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BVY 91-10

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: a. License No. DPR-28 (Docket No. 50-271)

Subject: Vermont Yankee Cycle 15 Start-Up Test Report

Dear Sir:

Enclosed please find the Cycle 15 Start-Up Test Report for Vermont Yankee, which is submitted to you in accordance with the requirements of Section 6.7.A.1 of the Vermont Yankee Technical Specifications.

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

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Leonard A. Tremblay, Jr.

Leonard A. Tremblay, Jr.
Senior Licensing Engineer

Enclosure

cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

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STARTUP TEST REPORT

VERMONT YANKEE CYCLE 15

Introduction

Vermont Yankee Cycle 15 initial startup commenced on 14 October 1990 following a 45.5 day outage for refueling and maintenance. The core loading for Cycle 15 consists of:

104	BP8DRB299	Reinserts loaded in Cycle 13
48	DB324B	Reinserts loaded in Cycle 14
88	DB326B	Reinserts loaded in Cycle 14
60	BP8DWB311-10GZ	Non-irradiated assemblies loaded in Cycle 15
64	BP8DWB311-11GZ	Non-irradiated assemblies loaded in Cycle 15
4	ANFIX-3.04B-EGZ	Non-irradiated qualification assemblies loaded in Cycle 15

An as-loaded Cycle 15 core map is included in Figure I. Details of the Cycle 15 core loading are contained in the Yankee Atomic Electric Company document YAEC-1749, "Vermont Yankee Cycle 15 Core Performance Analysis Report", August 1990.

The final as-loaded core loading was verified correct by Vermont Yankee and Yankee Atomic Electric Co. personnel on 26-27 September 1990.

Control rod coupling verification was satisfactorily performed for all 89 control rods after control rod friction testing on 27 September 1990. Control rod scram testing on all 89 rods was performed satisfactorily prior to reaching 30% core thermal power per the Technical Specifications. The testing was performed on 9 October 1990.

An in-sequence critical was performed satisfactorily on 10 October 1990. The cold shutdown margin was verified to be within the Technical Specifications based on data collected during the in-sequence critical.

Startup commenced on 14 October 1990 and full power steady state conditions were reached on 24 October 1990.

Core Verification

The final as-loaded core was verified correct on 26 and 27 September 1990. Three separate criteria were checked:

1. Proper fuel bundle seating was verified by traversing the core with the refueling grapple raised about 1/2" to 3/4" above three randomly selected peripheral bundles.

2. Proper bundle orientation, channel fastener integrity and upper tie plate cleaniness were verified. One bundle was found with a bent channel fastener. The bundle was removed and the fastener was replaced and seating was reverified.

3. Proper core loading was verified by checking the serial number of each bundle through the use of an underwater video camera. Two identical new fuel bundles were found to be switched. The misloading was corrected. The verification was recorded on tape and later independently reviewed and reverified to agree with the licensed core loading shown in Figure I.

Process Computer Data Checks

Process Computer data shuffling checks were completed on 12 October 1990. 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 Co. (YAEC) and found to be satisfactory.

In-Sequence Critical

Control rod sequence 15-A-2(1) was used to perform the in-sequence critical test. On 10 October 1990 control rods were withdrawn in a normal startup sequence until criticality was achieved. Criticality was achieved on the last rod in Group 7 (22-19) at notch position 12. The moderator temperature was 116 deg. F.

The actual critical rod pattern and the YAEC prediction agreed within +/- 1% delta-k/k. Figure II shows the actual, predicted and the +/- 1% delta-k/k critical rod patterns.

Cold Shutdown Margin Testing

The cold shutdown margin calculation was performed using the data collected during the in-sequence critical and information provided in the YAEC "Core Management Report". The minimum cold shutdown margin required was 0.32% delta-k/k. The actual was shown to be 2.34% delta-k/k.

Control Rod Scram Testing

Single rod scram testing of all 89 control rods was performed sucessfully on 9 October 1990. All insertion times were within the limits defined in the Technical Specifications. Results are presented in Table I-A.

In accordance with Technical Specifications Section 4.3.C.2, scram time information for scrams occurring since the transmittal of the previous startup test report are also included. See Table I-B.

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

Thermal Hydraulic Limits and Power Distribution

The core maximum fraction of critical power (CMFCP), the core maximum fraction of limiting power density (CMFLPD), the maximum average planar linear heat generation rate ratio to its limit (MAPRAT) and the ratio of CMFLPD to the fration of rated power (FRP) were all checked daily during the startup using the process computer. All checks of core thermal limits were within the limits specified in the Technical Specifications.

The process computer power distribution was updated four times using the Traversing Incore Probe (TIP) system during the ascent to full power. The results of these updates and the rated power case are presented in Table II.

The Local Power Range Monitors (LPRMs) were calibrated twice in conjunction with TIP sets. The LPRM high and low trip alarm setpoints were verified correct prior to startup on 12 October 1990. The TIPs and LPRMs were both functionally tested and found to operate satisfactorily.

The process computer power distribution update performed on 24 October 1990 (TIP set 1362) was used as a basis for comparison with an off line calculation performed using the Yankee Atomic Electric Co. nodal computer code SIMULATE-3. For that power distribution the SIMULATE-3 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-3 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 24 October 1990. All three TIP system traces were reproducible to within 1.5%.

The total TIP uncertainty was calculated using TIP set 1362. Since the control rod pattern was nearly symmetric, the actual plant TIP readings were used in the calculation. The resulting total TIP uncertainty for this case was 1.5%. The results of the TIP uncertainty test as shown in Figure III are well below the 8.7% acceptance criterion.

Table I-A
Control Rod Scram Testing Results
Vermont Yankee Beginning of Cycle 15

Single Rod Scrams - 9 October 1990

Maximum 87.84% insertion time (seconds) = 2.923
Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

	4.51%	25.34%	46.18%	87.84%
Mean Time for % insertion				
Measured time (seconds)	0.349	0.867	1.398	2.522
Tech. Spec. limit (seconds)	0.358	0.912	1.468	2.686
Slowest 2x2 array for % insertion				
Measured time (seconds)	0.372	0.899	1.430	2.564
Tech. Spec. limit (seconds)	0.379	0.967	1.556	2.848

Table I-B
Control Rod Scram Testing Results
Vermont Yankee Cycle 14

Single Rod Scrams at Power - 23 September 1989

Maximum 87.84% insertion time (seconds) = 2.976
Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

	4.51%	25.34%	46.18%	87.84%
Mean Time for % insertion				
Measured time (seconds)	0.344	0.855	1.373	2.478
Tech. Spec. limit (seconds)	0.358	0.912	1.468	2.686
Slowest 2x2 array for % insertion				
Measured time (seconds)	0.371	0.896	1.437	2.587
Tech. Spec. limit (seconds)	0.379	0.967	1.556	2.848

Single Rod Scrams - 19 March 1990

Maximum 87.84% insertion time (seconds) = 2.976
Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

	4.51%	25.34%	46.18%	87.84%
Mean Time for % insertion				
Measured time (seconds)	0.355	0.876	1.402	2.521
Tech. Spec. limit (seconds)	0.358	0.912	1.468	2.686
Slowest 2x2 array for % insertion				
Measured time (seconds)	0.377	0.929	1.476	2.634
Tech. Spec. limit (seconds)	0.379	0.967	1.556	2.848

Table I-B (cont'd)
Control Rod Scram Testing Results
Vermont Yankee Cycle 14

Full Scram - 21 March 1990

Maximum 87.84% insertion time (seconds) = 2.976
Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

	4.51%	25.34%	46.18%	87.84%
Mean Time for % insertion				
Measured time (seconds)	0.324	0.834	1.350	2.454
Tech. Spec. limit (seconds)	0.358	0.912	1.468	2.686
Slowest 2x2 array for % insertion				
Measured time (seconds)	0.341	0.860	1.402	2.553
Tech. Spec. limit (seconds)	0.379	0.967	1.556	2.848

Full Scram - 1 June 1990

Maximum 87.84% insertion time (seconds) = 3.012
Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

	4.51%	25.34%	46.18%	87.84%
Mean Time for % insertion				
Measured time (seconds)	0.254	0.743	1.241	2.318
Tech. Spec. limit (seconds)	0.358	0.912	1.468	2.686
Slowest 2x2 array for % insertion				
Measured time (seconds)	0.276	0.807	1.344	2.494
Tech. Spec. limit (seconds)	0.379	0.967	1.556	2.848

Table II
Power Distribution Measurements
Vermont Yankee Beginning of Cycle 15

Date	Time	% CTP	% Flow	CMFLPD	CMFCP	MAPRAT
18 Oct. 90	1831	44.4	49.2	0.536	0.607	0.515
19 Oct. 90	0652	59.3	49.4	0.672	0.733	0.649
19 Oct. 90	2102	74.6	62.2	0.753	0.793	0.726
21 Oct. 90	0814	74.4	60.4	0.742	0.797	0.721
24 Oct. 90	1045	99.6	99.5	0.916	0.865	0.891

The Tech. Spec. limit for the three thermal limits above is less than or equal to 1.0.

Table III
Comparison of Process Computer and SIMULATE-3
Core Average Axial Power Distributions
Vermont Yankee Beginning of Cycle 15

Node	Process Computer	SIMULATE-3
25	0.140	0.140
24	0.320	0.325
23	0.543	0.551
22	0.687	0.682
21	0.784	0.771
20	0.869	0.877
19	0.963	0.966
18	1.019	1.023
17	1.086	1.099
16	1.174	1.176
15	1.206	1.199
14	1.177	1.178
13	1.202	1.206
12	1.227	1.216
11	1.218	1.214
10	1.195	1.211
9	1.241	1.242
8	1.271	1.283
7	1.275	1.335
6	1.330	1.383
5	1.337	1.387
4	1.285	1.331
3	1.141	1.[illegible]60
2	0.858	0.826
1	0.452	0.221

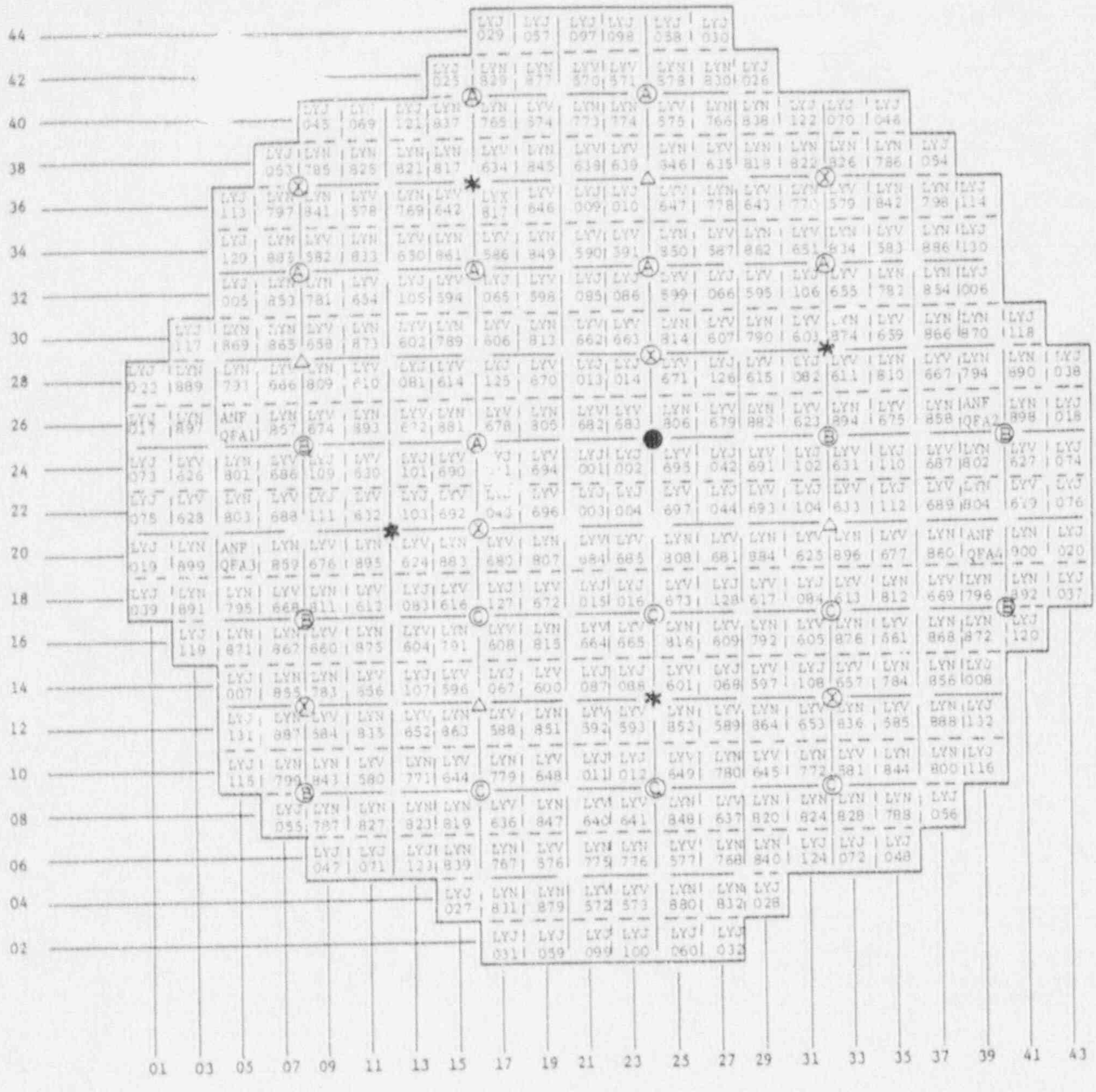
Table IV
Comparison of Ten Highest Relative Radial Powers
Vermont Yankee Beginning of Cycle 15

Location	Process Computer	SIMULATE-3
29-12	1.263	1.266
25-16	1.230	1.246
33-20	1.245	1.245
33-18	1.262	1.243
35-18	1.237	1.243
27-12	1.259	1.241
27-10	1.233	1.241
25-12	1.235	1.239
33-16	1.262	1.267
29-18	1.231	1.222

Figure I

CYCLE 15 CORE MAP

VERMONT YANKEE



● LPRM LOCATION (COMMON LOCATION FOR ALL TIP MACHINES)

○ LPRM LOCATION (LETTER INDICATES TIP MACHINE)

⊗ IRM LOCATION

△ SRM LOCATION

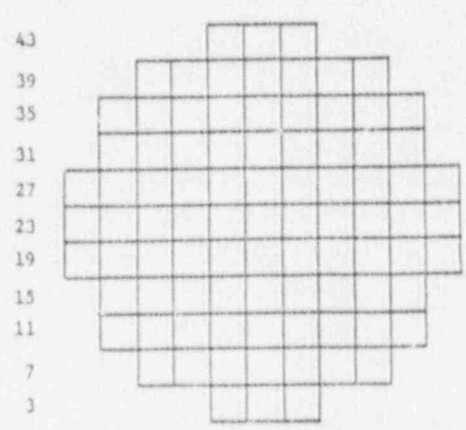


Figure II
Vermont Yankee
Beginning of Cycle 15
Critical Rod Configuration Comparison

-1% ΔK/K

	02	06	10	14	18	22	26	30	34	38	42
43											
39			48		48		48		48		
35											
31			48				18		48		
27											
23	48		48		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						08					
39			48		48		48		48		
35				10				10			
31			48		48		48		48		
27		08				10				08	
23	48		48		48		48		48		48
19		10				08				10	
15			48		48		48		48		
11				08				08			
07			48		48		48		48		
03						10					

+1% ΔK/K

	02	06	10	14	18	22	26	30	34	38	42
43						12					
39			48		48		48		48		
35				48				18			
31			48		46		48		48		
27		12				48				12	
23	48		48		48		48		48		48
19		48				12				48	
15			48		48		48		48		
11				12				12			
07			48		48		48		48		
03						48					

Actual Critical Pattern

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

Note: A blank box denotes rod position 00.

Figure III

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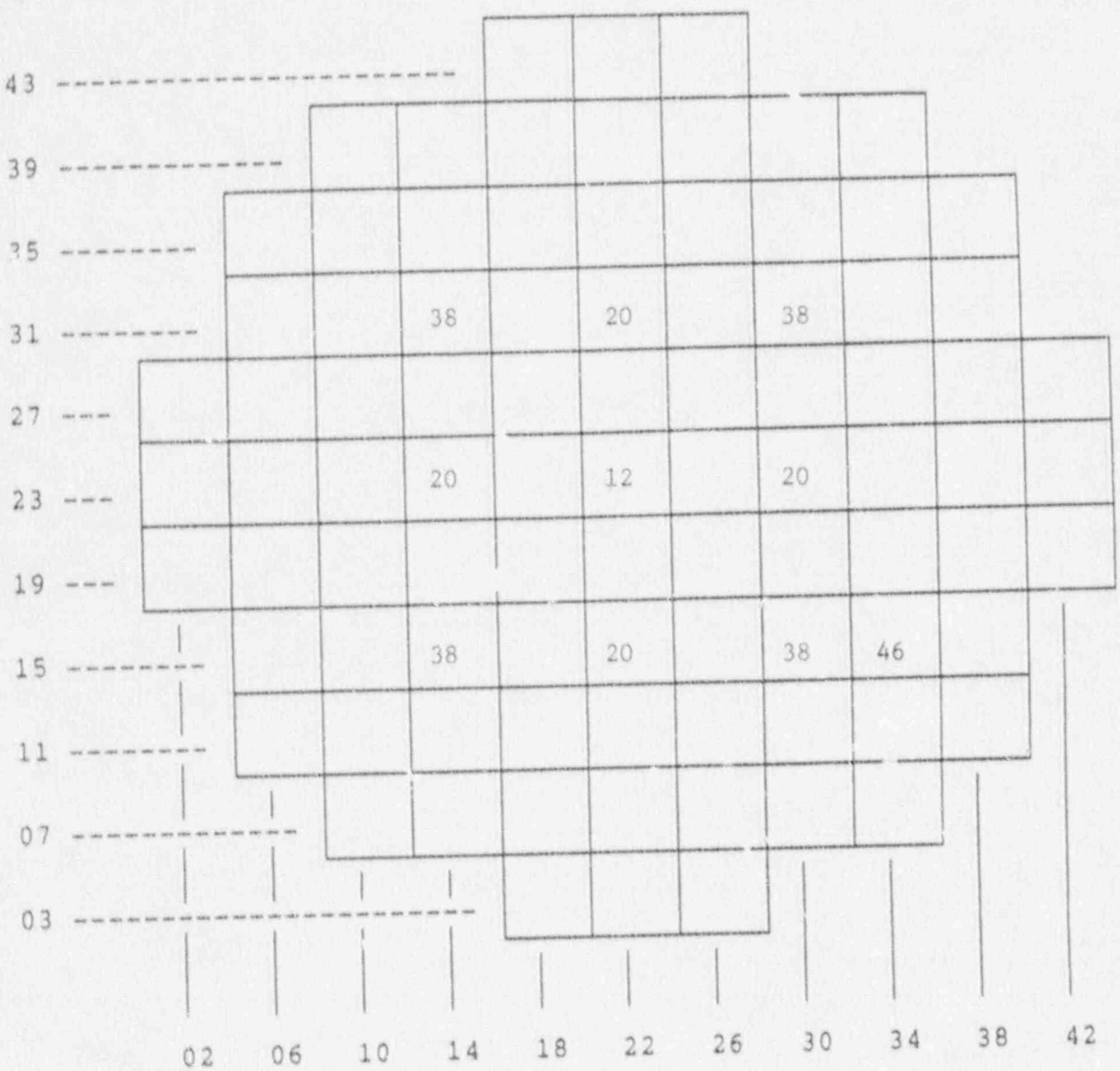
Total TIP Uncertainty



TIP: 1362

DATE: 24 October 1990

CTP: 99.6%

Core Flow: 99.5%

Uncertainty: 1.5%