SUPPLEMENTAL SAFETY EVALUATION REPORT REGARDING THE
PROPOSED N-16 TRANSIT TIME FLOW METER FOR THE
COMANCHE PEAK REACTORS, UNITS 1 AND 2.

4.4 Thermal - Hydraulic Design

The Core Performance Branch in its SSER for the Comanche Peak reactors has identified the flow measurement uncertainty with the Transit Time Flow Meter (TTFM) as an open item (Reference 1). The applicant requested that we approve a volumetric flow measurement uncertainty of of ±1.5% and referenced the Westinghouse Electric Corporation (W) report WACP-9172 (References 2,3) which was originally submitted for review in 1978. That review had been suspended and then resumed in April 1984, both by request of W. Although our review of WCAP-9172 for generic approval is incomplete, it has progressed sufficiently to permit our evaluation of the TTFM application to Comanche Peak. Other information submitted as a result of our review is provided in references 4 and 5. In addition two meetings were held in Bethesda, Maryland on September 5, and October 11, 1984, attended by the applicant, NRR, W, and ORNL (September 5) acting as consultant to the staff. The objectives of the review were to establish the acceptability of the TTFM for application to the Comanche Peak reactors and to evaluate the volumetric flow measurement uncertainty of the TTFM system as applied to those reactors.

Evaluation

The TTFM uses the N-16 activity fluctuation in the hot leg to determine the mean transit time between a pair of gamma ray detectors placed along (and on the outside) of the pipe. Signal cross correlation is used to measure the "transit time" between the fixed points of the detectors and, hence, to deduce the fluid velocity. When the pipe internal diameter is known, the volumetric flow can be determined. The detection efficiency for the fluid traveling directly in front of the detector is high with respect to the fluid diametrically opposite. In the case of the Comanche Peak plants there are four pairs of detectors on the three loops and three pairs on the fourth.

This arrangement gives a good averaging of the flow in each loop. With the known volumetric flow the average temperature in the hot leg can be determined when a calorimetric measurement is performed. To have a meaningful sample for a signal cross correlation a minimum of 20 minutes of measurements is required. This requirement does not allow this method to be used where fast response signals are needed, therefore, it is used only for the cold leg elbow tap calibration because these meters have poor absolute measurement accuracy but adequate reproducibility.

The TTFM system has been tested at Ginna and at Prairie Island Unit 2. The Ginna tests established the principle and the high degree of reproducibility of the measurements. In the Prairie Island tests the flow was measured with a Leading Edge Flow Meter (LEFM) of +0.65, -0.67% accuracy and compared to the corresponding readings of the TTFM. A series of four tests showed a maximum deviation of 0.38% and an average flow difference of 0.16%. These values are well within the claimed accuracy of ±1.5% for the TTFM. However, single pair TTFM detector measurements located at the top and bottom of the hot leg pipe indicated differences, as large as ±1.65%. This result was interpreted in terms of flow stratification in the pipe. For the Comanche Peak reactors such potential inaccuracies are dealt with by using four pairs of detectors which have a good average "view" of the flow in the pipe. In addition a theoretical study of flow stratification error analysis supported the use of multiple pairs of detectors. The loop flow conditions in the Comanche Peak plant are very similar to those in Prairie Island and good agreement is expected. However, in view of the ±1.65% maximum deviation between two pairs of detectors and the lack of plant specific measurements at this time, the staff concluded that our approval should be limited to ±2.0%, comparable to accuracies which have been accepted for other flow measurement techniques, until completion of our generic review of WCAP-9172. The applicant has committed to provide plant data to contribute to our evaluation of the TTFM flow measurement uncertainty. The results of our generic evaluation may be applied to Comanche Peak.

Regulatory Position

The staff found that the TTFM principle has been adequately demonstrated. Based on the results of the Prairie Island measurements and other supporting analyses, the staff found that a ±2.0% uncertainty in the volumetric flow measurement using the TTFM would be acceptable. However, the applicant has agreed to submit detailed TTFM performance data during the first cycle for staff review. These data will be used in the staff's ongoing review of WCAP-9172. The staff will review an application to revise the ±2.0% value of the volumetric uncertainty in the future if sufficient plant specific information becomes available to support a lower value. The conclusions of our generic review of WCAP-9172 may also be applied to Comanche Peak.

We will require that the Comanche Peak technical specifications include a minimum flow limit consistent with the plant safety analyses and based on the approved volumetric flow measurement uncertainty of ±2.0%.

REFERENCE

1. Rubenstein to Novak, "SSER Input for the Comanche Peak Reactor" dated, August 10, 1984.

2. WCAP-9172, "An N-16 Transit Time Flow Measurement System (TTFM) Description and Performance" K. F. Graham and J. M. Forker, Westinghouse Electric Corporation, February 1978.

3. Letter E. P. Rahe Jr., W to C. O. Thomas, NRR, dated September 14, 1983 (Ref. NS-TMA-1838) and Letter T. A. Anderson, W to J. F. Stolz, NRR, dated June 2, 1978 (Ref. NS-TMA-1838).

4. Letter Report: R. E. Rahe, W, to C. O. Thomas, NRR, dated August 24,1984.

5. Letter Report: A. Parker, W to J. George, TUSI, dated July 5, 1983.