TU ELECTRIC

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Attn: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 and 50-446
N16 TRANSIT TIME FLOW METER (TTFM)

REF: NUREG 0797, Supplement No. 12, "Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2," January 1990.

Gentlemen:

TU Electric has completed a performance review of the N16 transit time flow meter (TTFM) during the first operating cycle of Unit 1.

As previously committed in the referenced document, this letter transmits the performance data collected and the associated conclusions. Specifically, Attachment 1 contains a detailed discussion of the azimuthal uncertainty term. Tables 1 through 4 contain loop specific results from each of five test runs conducted on each loop. Figure 1 superimposes the tabulated test results on a diagrammatic representation of a hot leg cross sectional view.

From the analysis of the tabulated data, the TTFM uncertainty terms contained in Table 3 of the CPSES Improved Thermal Design Procedure report were shown to remain bounding. Therefore, the contribution of the TTFM volumetric flow rate uncertainty to the overall RCS flow rate uncertainty specified in the CPSES Unit 1 Technical Specifications also remains bounding.

In addition, due to similar installation of N16 detectors, these conclusions apply to the use of the TTFM on Unit 2.

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Documents supporting these conclusions contain Westinghouse proprietary information and are available for your review. Please contact Mr. J. D. Seawright at (214) 812-4375 should you have any questions.

Sincerely,

William J. Cahill, Jr.

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By: Roger D. Walker
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Attachment

c - Mr. R. D. Martin, Region IV
Resident Inspectors, CPSES (2)
Mr. T. A. Bergman, NRR

DISCUSSION OF AZIMUTHAL UNCERTAINTY TERM

I. Current uncertainty of the TTFM includes the following:

* 1% flow systematic error (Westinghouse original value)

* 1.4075% flow random error ("NRC conservatism" factor)

II. The NRC conservatism factor stemmed from a concern involving the deviation between velocities measured by the "top" and "bottom" detectors during testing (as documented in WCAP 9172). This testing was conducted on a two loop plant and involved limited N16 detector geometry variations. Since the CPSES N16 detector installation is asymmetric on one of four loops (see figure 1), analysis of actual test data allows the azimuthal profile to be determined.

III. Assume the azimuthal uncertainty is systematic:
Applying a least squares fit to the data tabulated in Tables 1-4, the azimuthal velocity profile was found to be well represented by the following relation:

$$\text{velocity} = 55.026 + 1.136 \sin(\text{theta} + 58.66)$$

This demonstrates the symmetry of the azimuthal velocity profile. Consequently, the azimuthal error may be assumed to cancel out on the three loops with N16 detectors located 180 degrees apart. For loop four, with detectors spaced 150 degrees apart, a 0.28% flow error results due to the azimuthal term.

Therefore, treating the azimuthal uncertainty as a systematic term results in values of 0% flow error for 3 loops and 0.28% flow error for the fourth loop. These values are significantly less than the currently assumed azimuthal uncertainties listed in Item I above.

IV. Assume the azimuthal uncertainty is random:
Statistically, the tabulated data produce a standard deviation of the mean values equal to $\pm$0.535% flow (from the average flow velocities for each of the 4 loops). Statistically, this equates to a single loop value of $\pm$1.07% flow, which is only slightly larger than the 1% flow error assumed by Westinghouse. However, it must be noted that the currently assumed azimuthal uncertainty of $\pm$1% flow is treated as <u>systematic</u> in the TTFM overall uncertainty evaluation. Treating the term as random results in a significantly smaller overall TTFM error, even when substituting the slightly larger value of $\pm$1.07% flow.

V. Therefore, independent of how the azimuthal error term is chosen to be treated (i.e. systematic or random), the tabulated performance data demonstrate that the current method/values and resulting TTFM volumetric flow uncertainty are conservative.

TABLE 1

RCS MEASURED HOT LEG COOLANT VELOCITIES (TTFM DATA)
COMANCHE PEAK UNIT 1 (CYCLE 1 - NEAR EOL - 7/16/91)

LOOP 1 MEASURED COOLANT VELOCITIES (FT/SEC)

Measurement	Top[1] Detectors (Ft/Sec)	Bottom[1] Detectors (Ft/Sec)	Average (Ft/Sec)	(Top-Bottom)x100% Average (%)
Run 1	54.701	55.083	54.892	-0.70%
Run 2	54.779	54.823	54.801	-0.08%
Run 3	54.742	55.392	55.067	-1.18%
Run 4	54.711	55.055	54.883	-0.63%
Run 5	54.747	55.451	55.099	-1.28%
Mean	54.736	55.161	54.948	-0.77%
Standard Deviation	.0310	0.259	0.128	----
Standard Error of Mean	.0139	0.1160	0.057	----

[1]For coolant loops 1, 2 and 3, the N-16 detectors are on the sides of the hot leg pipe. The detectors labeled "Top" are on the left when facing the reactor vessel.

TABLE 2

RCS MEASURED HOT LEG COOLANT VELOCITIES (TTFM DATA)
COMANCHE PEAK UNIT 1 (CYCLE 1 - NEAR EOL - 7/25/91)

LOOP 2 MEASURED COOLANT VELOCITIES (FT/SEC)

Measurement	Top[1] Detectors (Ft/Sec)	Bottom[1] Detectors (Ft/Sec)	Average (Ft/Sec)	(Top-Bottom)x100% Average (%)
Run 1	56.094	54.579	55.336	2.74%
Run 2	56.113	54.829	55.471	2.31%
Run 3	56.134	54.762	55 448	2.47%
Run 4	56.000	54.791	55.396	2.18%
Run 5	56.047	54.763	55.405	2.32%
Mean	56.078	54.745	55.411	2.41%
Standard Deviation	0.0540	0.0966	0.0521	----
Standard Error of Mean	0.0241	0.0432	0.0233	----

[1]For coolant loops 1, 2 and 3, the N-16 detectors are on the sides of the hot leg pipe. The detectors labeled "Top" are on the left when facing the reactor vessel.

TABLE 3

RCS MEASURED HOT LEG COOLANT VELOCITIES (TTFM DATA)
COMANCHE PEAK UNIT 1 (CYCLE 1 - NEAR EOL - 8/1/91)

LOOP 3 MEASURED COOLANT VELOCITIES (FT/SEC)

Measurement	Top[1] Detectors (Ft/Sec)	Bottom[1] Detectors (Ft/Sec)	Average (Ft/Sec)	(Top-Bottom)x100% Average (%)
Run 1	54.025	56.107	55.066	-3.78%
Run 2	53.868	55.638	54.753	-3.23%
Run 3	53.956	55.858	54.907	-3.46%
Run 4	53.993	55.906	54.950	-3.48%
Run 5	54.116	55.940	55.028	-3.31%
Mean	53.992	55.890	54.941	-3.46%
Standard Deviation	0.0914	0.1693	0.1222	----
Standard Error of Mean	0.0409	0.0757	0.0547	----

[1] For coolant loops 1, 2 and 3, the N-16 detectors are on the sides of the hot leg pipe. The detectors labeled "Top" are on the left when facing the reactor vessel.

TABLE 4

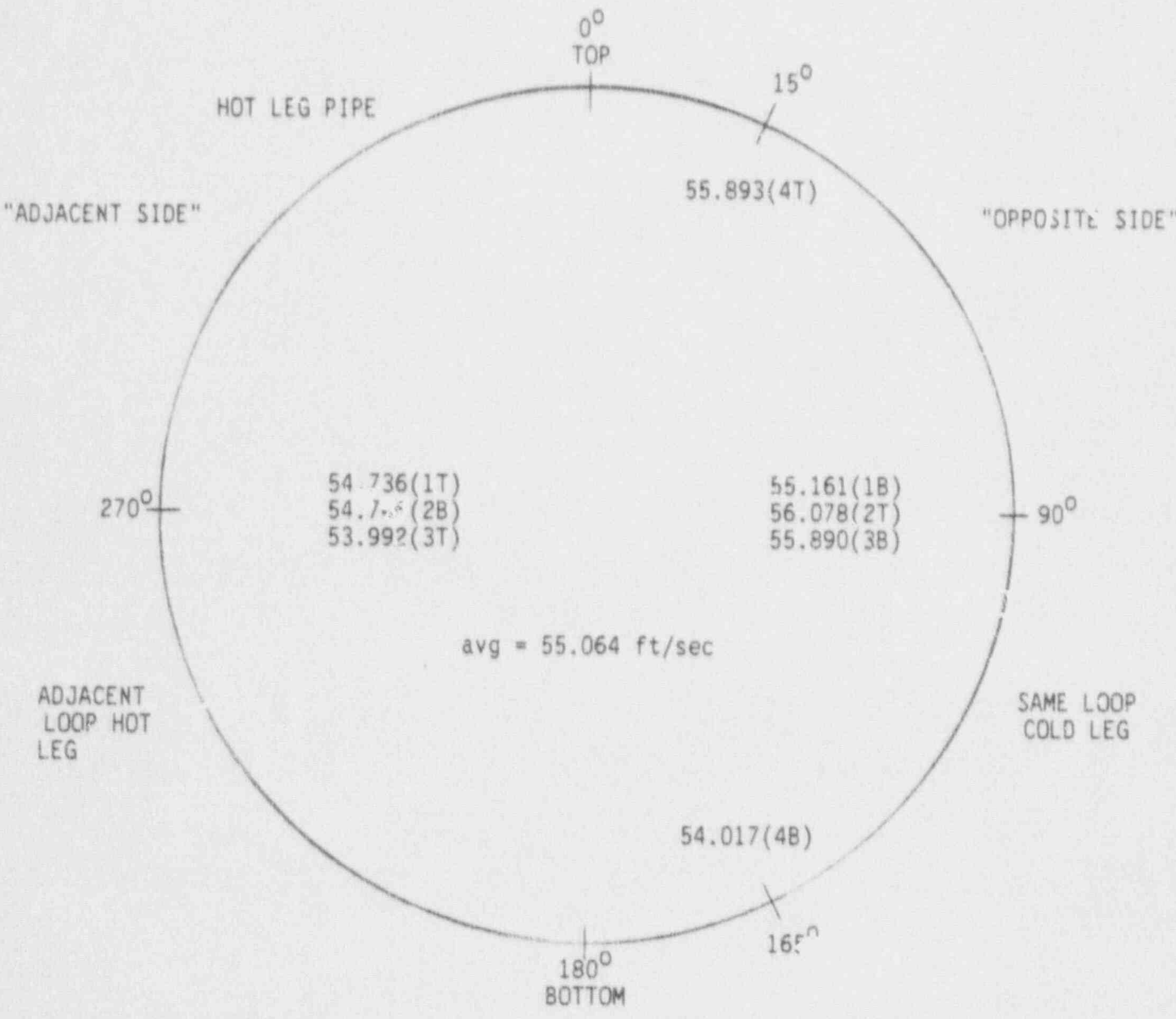
RCS MEASURED HOT LEG COOLANT VELOCITIES (TTFM DATA)
COMANCHE PEAK UNIT 1 (CYCLE 1 - NEAR EOL - 7/2/91)

LOOP 4 MEASURED COOLANT VELOCITIES (FT/SEC)

Measurement	Top[1] Detectors (Ft/Sec)	Bottom[1] Detectors (Ft/Sec)	Average (Ft/Sec)	(Top-Bottom)x100% Average (%)
Run 1	55.850	53.766	54.813	3.78%
Run 2	55.742	54.142	54.942	2.91%
Run 3	56.034	53.886	54.960	3.91%
Run 4	55.820	54.204	55.012	2.94%
Run 5	56.018	54.076	55.048	3.53%
Mean	55.893	54.017	54.955	3.41%
Standard Deviation	0.1200	0.1803	0.0895	----
Standard Error of Mean	0.0572	0.0806	0.0400	---

[1]For coolant loop 4. the detectors are near the top and bottom of the pipe.

FIGURE 1



COMMANCHE PEAK UNIT 1 NEAR EOL TTFM
Reactor coolant hot leg coolant velocities (ft/sec) mapped to loop 1 orientation facing reactor.