STARTUP TEST REPORT

VERMONT YANKEE CYCLE 11

Introduction:

Vermont Yankee Cycle 11 initial startup commenced on August 6, 1984 following a 7 week outage for annual refueling and maintenance related activities. Fuel sipping was performed during the outage due to increased off gas activity observed last cycle. A total of 92 fuel bundles were sipped, with one failed fuel bundle being found. This bundle was subsequently reconstituted and inserted for Cycle 11.

The core loading for Cycle 11 consisted of:

2 P8x8R P8DPB289 Reinserts from cycle 7
34 P8x8R P8DPB289 Reinserts from cycle 8
120 P8x8R P8DPB289 Reinserts from cycle 9
108 P8x8R P8DPB289 Reinserts from cycle 10
104 P8x8R P8DPB289 non-irradiated assemblies

An as loaded Cycle 11 core map is included as Figure I. Details of the cycle 11 core loading are contained in the Yankee Atomic Electric Company document YAEC-1403. "Vermont Yankee Cycle 11 Core Performance Analysis, April 1984"

Shutdown margin testing was performed satisfactorily on July 27, 1984. An in-sequence critical was performed satisfactorily July 27, 1984. Reactor power was limited to 75% due to the loss of one condensate pump. This steady state power level was reached on August 17,1984. With the return of the condensate pump, steady state full power was achieved on October 5,1984.

Control rod coupling verification was performed satisfactorily for all 89 control rods on July 24,25 and 27, 1984. Control rod scram testing was performed satisfactorily for all 89 rods on August 2-8,1984.

The final as loaded core was verified correct by Vermont Yankee and Yankee Atomic Electric personnel on July 24, 1984.

Core Verification:

The final core loading was verified correct on July 24, 1984. Three separate criteria were checked:

1. Proper bundle orientation was verified by checking channel fastener orientation and assuring that fastener orientation agreed with that shown in Figure II.

2. Proper bundle seating was verified by following Vermont Yankee Procedure VYOP 1411.

3. Proper core loading was verified by checking the serial number of each bundle through use of a video camera. This verification was recorded on video tape and was later independently reviewed and reverified to agree with the licensed core loading of Figure 1.

8411260185 841106
PDR ADOCK 05000271
P PDR

Process Computer Data Checks:

Process computer data shuffling checks were completed August 7,1984. These checks included various manual and computer checks of the new data constants. A check for the consistency of the data was also performed by Yankee Atomic Electric Company and found to be satisfactory.

Shutdown Margin Testing:

A subcritical shutdown margin test was performed on July 27,1984 by withdrawing the analytically determined strongest rod to the full out position and then withdrawing a diagnally adjacent margin rod for which a rod worth curve has been calculated. A shutdown margin of at least 1.18% DELTA K/K was demonstrated. The reactor remained subcritical through the test, thereby satisfying the Tech. Spec. requirement to demonstrate a shutdown margin of 0.32% DELTA K/K for cycle 11.

In-Sequence Critical:

Sequence 11 A-1 was used to perform the in-sequence critical test.

On July 27, 1984 control rods were withdrawn in-sequence until criticality was attained. Criticality was achieved on the 7th rod in group 2 (26-31) at notch position 16. The moderator temperature was 94 degrees Farenheit.

The actual critical rod pattern and the YAEC prediction agreed within plus or minus 1% DELTA K/K. Figure III shows the actual, predicted and plus or minus 1% DELTA K/K critical rod patterns.

Rod Scram Testing:

All 89 control rods were scram tested on August 2nd through 8th, 1984. All insertion times were within the limits defined in the Vermont Yankee Tech. Specs. Results of the testing are presented in Table IA.

In accordance with Tech. Specs. Section 4.3.C.2 scram time information available for scrams occuring since the transmittal of the previous startup test report is also included in Table IB. All insertion times were within the limits defined in the Vermont Yankee Tech. Specs.

All scram time information was evaluated to ensure that proper drive performance is being maintained. No degradation of drive performance is noticeable.

Thermal Hydraulic Limits and Power Distrubtion:

Core Maximum Fraction of Critical Power (CMFCP), Core Maximum Fraction of Limiting Power Density (CMFLPD), Maximum Average Planar Linear Heat Generation Rate ratio (MAPRAT) and the ratio of CMFLPD to the fraction of Rated power (CMFLPD/FRP) were all checked daily during the startup using the process computer. All checks of core thermal limits were within the limits specified in Technical Specifications.

The results of the Backup Core Limits Evaluation (BUCLE) program were compared to results of the process computer for the same core conditions. The results were essentially identical as can be seen in Table II.

The process computer power distribution was updated twenty (20) times using the TIP system during the ascent to full power. The result of these updates are presented in Table III.

The LPRM's were calibrated three (3) times in conjunction with TIP sets 885 , 890 and 905. The initial checkout of LPRM high and low trip alarm setpoints was done at 0% power on 8/1/84. The TIP and LPRM systems were both functionally tested and found to operate satisfactorily.

The process computer power distribution update performed October 9,1984 (TIP 904) was used as a basis for comparsion with an offline calculation performed using the Yankee Atomic Electric Company nodal code SIMULATE. This was the first appropriate full power TIP calibration available. For the power distribution of October 9,1984 the SIMULATE core average axial power distribution was compared to that calculated by the plant process computer: comparisons are shown in Table IV. A comparsion was also performed between SIMULATE and process computer peak radial power: comparisons are shown in Table V.

TIP Reproducibility and TIP symmetry:

TIP system reproducibility was checked in conjunction with the power distribution update performed October 17,1984. All three TIP system traces were reproducible to within 3.3%.

The A-1 sequence used as the initial control rod sequence varied slightly from and eighth core symmetric pattern with octant symmetric rod locations at notch position 38 and 24. Due to this lack of eighth core symmetry, calculation of a total TIP uncertainty was calculated using synthetic traces from a SIMULATE case at the same conditions as calibration 904, but with control rods at core locations 26-35 and 34-27, as well as their symmetric counterparts, set to position 32. These synthetic traces were pointwise adjusted by SIMULATE using the ratio of the actual TIP 904 traces to the synthetic SIMULATE TIP 904 traces. By using the pointwise adjustment ratios, it is possible to estimate what the actual TIP traces would be for a symmetric pattern.

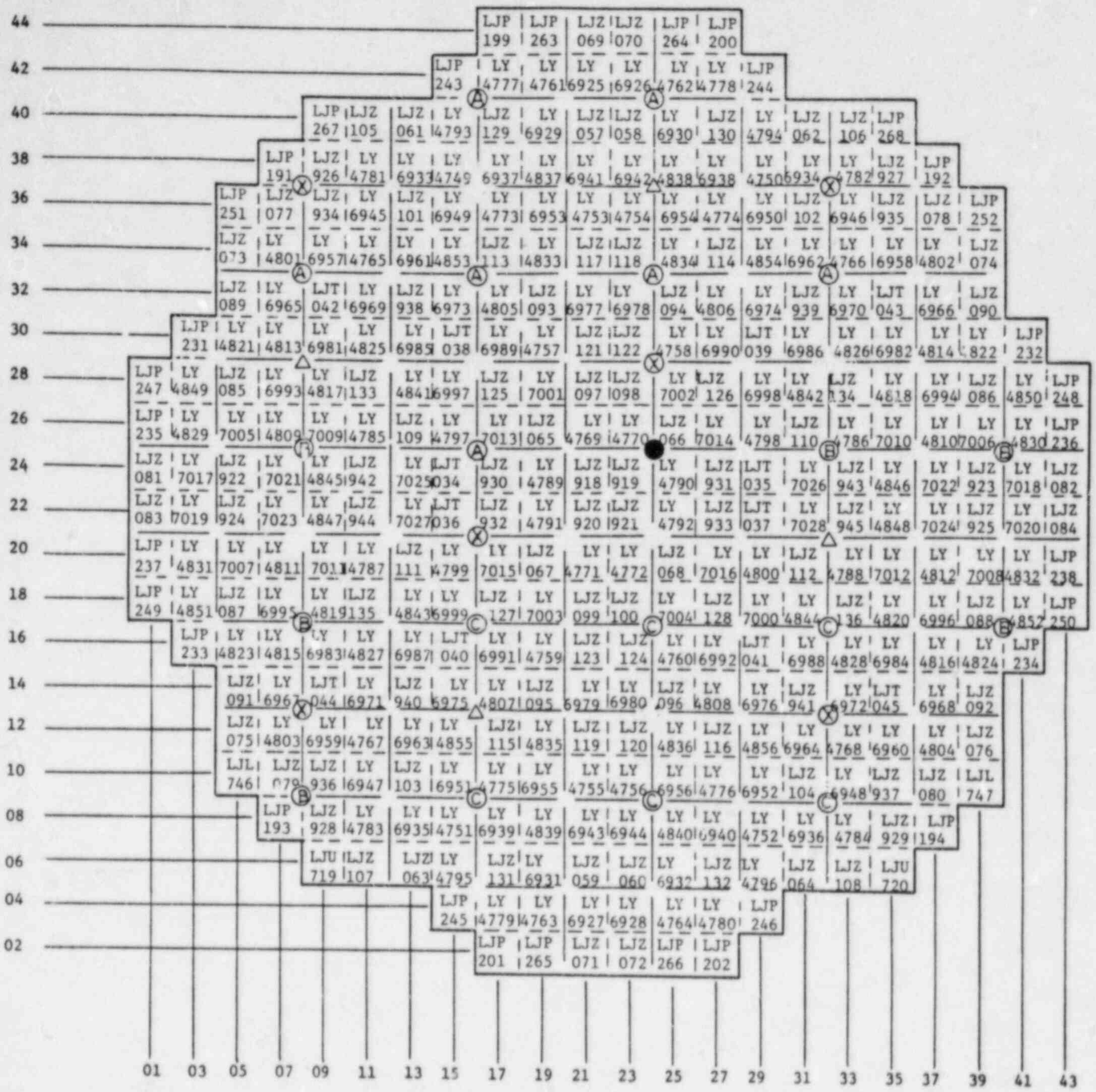
The resulting total TIP uncertainty for this case was 1.98%.

The results of the TIP uncertainty test as shown in Table VI are well below the 8.7% acceptance criteria.

Figure I

CYCLE 11 CORE MAP

VERMONT YANKEE



● LPRM LOCATION (COMMON LOCATION FOR ALL TIP MACHINES)

○ LPRM LOCATION (LETTER INDICATES TIP MACHINE)

⊗ IRM LOCATION

△ SRM LOCATION

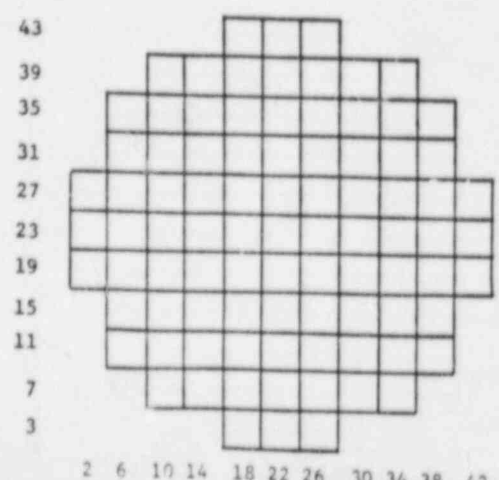
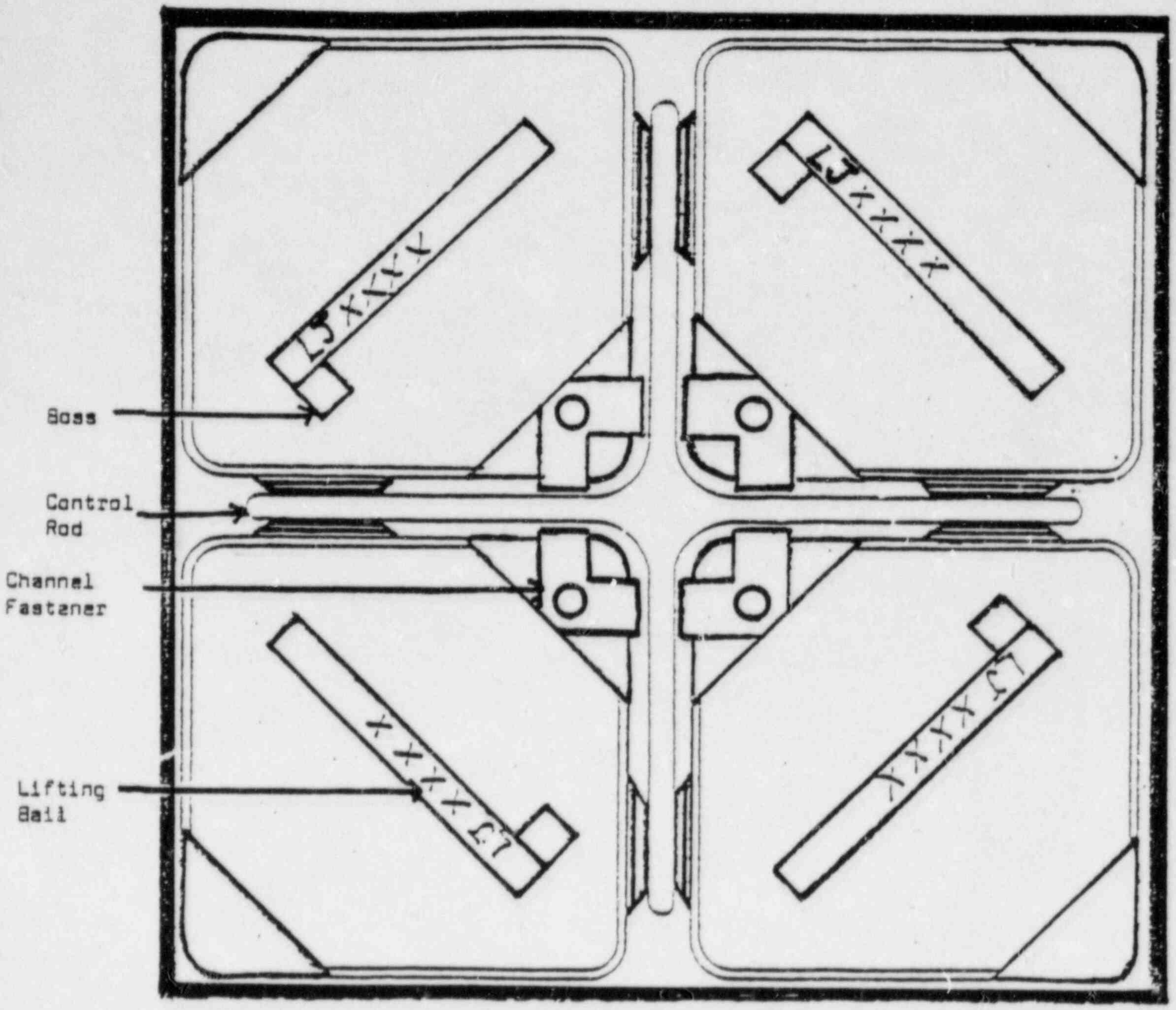


FIGURE II

CORE CELL LOADING CONFIGURATION



CRITICAL ROD CONFIGURATION COMPARISON

Figure III

Vermont Yankee Beginning of Cycle 11

	02	06	10	14	18	22	26	30	34	38	42
43											
39					48		48				
35											
31			48						48		
27											
23	48						48				48
19											
15			48						48		
11											
07					48		14				
03											

-1% ΔK/K

	02	06	10	14	18	22	26	30	34	38	42
43											
39			48		48		48		48		
35											
31			48						48		
27											
23	48		12		48		48		48		48
19											
15			48						48		
11											
07			48		48		48		48		
03											

Predicted Critical Pattern

	02	06	10	14	18	22	26	30	34	38	42
43											
39			48		48		48		48		
35											
31			48		48		48		48		
27											
23	48		48		48		48		48		48
19											
15			48		48		18		48		
11											
07			48		48		48		48		
03											

+1% Δk/k

	02	06	10	14	18	22	26	30	34	38	42
43											
39			48		48		48		48		
35											
31			48				16		48		
27											
23	48		48		48		48		48		48
19											
15			48						48		
11											
07			48		48		48		48		
03											

Actual Critical Pattern

TABLE IA
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE BEGINNING OF CYCLE 11

Scram #125 August 8, 1984

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.351	0.870	1.411	2.546
Tech.Spec.Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.920
Tech.Spec. limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.368	0.915	1.487	2.697
Tech.Spec. limit (sec)	0.379	0.967	1.556	2.848

TABLE IB
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE CYCLE 11

Scram #120 June 20, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.309	0.818	1.338	2.430
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.764 sec.
Tech. Spec. limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.349	0.876	1.433	2.609
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #121 June 29, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.295	0.802	1.318	2.440
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.756 sec.
Tech. Spec. Limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.335	0.877	1.424	2.591
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #122 August 27, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.263	0.760	1.264	2.367
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.664 sec.
Tech. Spec. Limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.273	0.799	1.336	2.477
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #123 January 5, 1984

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.253	0.765	1.287	2.373
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.616 sec.
Tech. Spec. Limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.269	0.807	1.363	2.488
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

TABLE IB (cont'd)
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE CYCLE 11

Scram #124 April 16, 1984

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.283	0.787	1.307	2.427
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.808 sec.
Tech. Spec. limit for slowest 87.84% insertion time = 7 sec.

Slowest 2x2 Array for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.291	0.813	1.379	2.552
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

TABLE II

COMPARISON OF BUCLE AND PROCESS COMPUTER
THERMAL LIMITS CALCULATION

Parameter	BUCLE	Process Computer (8/9/84)
CMFCP*	0.382	0.385
Location	25-24	25-24
CMFLPD*	0.284	0.287
Location	23-26-18	23-26-18
MAPRAT*	0.265	0.269
Location	23-26-18	23-26-18

* Tech. Spec. Limit = 1.000

TABLE III

POWER DISTRIBUTION MEASUREMENTS - CYCLE 11 START-UP

Date	Power %	Core Flow %	CMFLPD*	CMFCP*	MAPRAT*
8/9/84	21.9	31.6	.287	.385	.269
8/9/84	21.6	31.4	.286	.384	.267
8/12/84	51.3	35.3	.457	.765	.444
8/12/84	60.3	50.3	.539	.736	.523
8/13/84	66.6	49.8	.559	.799	.541
8/13/84	67.2	49.6	.577	.821	.557
8/13/84	65.7	49.9	.569	.809	.549
8/13/84	51.7	35.4	.530	.780	.519
8/16/84	63.0	50.5	.544	.757	.522
8/23/84	80.0	91.8	.767	.747	.757
9/4/84	79.9	92.3	.765	.738	.758
9/5/84	60.3	42.4	.582	.806	.573
9/7/84	86.7	69.5	.763	.862	.754
9/14/84	95.4	97.6	.859	.842	.857
10/2/84	64.8	49.1	.570	.792	.555
10/2/84	64.5	49.2	.595	.776	.562
10/2/84	68.3	48.1	.650	.822	.634
10/3/84	76.8	58.8	.727	.849	.723
10/4/84	94.8	95.2	.893	.835	.891
10/9/84	100.0	97.5	.901	.870	.898

* Tech. Spec. Limit = 1.000

Table IV

Comparison of SIMULATE and Direct From Traces Average Axial Distributions

Node	Direct From Traces	SIMULATE
24	.4504	.3578
23	.6634	.5865
22	.8320	.7712
21	.9277	.9122
20	1.0148	1.0145
19	1.0968	1.0842
18	1.1139	1.1232
17	1.0836	1.1287
16	1.1275	1.1374
15	1.1342	1.1477
14	1.1062	1.1540
13	1.1214	1.1501
12	1.1163	1.1284
11	1.0996	1.1211
10	1.0949	1.1266
9	1.1424	1.1388
8	1.1619	1.1522
7	1.1411	1.1579
6	1.1479	1.1443
5	1.1035	1.0939
4	1.0321	1.0364
3	.9367	.9597
2	.7983	.8317
1	.5535	.5416

Table V

Comparison of 10 Highest Relative Radial Powers

Location	SIMULATE	Plant
17-14	1.334	1.371
21-10	1.343	1.359
19-16	1.300	1.336
15-12	1.306	1.332
13-18	1.283	1.331
15-20	1.265	1.323
19-12	1.318	1.300
15-14	1.287	1.272
11-16	1.240	1.272
21-14	1.314	1.269

Table VI
Total TIP Uncertainty

Case	Rod Pattern	Power (%)	Core Flow (%)	Unceratinty (%)
SYM904	32 14 32	99.98	97.52	1.98