# VERMONT YANKEE NUCLEAR POWER CORPORATION



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

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

Subject: Vermont 'inkee Cycle J# Ctart 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. 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:

04	BPBDRB299	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-3.048-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, /ermont 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 (as 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 satisfaccorily 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 critaria were checked:

- 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.
- 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 matual 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 insequence 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 successfully 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 as 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 fraction 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 Technica' 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 T<sup>\*</sup>Ps 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 tied 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

11

Maximum 87.84% insertion time (secr.ds) = 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. Sp2c. limit for slowest 87.84% insertion time (seconds) = 7.000

Mean Time for & insertion	4.51%	25.34%	46.18%	87.84%
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 8: 4% insertion time (seconds) = 2.976 Tech. Spec. limit for slowest 87.84% insertion time (seconds) = 7.000

Mean Time for % insertion	4.51%	25.34%	46.18%	87.84%
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

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

Mean Time for & insertion	4.51%	25,34%	46,18%	87.84%
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

	1	Cable II			
Power	Distri	bution Me	isur	ements	
Vermont	Yankee	Beginning	g 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 's than or equal to 1.0.

7

## Table III

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

	Process	
Node	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 60
2	0.858	0.825
1	0.452	0.221

			Table	IV		
Comparison	of	Ten Hig	ghest	Relative	Radial	Powers
Varna	nt	Yankee	Begin	nning of	Cycle 1	6

Location	Process <u>Computer</u>	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

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			기가 손님의 모님이 안 많은 것 같아.	
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- LPRM LOCATION (COMMON LOCATION FOR ALL TIP MACHINES)
- O LPRM LOCATION (LETTER INDICATES TIP MACHINE)
- S IRH LOCATION
- A SEM LOCATION



1 0





+1% &K/K

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Actual Critical Pattern

Note: A blank box denotes rod position 00.

Figure III

VERMONT YANKEE Total TIP Uncertainty



TIP: 1362

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DATE: 24 October 1990

CTP: 99.6%

Core Flow: 99.5%

Uncertainty: 1.5%