DRESDEN UNIT 2

STARTUP TEST NO. 3

TIP SYSTEM SYMMETRY, REPRODUCIBILITY, AND TOTAL UNCERTAINTY

PURPOSE

The primary purpose of this test is to determine the Transversing In-Core Probe (TIP) system total uncertainty (using a detailed statistical analysis) which consists of geometric and random noise components. A gross TIP symmetry check, which involves comparing integrated symmetrical TIP string readings is also performed.

CRITERIA

1) TIP Uncertainty-Gross Check

   The maximum deviation between symmetrically located TIP pairs of LPRM strings should be less than 25%.

2) Total TIP Uncertainty-Statistical Check

   The TIP geometric-random noise uncertainty obtained by averaging the uncertainties for all data sets must be less than 9%.

NOTE: A minimum of two and up to six data sets may be used to meet the above criteria. If either criterion is not met and the calculations have been rechecked, the calibration of the TIP system (e.g. axial alignment) shall be checked. For the statistical check, it may be necessary to omit data pairs from the analysis if exact octant symmetry is not attainable in fuel loading or control rod patterns. In such cases, offline code predictions of exposure or control rod induced asymmetry may prove useful in explaining the uncertainty.

RESULTS

Two complete sets of data required for evaluating TIP uncertainty were obtained during the D2 BOC 8 Startup Testing Program. Data was obtained at steady state power levels greater than 75% of rated power. The results for each method of analysis are summarized below.

1) TIP Uncertainty (Gross Check)

   To determine the symmetry component of TIP uncertainty, machine normalized, full power adjusted TIP readings were obtained and averaged for each symmetric TIP pair. The percent deviation between each symmetrical TIP pair and their average was calculated and is given in Table 3.1. The maximum average deviation over all symmetric TIP pairs was 2.87%, with a maximum deviation of 7.64%. The worst case pair is well below the 25% criterion on maximum deviation.

2) Total TIP Uncertainty (Statistical Check)

The total TIP uncertainty was calculated using the method recommended by General Electric. Individual nodal values of BASE (from the process computer) in the upper left-hand quadrant of the core were divided by their symmetric counterpart and used to find an average ratio $\bar{R}$. This $\bar{R}$ was then used to calculate the random noise-geometric uncertainty. Calculations were made by the STATS computer program. The first data set gave a value for random noise-geometric TIP uncertainty of 3.24% (5-22-81) and the second of 3.22% (6-19-81). This yields an average of 3.23% which is less than the 9% criterion.

TIP SYMMETRY - GROSS CHECK

Table 3.1

TIP Pair	% Deviation on 5-22-81	% Deviation on 6-19-81
1	4.24	5.59
2	0.62	0.04
3	6.19	4.72
4	2.59	3.54
5	3.29	2.79
6	2.79	3.17
7	7.45	7.64
8	0.44	0.17
9	1.65	0.30
10	5.46	3.77
11	5.60	5.32
12	1.31	1.40
13	0.06	0.14
14	0.75	0.44
15	0.66	0.27
16	1.54	0.49
17	2.69	1.56
18	4.39	6.36
Average:	2.87	2.65

SYMMETRIC TIP LOCATIONS

TIP PAIR	LPRM
1	08-17
	16-09
2	08-25
	24-09
3	08-33
	32-09
4	08-41
	40-09
5	08-49
	48-09
6	16-25
	24-17
7	16-33
	32-17
8	16-41
	40-17
9	16-49
	48-17

TIP PAIR	LPRM
10	24-33
	32-25
11	24-41
	40-25
12	24-49
	48-25
13	24-57
	56-25
14	32-41
	40-33
15	32-49
	48-33
16	32-57
	56-33
17	40-49
	48-41
18	40-57
	56-41