VERMONT YANKEE
NUCLEAR POWER CORPORATION

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June 14, 1989
BVY 89-51

United States Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

Attention: Mr. William T. Russell
Regional Administrator

References: (a) License No. DPR-28 (Docket No. 50-271)
(b) Vermont Yankee Technical Specification, Section 6.7.A.1

Subject: Vermont Yankee Cycle 14 Start-Up Test Report

Dear Sir:

Enclosed please find the Cycle 14 Start-Up Test Report for Vermont Yankee which is submitted to you in accordance with the requirements of Reference (b).

We trust that you will find this information satisfactory; however, should you desire additional information, please contact us.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Robert W. Capstick
Licensing Engineer

RWC/b11/0413w

Enclosure

cc: U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

NRC Resident Inspector - VYNPS

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STARTUP TEST REPORT

VERMONT YANKEE CYCLE 14

Introduction:

Vermont Yankee Cycle 14 initial startup commenced on April 8, 1989 following an 8 week outage for refueling, maintenance related activities and fuel sipping.

The core loading for Cycle 14 consisted of:

96	P8x8R	P8DPB289	reinserts from Cycle 12
136	P8x8R	BP8DRB299	reinserts from Cycle 13
48	P8x8R	BD324B	non-irradiated assemblies
88	P8x8R	BD326B	non-irradiated assemblies

An as loaded Cycle 14 core map is included as Figure I. Details of the Cycle 14 core loading are contained in the Yankee Atomic Electric Company document YAEC-1706, "Vermont Yankee Cycle 14 Core Performance Analysis, October, 1988".

An in-sequence critical was performed satisfactorily on March 2, 1989. The shutdown margin was verified to be satisfactory based on the data collected from the in-sequence critical. Startup commenced April 7, 1989 and steady state full power conditions were reached April 14, 1989.

Control rod coupling verification was performed satisfactorily for all 89 control rods on Feb. 28, Mar. 1, and Mar. 2, 1989. Control rod scram testing was performed satisfactorily prior to reaching 30% power per Tech. Specs. for all 89 control rods on March 28 and April 10, 1989.

The final as loaded core loading was verified correct by Vermont Yankee and Yankee Atomic Electric personnel on Feb. 28, 1989.

Core Verification:

The final core loading was verified correct on Feb. 28, 1989. 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 the 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 I.

Process Computer Data Checks:

Process computer data shuffling checks were completed April 5, 1989. These checks included various manual and computer checks of the new data constants. A check for consistency of the data was also performed by Yankee Atomic Electric Company and found to be satisfactory.

In-Sequence Critical:

Sequence 14-A-2 was used to perform the in-sequence critical test.

On March 2, 1989 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 20. The moderator temperature was 84.0°F.

The actual critical rod pattern and the YAEC prediction agreed within +/- 1% $\Delta K/K$. Figure III shows the actual, predicted and the +/- 1% $\Delta K/K$ critical rod patterns.

Shutdown Margin Testing

The shutdown margin calculation was performed using data collected during the in-sequence critical and information provided in the Core Management Report. The required shutdown margin to be demonstrated was 0.32% $\Delta K/K$. The actual shutdown margin was shown to be 1.036% $\Delta K/K$.

Rod Scram Testing:

Scram testing of all 89 control rods was completed on April 10, 1989. All insertion times were within the limits defined in the Vermont Yankee Technical Specifications. Results of the testing are presented in Table IA.

In accordance with Technical Specifications Section 4.3.C.2, scram time information available for scrams occurring 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 Technical Specifications.

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 Distribution:

Core Maximum Fraction of Critical Power (CMFCP), Core Maximum Fraction of Limiting Power Density (CMFLPD), Maximum Average Planar Linear Heat Generation Rate ratio to its limit (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 process computer power distribution was updated nine (9) times using the TIP system during the ascent to full power. The results of these updates are presented in Table II.

The LPRMs were calibrated once in conjunction with TIP set 1252. The initial checkout of LPRM high and low trip alarm setpoints was done at 0% power on Mar. 30, 1989. The TIPs and the LPRMs were both functionally tested and found to operate satisfactorily.

The process computer power distribution update performed April 19, 1989 (TIP 1261) was used as a basis for comparison with an off line calculation performed using the Yankee Atomic Electric Company nodal code SIMULATE. For the power distribution of April 19, 1989 the SIMULATE core average axial power distribution was compared to that calculated by the plant process computer; comparisons are shown in Table III. A comparison was also performed between SIMULATE and process computer peak radial power; comparisons are shown in Table IV.

TIP Reproducibility and TIP Symmetry:

TIP system reproducibility was checked in conjunction with the power distribution update performed on April 10, 1989. All three TIP system traces were reproducible to within 2.4%.

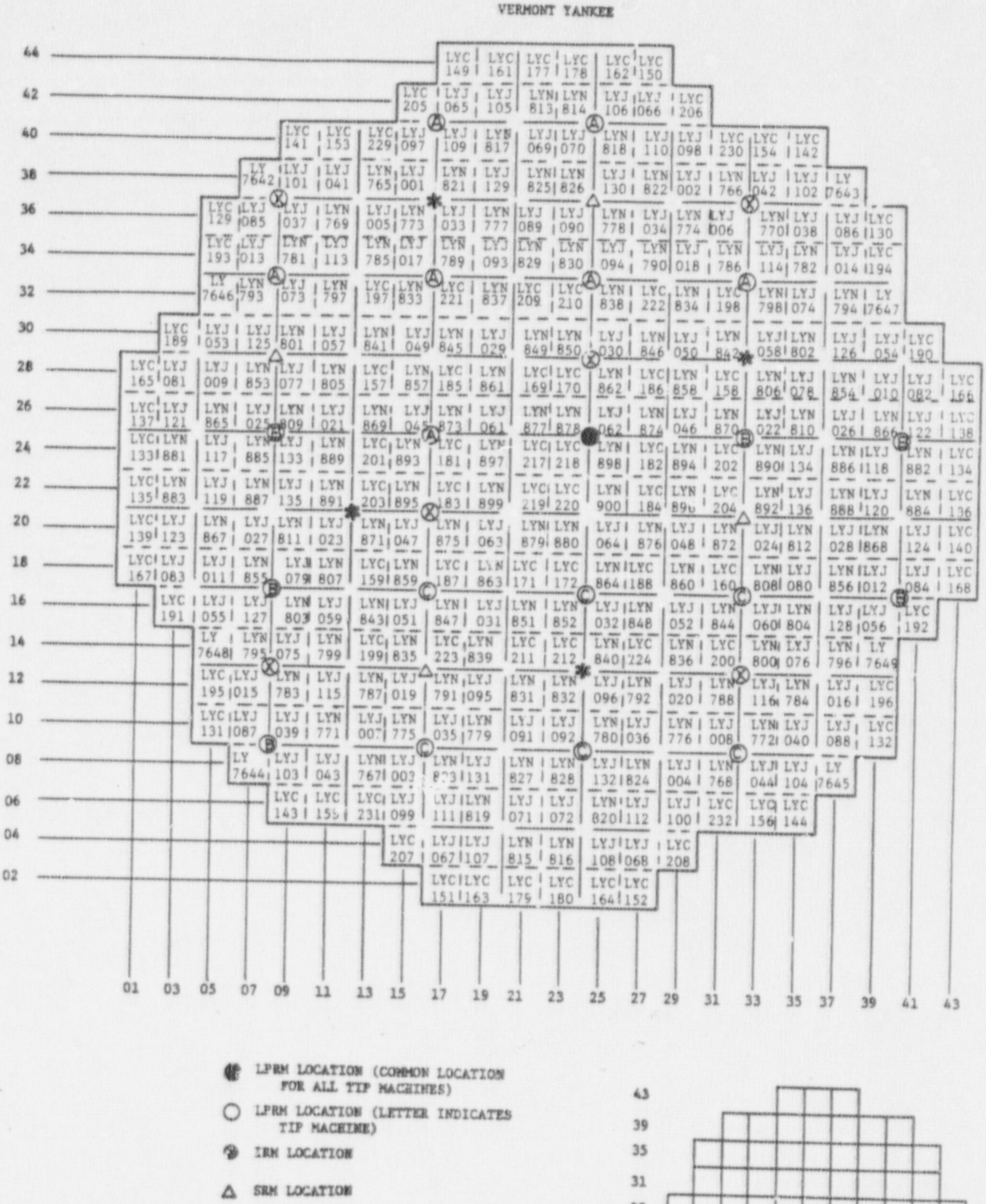
The total TIP uncertainty was calculated using TIP 1261. Since the rod pattern was symmetric, the actual plant TIP readings were used in the calculation.

The resulting total TIP uncertainty for this case was 1.73 percent.

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

Figure I

Cycle 14 Core Map



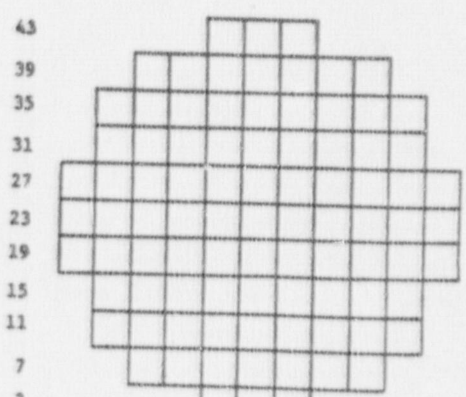


FIGURE II

CORE CELL LOADING CONFIGURATION

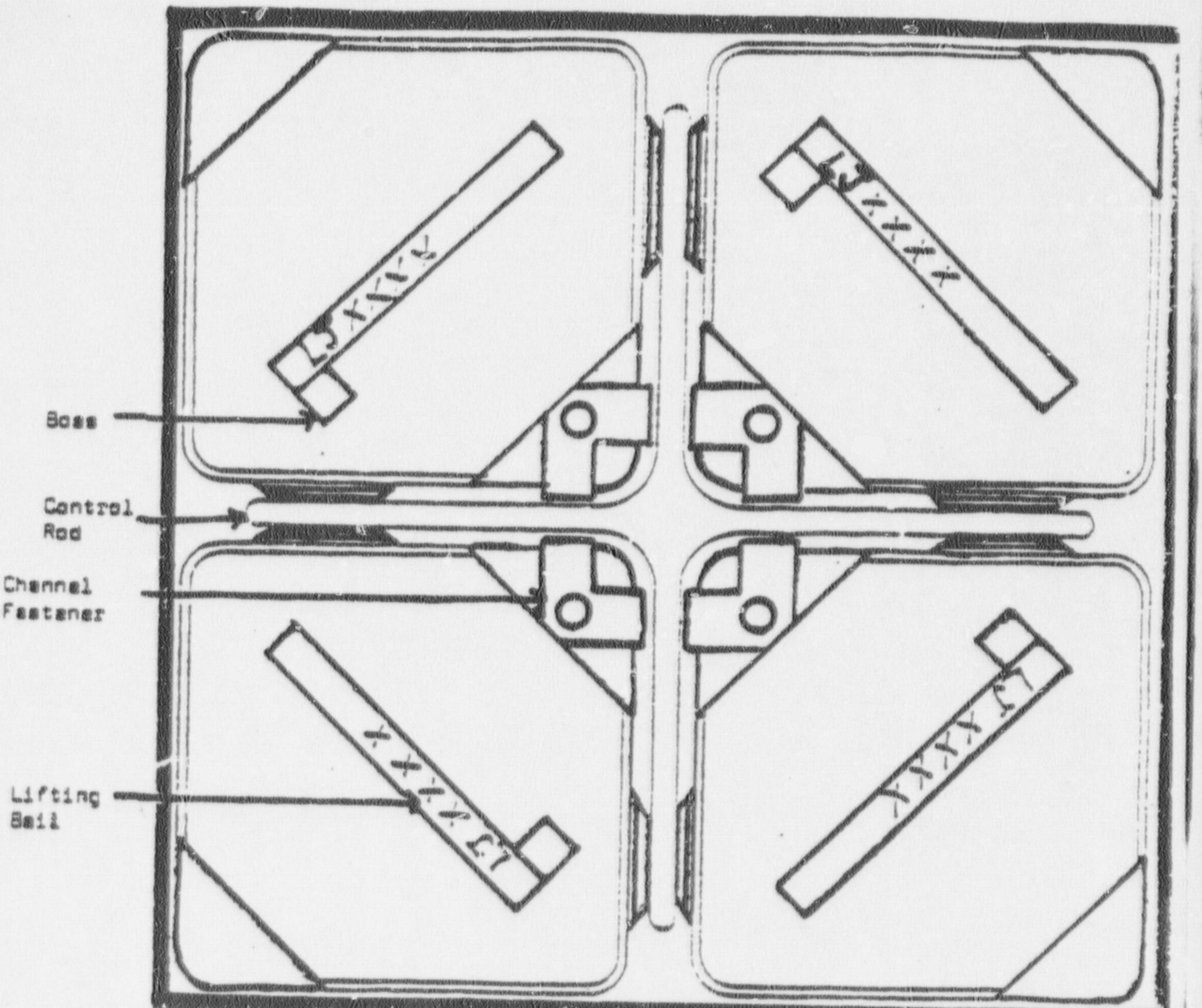
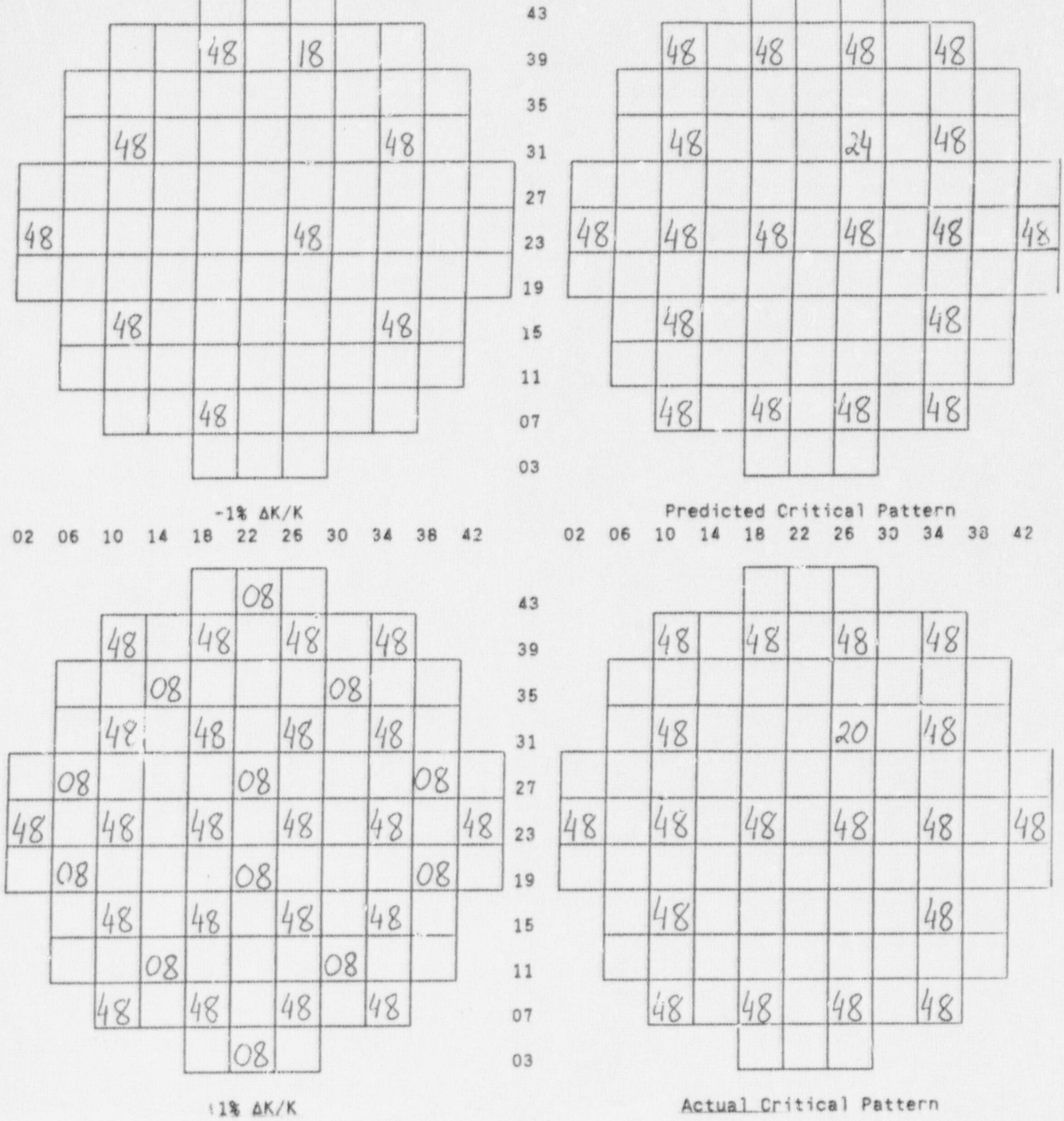


Figure III
CRITICAL ROD CONFIGURATION COMPARISON
VERMONT YANKEE
BEGINNING OF CYCLE 14



□ = Position 00

TABLE IA
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE BEGINNING OF CYCLE 14

Single rod scrams - April 10, 1989

Mean time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.341	0.862	1.391	2.522
Tech. Spec. limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time (sec) = 2.871
Tech. Spec. limit for slowest 87.84% insertion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.371	0.892	1.423	2.570
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

TABLE IB
CONTROL ROD SCRAM TIME RESULTS
VERMONT YANKEE CYCLE 13

Full scram - October 3, 1987

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.299	0.834	1.379	2.535
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 3.089
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.331	0.910	1.482	2.679
Tech. Spec. limit	0.379	0.967	1.556	2.848

Full scram - November 8, 1987

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.309	0.832	1.371	2.512
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 3.073
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.343	0.933	1.517	2.749
Tech. Spec. limit	0.379	0.967	1.556	2.848

Single rod scrams at power - April 30, 1988

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.318	0.837	1.367	2.497
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 3.073
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.348	0.918	1.493	2.667
Tech. Spec. limit	0.379	0.967	1.556	2.848

TABLE IB (cont'd)
CONTROL ROD SCRAM TIME RESULTS
VERMONT YANKEE CYCLE 13

Full scram - June 18, 1988

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.274	0.778	1.286	2.377
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 2.793
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.286	0.819	1.348	2.493
Tech. Spec. limit	0.379	0.967	1.556	2.848

Full scram - June 24, 1988

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.273	0.773	1.279	2.370
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 2.850
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.285	0.812	1.338	2.470
Tech. Spec. limit	0.379	0.967	1.556	2.848

Single rod scrams at power - October 29, 1988

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.309	0.819	1.335	2.445
Tech. Spec. limit	0.358	0.912	1.468	2.686

Maximum 87.84% imsertion time (sec) = 2.850
Tech. Spec. limit for slowest 87.84% insetion time (sec) = 7.000

Slowest 2x2 array for % insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.351	0.874	1.398	2.551
Tech. Spec. limit	0.379	0.967	1.556	2.848

TABLE II

Power Distribution Measurements - Cycle 14 Start-Up
April 7, 1989 - April 14, 1989

Date	Power(%)	Core Flow (%)	CMFLPD*	CMFCP*	MAPRAT*
4/9/89	22.48	34.33	0.225	0.395	0.218
4/10/89	48.54	48.96	0.551	0.632	0.528
4/11/89	46.12	48.98	0.528	0.608	0.507
4/11/89	58.67	49.17	0.581	0.714	0.574
4/11/89	68.90	53.19	0.720	0.836	0.715
4/12/89	84.28	73.04	0.778	0.846	0.764
4/12/89	86.00	72.83	0.837	0.856	0.821
4/13/89	99.72	98.40	0.966	0.908	0.946
4/14/89	91.52	82.94	0.854	0.[illegible]	0.841

* Tech. Spec Limit = 1.000

TABLE III

Comparison of Process Computer and SIMULATE Core Average Axial Power Distributions

Node	Process Computer	SIMULATE PARTB
25	.1451	.0850
24	.3287	.3470
23	.4878	.4824
22	.6040	.5970
21	.7009	.7107
20	.8129	.8280
19	.9723	.9677
18	1.0662	1.0792
17	1.1301	1.1712
16	1.2371	1.2445
15	1.2864	1.2953
14	1.2665	1.3142
13	1.3048	1.3375
12	1.3475	1.3623
11	1.3448	1.3802
10	1.3319	1.3791
9	1.3037	1.3425
8	1.2895	1.3189
7	1.2447	1.2914
6	1.2322	1.2369
5	1.2082	1.1805
4	1.1250	1.1034
3	.9851	.9714
2	.7354	.7580
1	.4204	.2153

TABLE IV

Comparison of 10 Highest Relative Radial Powers

Location	SIMULATE	Plant
23-26	1.338	1.355
25-24	1.338	1.355
25-26	1.286	1.334
25-28	1.323	1.325
25-30	1.225	1.261
27-26	1.323	1.327
27-30	1.275	1.272
29-26	1.225	1.269
29-28	1.275	1.276
33-24	1.251	1.252

TABLE V

Total TIP Uncertainty

TIP Case	Rod Pattern			Power(%)	Core Flow(%)	Uncertainty(%)
1261	36			99.75	97.63	1.73
	20	30				
		20	36			