat transfer.

Sensitivity studies show that even with the most conservative, though non-mechanistic, assumption of zero heat transfer credit during the core spray distribution period, the same evaluation model shows that the peak cladding temperature remains below 2200^{o}F. Based upon this conclusion, it is evident that variations in core spray distribution are non-limiting for the LaSalle reactors.