STARTUP TEST REPORT

VERMONT YANKEE CYCLE 10

Introduction:

Vermont Yankee Cycle 10 initial startup commenced on June 17, 1983 following a 15 week outage for annual refueling and maintenance related activities. No fuel sipping transpired.

The core loading for Cycle 10 consisted of:

60 P8x8R P8DPB289 Reinserts from cycle 7
80 P8x8R P8DPB289 Reinserts from cycle 8
120 P8x8R P8DPB289 Reinserts from cycle 9
108 P8x8R P8DPB289 Non irradiated assemblies

An as loaded cycle 10 core map is included as Figure I. Details of the cycle 10 core loading are contained in the Yankee Atomic Electric Company document YAEC-1342, "Vermont Yankee Cycle 10 Core Performance Analysis, January 1983.

Shutdown margin testing was performed satisfactorily on May 28, 1983. An in-sequence critical was performed satisfactorily May 28, 1983. Startup commenced June 17, 1983 and steady state full power conditions were reached June 27, 1983.

Control rod coupling verification was performed satisfactorily for all 89 control rods on May 22, 23, and 24, 1983. Control rod scram testing was performed satisfactorily for all 89 rods on June 4, 5, 1983.

The final as loaded core loading was verified correct by Vermont Yankee and Yankee Atomic Electric personnel on May 24, 1983.

Core Verification:

The final core loading was verified cc rect on May 24, 1983. 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 1.

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Process Computer Data Checks:

Process computer data shuffling checks were completed June 3, 1983. 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.

Shutdown Margin Testing

A subcritical shutdown margin test was performed on May 28, 1983 by withdrawing the analytically determined strongest rod to the full out position and then withdrawing a diagonally adjacent margin rod for which a rod worth curve has been calculated. A shutdown margin of at least 1.2972% $\Delta K/K$ was demonstrated. The reactor remained subcritical through the test, thereby satisfying the Tech. Spec. requirement to demonstrate a shutdown margin of 0.68% $\Delta K/K$ for cycle 10.

In-Sequence Critical

Sequence 10-A-1 was used to perform the in-sequence critical test.

On May 28, 1983 control rods were withdrawn in-sequence until criticality was attained. Criticality was achieved on the 9th rod in group 2 (18-31) at notch position 12. The moderator temperature was 103°F.

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

Rod Scram Testing

All 89 control rods were scram tested satisfactorily on June 5, 1983. 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 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 nine (9) 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 768, 773 and 776. The initial checkout of LPRM high and low trip alarm setpoints was done at 0% power on 6/7/83. The TIP's and LPRM's were both functionally tested and found to operate satisfactorily.

The process computer power distribution update performed June 29, 1983 (TIP 777) was used as a basis for comparison with an offline calculation performed using the Yankee Atomic Electric Company nodal code SIMULATE. For the power distribution of June 29, 1983 the SIMULATE core average axial power distribution was compared to that calculated by the plant process computer; comparisons are shown in Table IV. A comparison 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 August 2, 1983. All three TIP system traces were reproducible to within 2.3%.

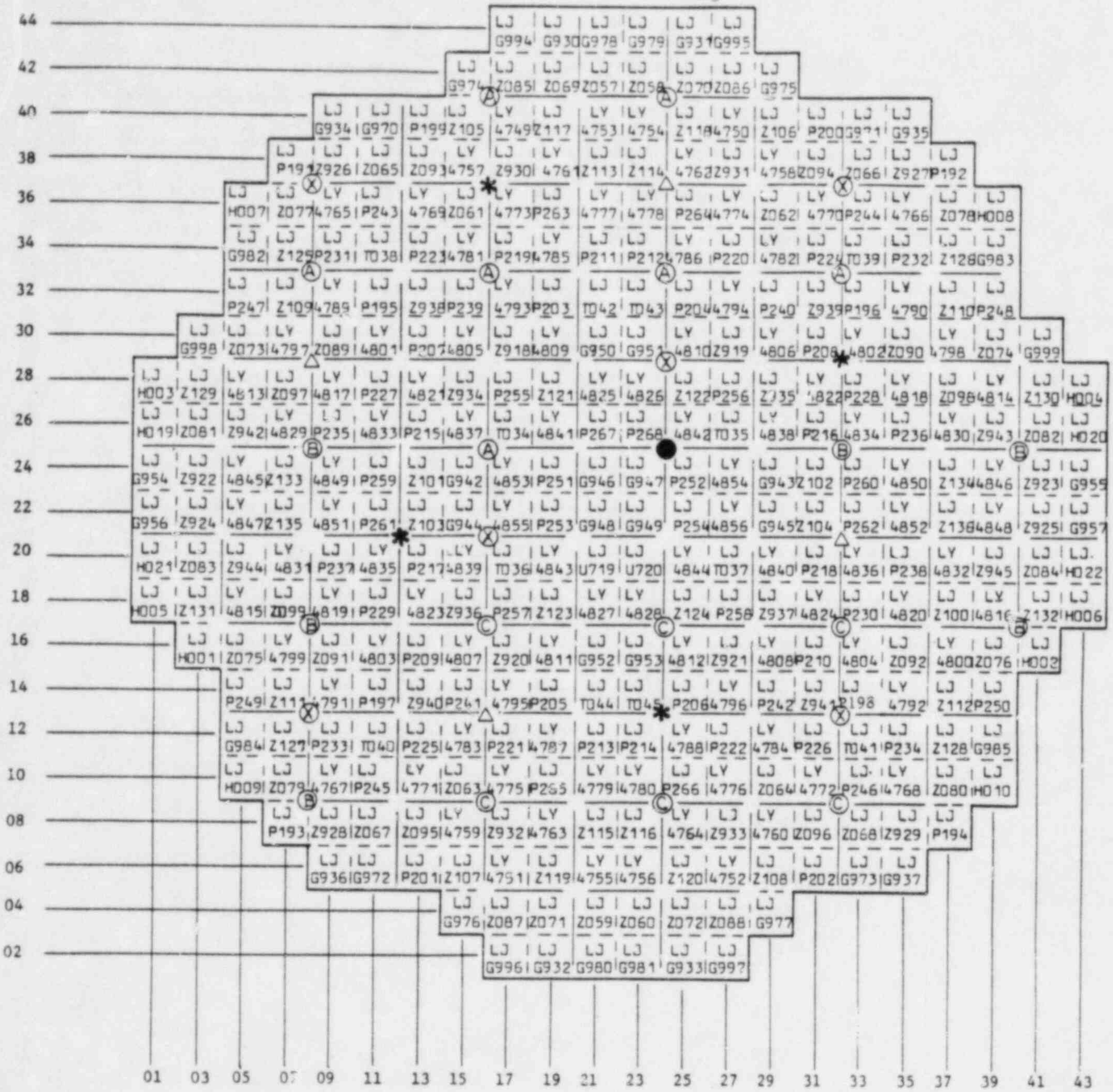
The A-1 sequence used as the initial control rod sequence varied significantly from an eighth core symmetric pattern with octant symmetric rod locations at notch postion 32 and 38. Due to this lack of eighth core symmetry, calculation of a total TIP uncertainty was calculated using synthetic traces from a SIMULATE case at the same conditions as calibration 777, but with control rods at core locations 26-35 and 34-27, as well as their symmetric counterparts, set to position 34. These synthetic traces were pointwise adjusted by SIMULATE using the ratio of the actual TIP 777 traces to the synthetic SIMULATE TIP 777 traces. By using the pointwise adjustment ratios it is possible to estimate what the actual TIP traces for symmetric pattern would be.

The resulting total TIP uncertainty for this case was 2.12 percent.

The results of the TIP uncertainty test as shown in Table VI are well below the .7% acceptance criteria.

Figure I

VERMONT YANKEE
Cycle 10 Core Loading



● LPRM LOCATION (COMMON LOCATION FOR ALL TIP MACHINES)

○ LPRM LOCATION (LETTER INDICATES TIP MACHINE)

⊗ IRM LOCATION

△ SRM LOCATION

✱ SOURCE LOCATION

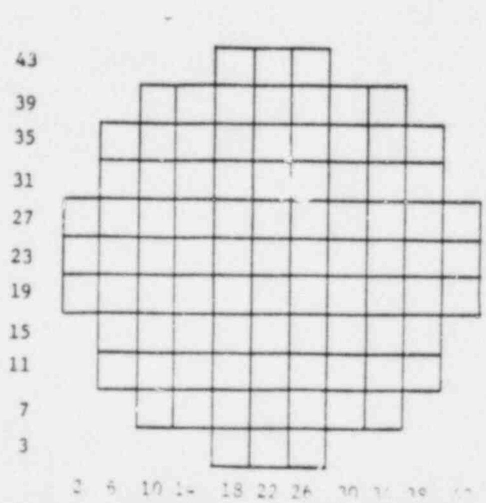


Figure II

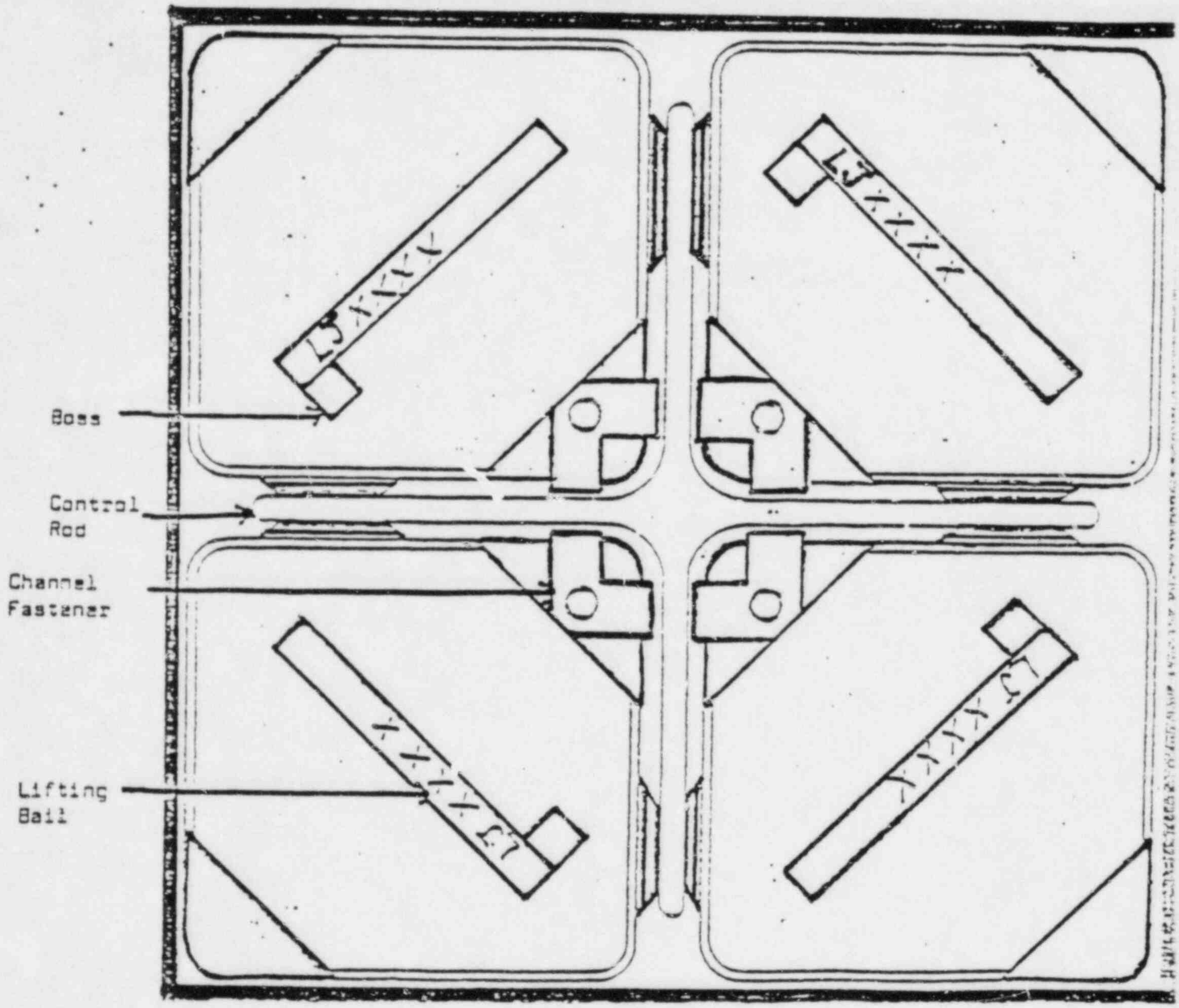
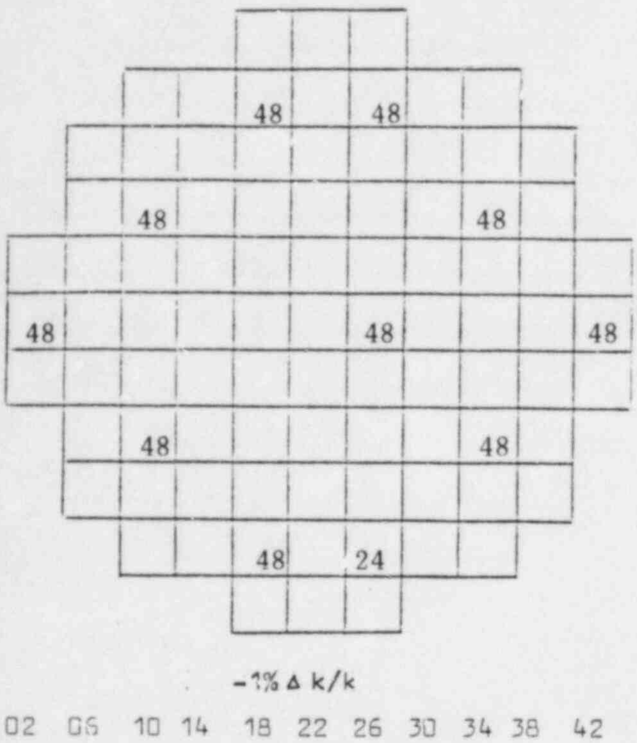
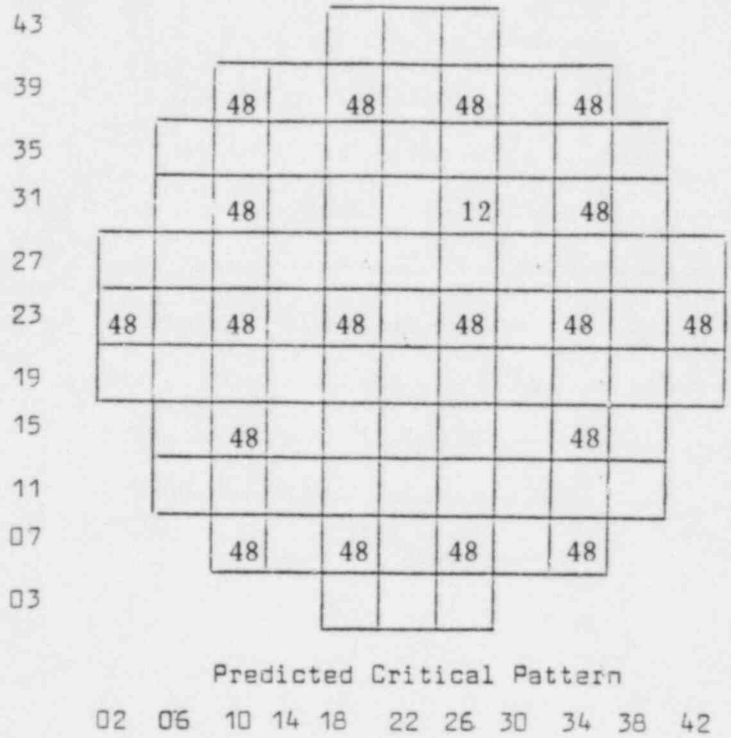


Figure III
CRITICAL ROD CONFIGURATION COMPARISON

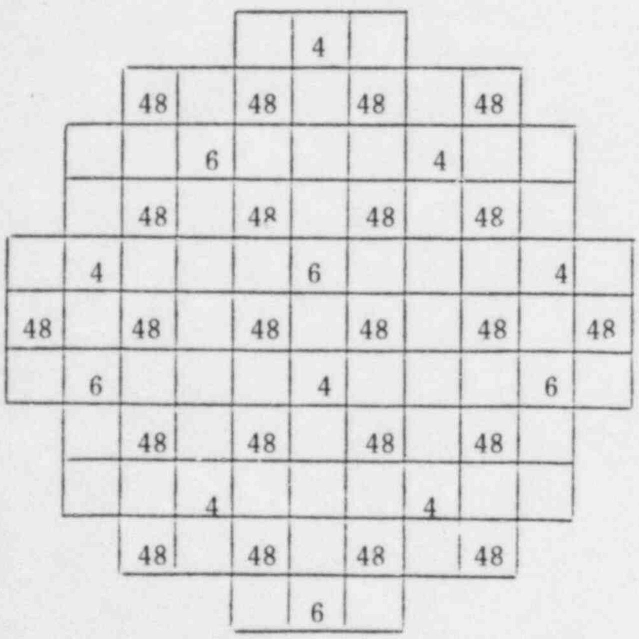
Vermont Yankee
Beginning of Cycle 10



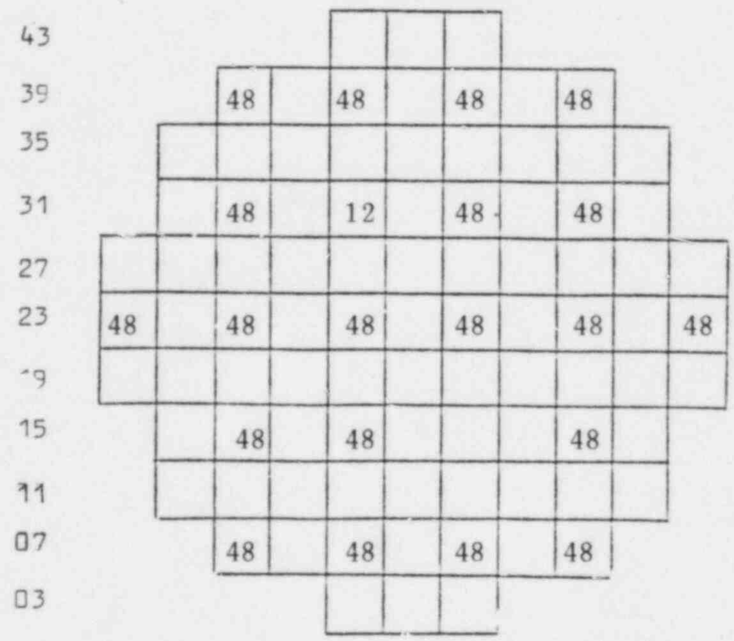
−1% Δ k/k



Predicted Critical Pattern



+1% Δ k/k



Actual Critical Pattern

TABLE IA
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE BEGINNING OF CYCLE 10

Scram #119 June 5, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.334	0.857	1.393	2.517
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.776 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)	0.371	0.909	1.456	2.596
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

TABLE IB
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE CYCLE 9

Scram #109 — December 26, 1981

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.288	0.817	1.372	2.489
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.152 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)	0.322	0.912	1.520	2.677
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #110 — January 26, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured Time (sec)	0.303	0.839	1.393	2.537
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.544 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)	0.323	0.939	1.555	2.779
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #111 — March 30, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured Time (sec)	0.278	0.798	1.344	2.455
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.804 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)	0.284	0.861	1.477	2.643
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

Scram #112 — April 24, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured Time (sec)	0.302	0.818	1.353	2.486
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.040 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)	0.317	0.893	1.491	2.683
Tech. Spec. Limit (sec)	0.379	0.967	1.556	2.848

TABLE IB (cont'd)
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE CYCLE 9

Scram #113 June 8, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.279	0.790	1.308	2.435
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.040 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)	0.299	0.827	1.389	2.557
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

Scram #114 August 15, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.258	0.756	1.262	2.371
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.040 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)	0.272	0.789	1.341	2.525
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

Scram #115 August 27, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.263	0.765	1.274	2.392
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 3.040 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)	0.287	0.809	1.363	2.544
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

Scram #116 October 14, 1982

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.263	0.769	1.276	2.390
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.848 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)	0.287	0.809	1.348	2.527
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

TABLE IB
CONTROL ROD SCRAM TESTING RESULTS
VERMONT YANKEE CYCLE 9

Scram #117 — January 8, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.285	0.802	1.326	2.449
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.848 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)	0.304	0.847	1.400	2.600
Tech. Spec. limit (sec)	0.379	0.967	1.556	2.848

Scram #118 — March 5, 1983

Mean Time for % Insertion	4.51%	25.34%	46.18%	87.84%
Measured time (sec)	0.285	0.816	1.354	2.509
Tech. Spec. Limit (sec)	0.358	0.912	1.468	2.686

Maximum 87.84% insertion time = 2.888 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)	0.307	0.860	1.433	2.651
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
CMFCP*	0.857	0.857
Location	31-22	31-22
CMFLPD*	0.623	0.623
Location	35-22-5	35-22-5
MAPRAT*	0.586	0.585
Location	35-24-5	35-24-5

*Tech. Spec. Limit = 1.000

TABLE III

POWER DISTRIBUTION MEASUREMENTS - CYCLE 10 STARTUP
JUNE 17, 1983 - JUNE 27, 1983

Date	Power %	Core Flow %	CMFLPD*	CMFCP*	MAPRAT*
6/21/83	23.4	34.5	0.274	0.361	0.255
6/22/83	23.1	34.1	0.276	0.359	0.256
6/22/83	46.7	37.1	0.471	0.660	0.457
6/23/83	67.9	50.4	0.587	0.837	0.552
6/23/83	74.1	53.2	0.639	0.882	0.622
6/23/83	72.6	53.2	0.636	0.871	0.619
6/25/83	72.6	50.3	0.659	0.892	0.642
6/25/83	80.7	57.2	0.730	0.922	0.711
6/29/83	100.1	46.81	0.865	0.898	0.847

* Tech. Spec. Limit = 1.000

TABLE IV

COMPARISON OF SIMULATE AND DIRECT FROM TRACES AVERAGE AXIAL DISTRIBUTION

Node	Direct From Traces	SIMULATE
24	.457	.306
23	.629	.503
22	.768	.663
21	.847	.787
20	.938	.883
19	1.008	.957
18	1.031	1.014
17	1.053	1.056
16	1.098	1.079
15	1.077	1.080
14	1.063	1.092
13	1.115	1.116
12	1.150	1.147
11	1.155	1.180
10	1.189	1.210
9	1.225	1.229
8	1.205	1.226
7	1.180	1.226
6	1.194	1.222
5	1.159	1.191
4	1.097	1.155
3	1.011	1.090
2	.830	.958
1	.521	.631

TABLE V

COMPARISON OF 10 HIGHEST RELATIVE RADIAL POWERS

Location	Simulate	Plant
21-14	1.317	1.362
17-16	1.242	1.275
17-14	1.219	1.231
15-18	1.251	1.285
15-16	1.251	1.231
13-22	1.340	1.406
13-18	1.190	1.249
13-14	1.314	1.321
11-22	1.227	1.241
09-22	1.228	1.245

TABLE VI

TOTAL TIP UNCERTAINTY

Case	Rod Pattern	Power (%)	Core Flow (%)	Uncertainty (%)
Simulate TIP 777	34 18 34	99.82	97.35	2.12

VERMONT YANKEE
NUCLEAR POWER CORPORATION

RD 5, Box 169, Ferry Road, Brattleboro, VT 05301

2.C.2.1
FVY 83-100

REPLY TO:
ENGINEERING OFFICE
1671 WORCESTER ROAD
FRAMINGHAM, MASSACHUSETTS 01701
TELEPHONE 617-872-8100

September 15, 1983

U.S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region I
631 Park Avenue
King of Prussia, PA 19406

Attention: Dr. Thomas E. Murley
Regional Administrator

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

Dear Sir:

Subject: Cycle X Startup Test Report

Enclosed you will find the Cycle X Startup 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

Warren P. Murphy

Warren P. Murphy
Vice President and
Manager of Operations

WPM/dm
cc: U.S. Nuclear Regulatory Commission
Office of Inspection & Enforcement
Washington, D.C. 20555

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