Summary of Concrete Problems
Wolf Creek Nuclear Plant

Concrete was placed for the reactor containment building base mat in a continuous operation on December 12 and 13, 1977. The total volume of the 10 foot thick mat was nearly 6500 cubic yards. Sample test cylinders of the concrete were taken during the placement and subsequently tested at 7 and 28 days after placement to determine the rate of strength gain. Sample cylinders for the final 90-day strength determination also were obtained. On March 13, 1978, the 90-day cylinders were tested---about 9% failed to meet one test criterion; about 50% failed to meet a second test criterion. The NRC inspector was informed of the apparent low cylinder strength on March 15, 1978. Inspection Report STN 50-482/78-04, dated March 31, 1978, noted that the question of the 90-day strength of the concrete for the reactor containment base mat had not been settled.

The licensee, Kansas Gas & Electric Company, informed the NRC on May 3, 1978 that, in the licensee's opinion, the apparent low test results of the concrete strength were not required to be reported to the NRC. The licensee agreed to send the NRC for its information, a report about the licensee's investigations which had been initiated. The NRC has provided interim reports, dated May 3, 1978, May 25, 1978, August 18, 1978, and September 29, 1978, about the progress of the licensee's investigation. The licensee's final report was submitted on October 26, 1978.

Review of the final report by the NRC raised questions about the conclusions contained in the report. On November 13, 1978, the Region IV (Dallas) Office of the NRC, with the assistance of a consultant, began an investigation into the apparent low strength concrete test cylinders. By December 1, 1978, the investigators had concluded from the information available that the specifications the licensee had established for acceptance of the concrete had not been met and that the reactor containment base mat strength was in question. The NRC preliminary evaluation of the base mat concrete strength based on the test cylinders indicated a value about 10% below the intended strength of 5,000 pounds per square inch (psi).

On December 5, 1978, a meeting was held by the Director of NRC Region IV with the licensee to discuss the status of the investigation and to emphasize the importance placed on this problem by the NRC.

On December 13, 1978, the licensee reported another concrete deficiency, a through-wall void in the concrete wall beneath the equipment hatch in the reactor containment building. Another void was found beneath the personnel lock, but was not a through-wall void. In a letter issued on December 19, 1978, the NRC, through its Region IV Office, informed Kansas Gas & Electric Company of the NRC's concerns regarding the concrete problems and the actions that the licensee was to address in order to satisfy these concerns. The concerns related to the overall quality assurance program including controls and procedures related to concrete placement, quality control, inspection, testing and qualification of personnel, as well as the independence of the inspection and verification organizations. The NRC also confirmed a commitment by the licensee to stop the placement of concrete in safety related structures until the quality assurance matters outlined in the letter were corrected and demonstrated to the satisfaction of the NRC.

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On January 4, 1979, a meeting was called by the NRC to discuss the findings of the NRC investigation and the position of the licensee on those findings. The meeting, held in Bethesda, Maryland, included representatives of all involved parties and members of the public and the news media.

As a result of the meeting, the licensee initiated additional testing on cube samples stated to have been cut from the remains of the original 90-day test cylinders. The licensee submitted a report on February 28, 1979, describing the results of these additional tests. The NRC in a letter dated February 8, 1979, requested that the licensee consider cut cube sample testing on remnants of 28-day test cylinders and that an assessment of the concrete strength be made using the test data obtained from all of the test cylinders. It was also requested that the value for the strength obtained be used to evaluate the load carrying capacity of the structure for the required loading combinations.

Region IV, after additional inspections at the site during February 1979, concluded that the licensee had satisfactorily met the commitments agreed to in the December 19, 1978 letter. On March 5, 1979, another letter was issued by Region IV which called for no further placement of concrete in the reactor containment building until the question on the acceptability of the base mat has been resolved. The licensee will, however, complete the necessary repairs to the voids in the reactor containment wall.

The licensee resumed placement of safety related concrete except for the reactor containment on March 6, 1979. On March 8, 1979, the licensee stopped work on safety related concrete after licensee quality control personnel observed that concrete was being moved by vibrators over a greater horizontal distance than permitted by the governing code. This deficiency was observed during the placement of a wall section of the auxiliary building. The initiative for the stop-work action was taken by the licensee. The licensee lifted the stop-work order on March 22, 1979, relative to placement of safety related concrete except for difficult placements and concrete in the reactor containment building.

The licensee lifted the stop-work order on March 22, 1979, relative to placement of safety related concrete including difficult placements but excluding concrete in the reactor containment building wall. The stop work order regarding placement of concrete in the reactor containment building wall is still in effect.

Region IV performed an augmented inspection effort for approximately six weeks, beginning the week of March 26, 1979, and running through the week of May 14, 1979, to observe work activities pertaining to placement of safety related concrete.

The licensee completed a reanalysis of the base mat and submitted the results to NRR on May 10, 1979. The reanalysis was performed in accordance with the original design commitments of the Wolf Creek PSAR using a calculated concrete strength of 4460 pounds per square inch.

NRC requested the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, to make a petrographic examination of concrete thin sections prepared by the PCA and examine fragments of cylinders. WES submitted a report of their examination on July 5, 1979.

On July 10, 1979, NRR issued an evaluation stating that based on their review of the test results and the results of the reanalysis, they conclude that the base mat concrete strength has not retrogressed, that the strengths of the base mat meets the original design criteria in the Wolf Creek PSAR, and that the mat will withstand the specified design loads and loading combinations without impairment of its structural integrity or its safety function.