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U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Gentlemen:

Re: Turkey Point Unit 3
Docket No. 50-250
Startup Physics Report

In accordance with Technical Specification 6.9.1.a, attached is the remaining portion of the start-up physics test report. The Unit 3 Cycle XI Start-Up Report documents the first time use of Hafnium Vessel Flux Depression Assemblies and their effect on core physics. The other portion of this report was submitted by our letter, L-87-500, dated December 7, 1987.

Should you have any questions, please contact us.

Very truly yours,

W. F. Conway
Acting Group Vice President
Nuclear Energy

WFC/SDF/gp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator,
Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

SDF/008.SPR

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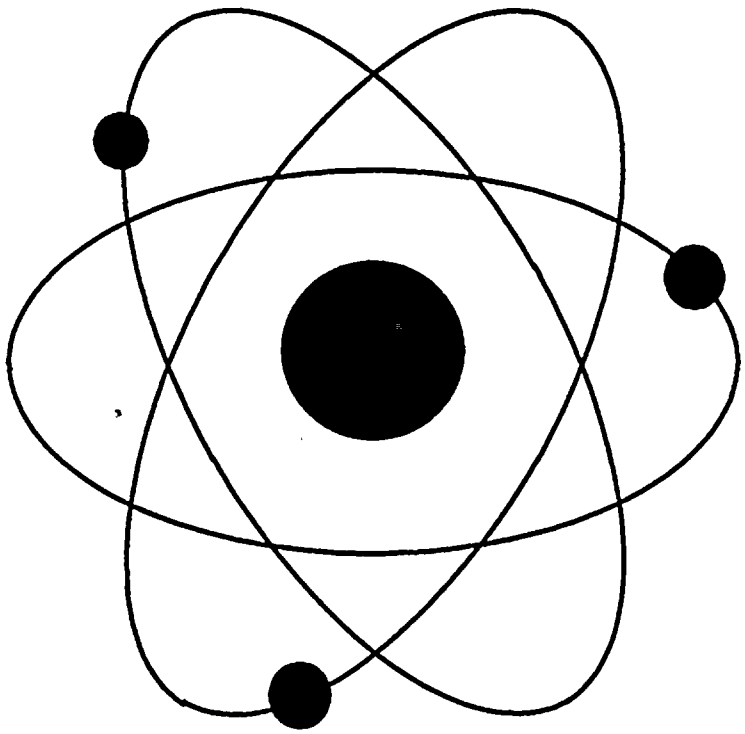
FLORIDA POWER AND LIGHT COMPANY

TURKEY POINT PLANT

UNIT 3 CYCLE XI

STARTUP REPORT

REV. 1



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INTRODUCTION

This report contains the official summary of the Startup Physics Tests performed on Turkey Point Unit 3 at the beginning of Cycle XI. The testing program was conducted in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, and Operating Procedure 0204.5, Nuclear Design Check Tests During Startup Sequence After Refueling, and meets the minimum requirements of ANSI/ANS 19.6.1, Revision 0 (12-13-85), Startup Physics Tests for Pressurized Water Reactors. Testing commenced on September 4, 1987, at 0750 and was completed on March 11, 1988 at 1400.

The Westinghouse Nuclear Design Report for Unit 3, Cycle XI, (WCAP-11454) is the design data from which deviations were measured for the purpose of verifying that acceptance criteria were met. The acceptance criteria stated are the more conservative of ANSI/ANS 19.6.1, Revision 0 or Operating Procedure 0204.5.

All of the tests included in this report meet their acceptance criteria.

The contents of this report provide the documentation required by Technical Specification 6.9.1.a.

Author: James P. Hendrickson
J. P. Hendrickson
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G. L. Marsh
Reactor Engineer

Reviewed by: J. L. Perryman
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Approved by: Vito A. Kaminskas
Vito A. Kaminskas
Reactor Supervisor PTN

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1.0 UNIT 3 CYCLE XI CORE

This section presents the as-loaded core configuration (Figure 1); the Control and Shutdown Rod pattern (Figure 2); and the Rod Drop Times for all rods as measured in Procedure 3-PMI-028.3 RPI Hot Calibration, CRDM Stepping Test, and Rod Drop Test (Figure 3).

All rods met the drop time limit of 2.4 seconds as per Technical Specification 3.2.3.

REACTOR FUEL LOCATION

DATE 5-31-87

TURKEY POINT PLANT UNIT NO. 3

CYCLE NO. XI

FIGURE 1

Legend

Assy. ID xx-xx

Insert ID ZZ ZZZZ

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
						AA-28 HF-12	AA-31 HF-25	AA-23 HF-17							R
				AA-36 149Z	CC-11 R-10	CC-16 185Z	M-27 46	CC-18 200Z	CC-27 R-39	AA-37 198Z					P
			AA-40 106Z	CC-28 227Z	BB-32 153Z	BB-56 R-17	CC-35 220Z	BB-26 R-36	BB-52 146Z	CC-10 193Z	AA-56 111Z				N
		AA-41 100Z	BB-27 114Z	CC-50 226Z	BB-23 R-11	CC-38 192Z	AA-51 R-100	CC-40 209Z	BB-02 R-40	CC-52 223Z	BB-37 182Z	AA-44 107Z			M
	AA-34 215Z	CC-31 221Z	CC-53 202Z	AA-45 R-21	CC-02 8P17 6WZ	BB-16 R-12	BB-19 112Z	BB-13 R-25	CC-04 8P18 1WZ	AA-33 R-20	CC-54 186Z	CC-12 214Z	AA-53 105Z		L
	CC-22 R-33	BB-30 147Z	BB-21 R-38	CC-05 8P17 9WZ	AA-02 155Z	BB-40 161Z	BB-49 R-42	BB-48 160Z	AA-16 151Z	CC-06 8P18 0WZ	BB-24 R-08	BB-38 152Z	CC-23 R-97		K
AA-24 HF-24	CC-19 183Z	BB-43 R-06	CC-46 179Z	BB-11 R-35	BB-51 208Z	CC-47 188Z	BB-17 222Z	CC-34 207Z	BB-55 125Z	BB-04 R-22	CC-48 219Z	BB-50 R-46	CC-20 212Z	AA-26 HF-18	J
AA-18 HF-04	M-52 30	CC-36 SS-1	AA-46 R-37	BB-01 137Z	BB-46 R-16	BB-07 109Z	M-17 R-09	BB-12 158Z	BB-31 R-26	BB-15 211Z	AA-50 R-14	CC-43 146Z	M-37 26	AA-17 HF-21	H
AA-05 HF-08	CC-15 224Z	BB-39 R-15	CC-44 190Z	BB-06 R-07	BB-45 184Z	CC-41 175Z	BB-14 195Z	CC-42 201Z	BB-34 106Z	BB-09 R-02	CC-37 203Z	BB-29 R-43	CC-17 194Z	AA-04 HF-19	G
	CC-09 R-19	BB-42 148Z	BB-10 R-24	CC-07 8P18 3WZ	AA-29 110Z	BB-28 113Z	BB-25 R-05	BB-35 159Z	AA-30 154Z	CC-01 8P18 2WZ	BB-20 R-44	BB-41 156Z	CC-26 R-18		F
	AA-52 204Z	CC-14 228Z	CC-55 216Z	AA-47 R-04	CC-08 8P17 7WZ	BB-03 R-32	BB-18 101Z	BB-08 R-29	CC-03 8P17 6WZ	AA-35 R-03	CC-49 225Z	CC-13 229Z	AA-54 150Z		E
		AA-39 103Z	BB-33 205Z	CC-56 199Z	BB-22 R-28	CC-39 178Z	AA-49 R-96	CC-33 218Z	BB-05 R-01	CC-51 180Z	BB-47 149Z	AA-43 104Z			D
			AA-42 115Z	CC-30 191Z	BB-54 157Z	BB-53 R-27	CC-45 213Z	BB-44 R-45	BB-36 105Z	CC-29 206Z	AA-48 102Z				C
				AA-55 197Z	CC-25 R-10	CC-32 217Z	M-41 52	CC-24 189Z	CC-21 R-41	AA-38 177Z					B
						AA-11 HF-26	AA-06 HF-14	AA-03 HF-03							A

Verified by Gary L. Mercier

Date 5-31-87

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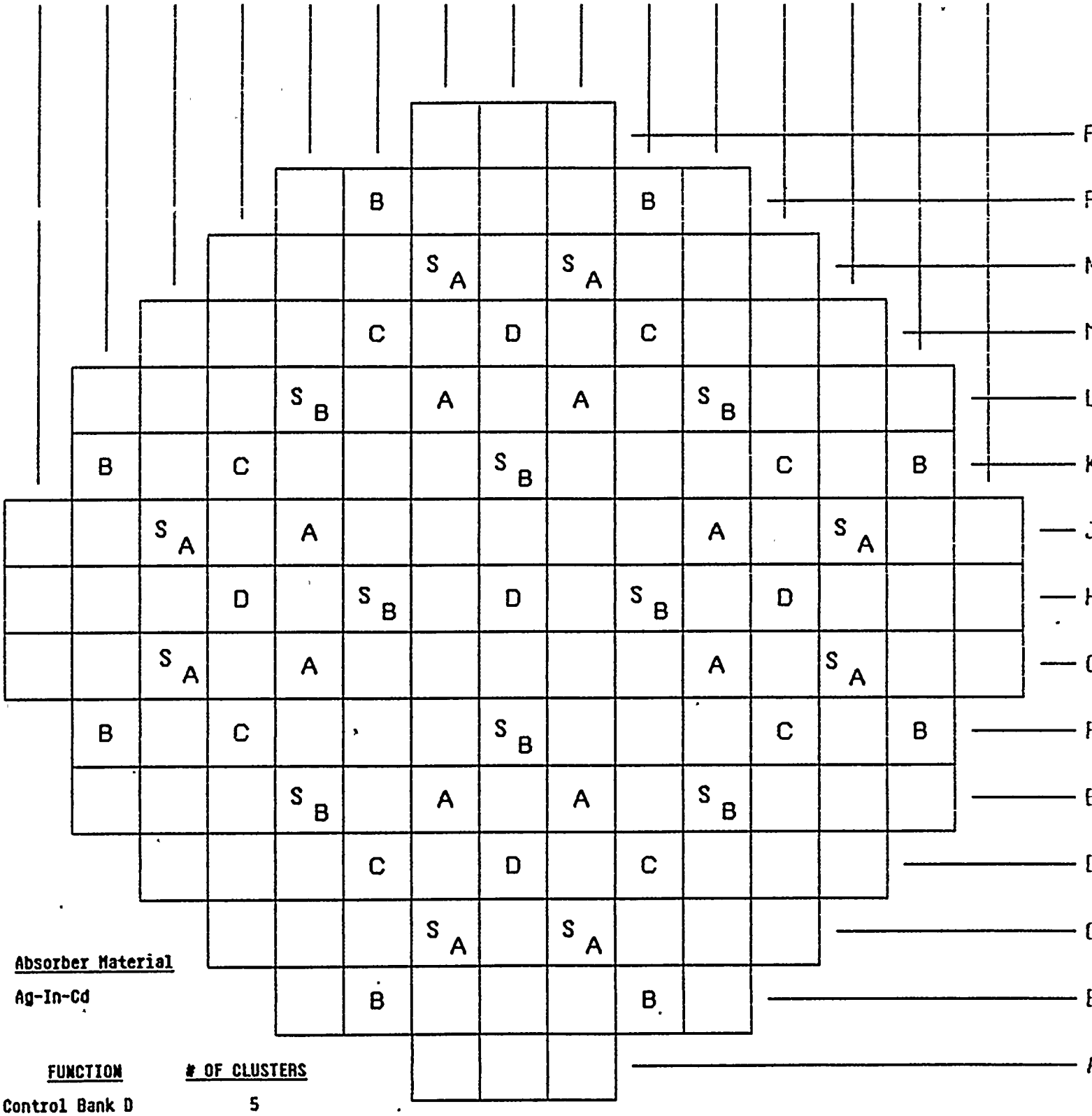
CONTROL ROD BANK LOCATION
TURKEY POINT PLANT UNIT NO.
CYCLE NO. XI

FIGURE 2

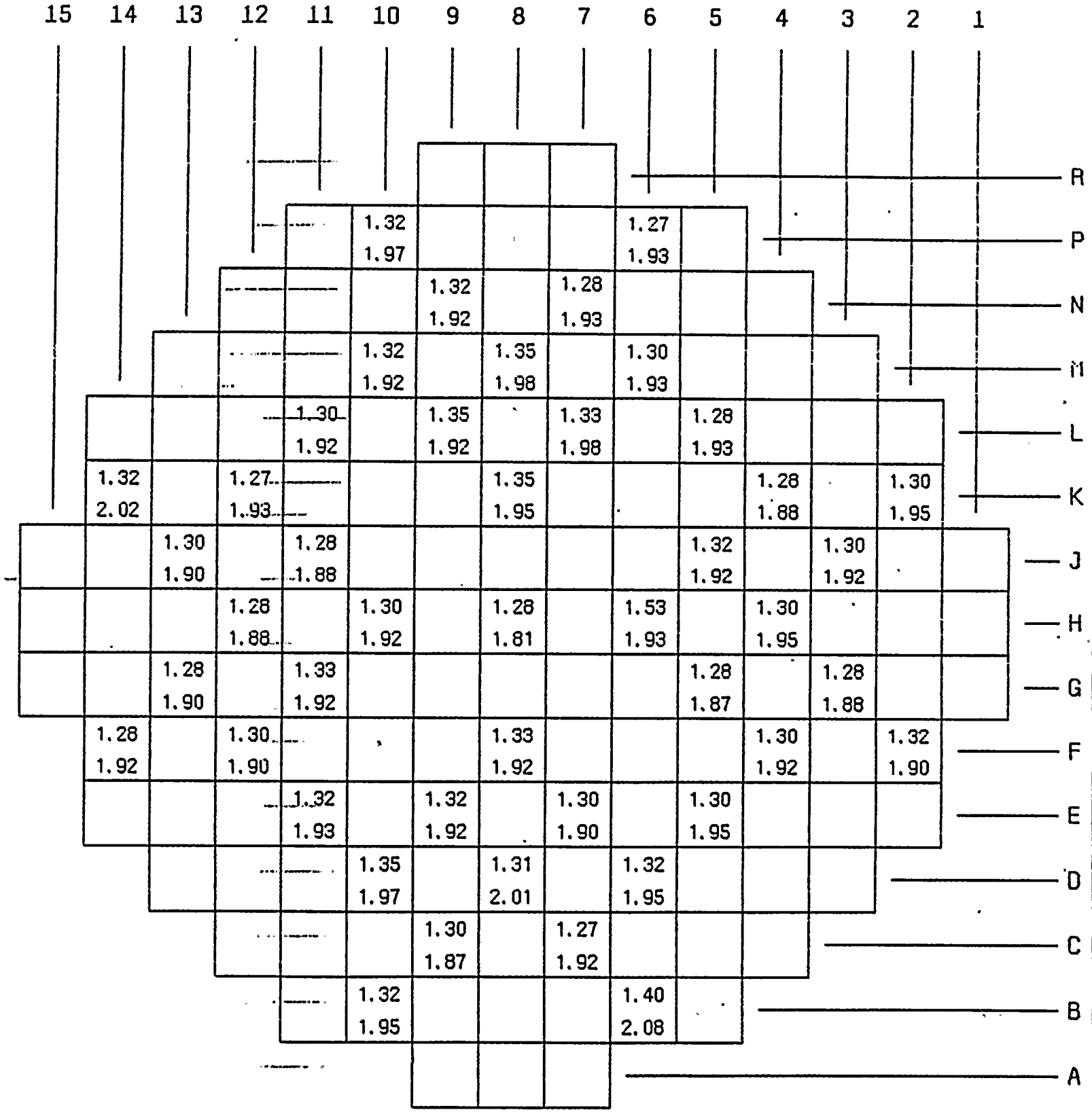


FUNCTION	# OF CLUSTERS
Control Bank D	5
Control Bank C	8
Control Bank B	8
Control Bank A	8
Control Bank SB	8
Control Bank SA	8

(A-L)

ROD DROP TIMES
TURKEY POINT PLANT UNIT NO. 3
CYCLE NO. XI

FIGURE 3



LEGEND

	Time to Dashpot
	Time to Bottom

2.0 INITIAL CRITICALITY

The approach to criticality began September 4, 1987, at 0750 hours in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling. Criticality was achieved September 5, 1987, at 0215 hours by withdrawing control rods to 160 steps on Bank D and diluting the RCS with 11,000 gallons of water.

Upon attaining criticality the flux level was increased to approximately 1 x 10^{-8} amps on the intermediate range to obtain critical data.

Tavg	=	547°F
Control Bank D	=	117 Steps
Boron	=	1710 ppm
Flux	=	1 x 10^{-8} amps

TABLE 2.1

FLUX

Picoammeter	N-35	N-36
1 x 10^{-8} amps	EOOS	1.5 x 10^{-8} amps

The following graph (Figure 4) is a plot of the ICRR during the approach to criticality.

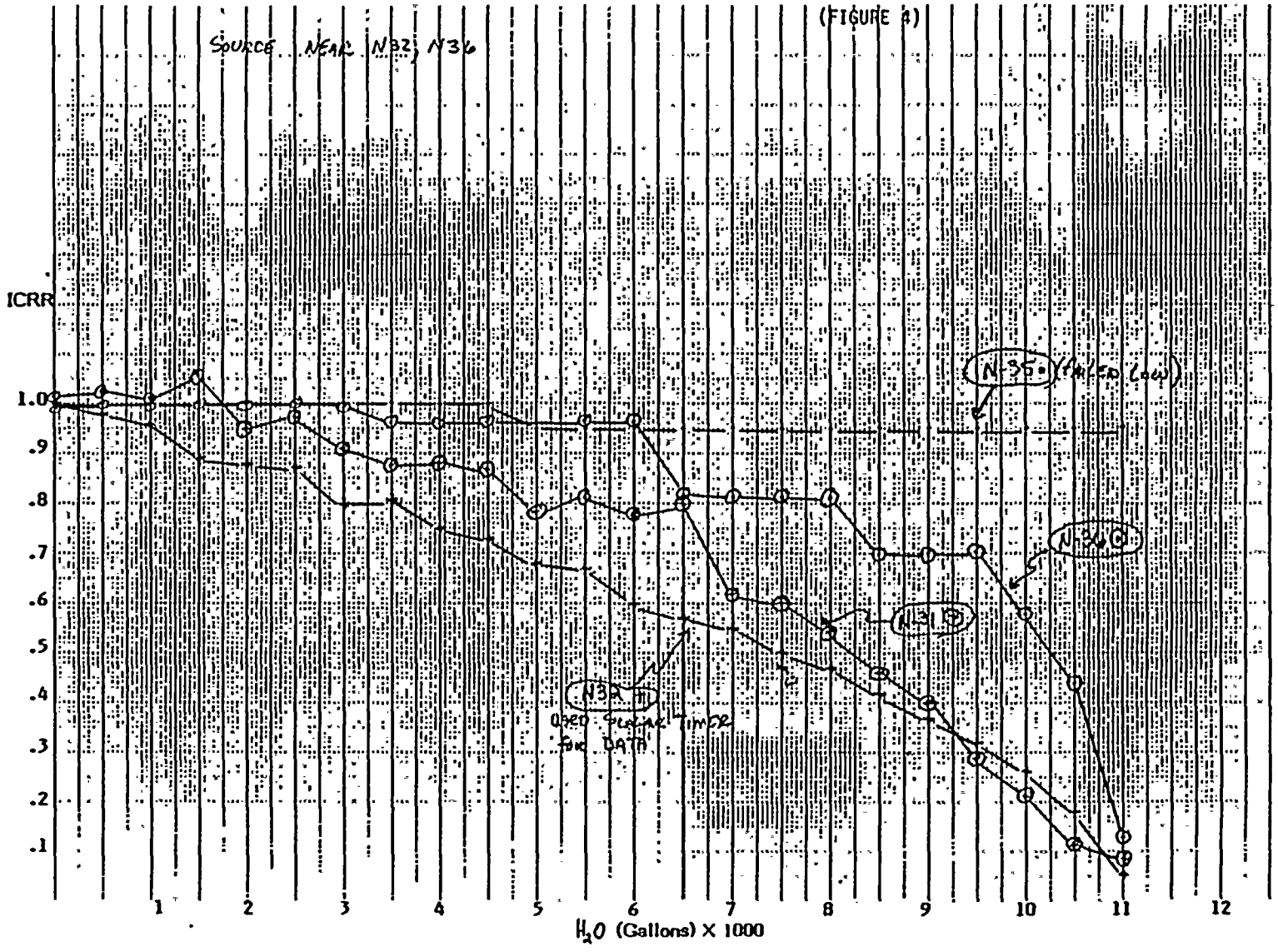
46 151(

+ → N32 N31 ⊗
• → N35 N36 ⊙

ICRR VS. DILUTION H_2O
OP 0204.3

Unit 3 Cycle XI
Date: 9/4/87

(FIGURE 4)



3.0 Summary of Tests

This section provides a summary of the results of the low power physics tests along with the Westinghouse design data. This report compares design and measured data using difference[1] and percent difference[2]. For each test, the acceptance criteria is listed at the bottom of the table.

[1]The difference = predicted - measured.

[2]For calculating the percent difference, the equation is:

$$\left[\frac{\text{Predicted Value}}{\text{Measured Value}} - 1\right] \times 100\%$$

3.1 Nuclear Heating

The point of adding Nuclear Heat was determined in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, Step 8.15 and Appendix A. This is performed by establishing a small positive startup rate and measuring the point (flux level) at which T_{avg} departs from its established, steady value.

Nuclear Heating was measured to first occur at:

TABLE 3.1.1

FLUX LEVEL (AMPS)

Picoammeter	N-36
4.32×10^{-7}	6.69×10^{-7}

All physics tests were conducted at or below 1.0×10^{-7} amps on the picoammeter connected to N-44 to assure Nuclear Heating did not occur.

3.2 Reactivity Vs. Period

Reactivity Computer checkout was done in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, Step 8.17 and Appendix B. This checkout is performed by inserting small (<60 pcm) positive and negative reactivities using rod motion, measuring the period generated and the indicated worth, and then comparing design worths to measured worths for the given period.

TABLE 3.2.1

Period (sec)	Reactivity (pcm)	Reactivity (design)	Diff (%)
-239	-36.0	-36.7	1.9
+232	+27.0	+27.0	0.0
-288	-29.0	-29.5	1.7
+157	+38.5	+38.5	0.0

Acceptance Criteria is +/- 10.0%.

3.3 Boron Endpoints (PPM)

The Boron Endpoints noted below are determined as per Operating Procedure 0204.5, Appendix A. A just-critical condition is established as near as practicable to the required rod configuration (i.e., ARO). The RCS boron concentration is determined and is then adjusted analytically for the ppm worth of the reactivity (measured in pcm) by which the actual critical state deviated from the design condition.

TABLE 3.3.1

BORON ENDPOINTS (PPM)

	Measured	Westinghouse	Comparison
ARO	1711	1744	33 PPM

Acceptance Criteria is +/- 50 ppm

3.4 ROD WORTH

Rod worths were measured as per Operating Procedure 0204.5, Appendices D and F. The Reference Bank (highest predicted worth) was diluted into the core. The boron concentration prior to and subsequent to this insertion was determined and the difference in the two boron concentrations is defined as the boron (Rod) worth of the Bank (Table 3.4). The differential and integral worth of control bank C was measured and plotted (Figure 5). Additionally, the integral worth of banks C and D in overlap was measured and plotted (Figure 6).

TABLE 3.4

ROD WORTH (PPM)

	Measured	Westinghouse
CBC	175	152

3.5 ROD WORTH (PCM)

The remaining rod bank worths were measured using the rod swap technique, "swapping" negative reactivity insertions on the bank being measured with positive reactivity insertions from the Reference Bank.

TABLE 3.5.1

ROD WORTH (PCM)

	Measured	Westinghouse	Diff (PCM)	% Diff
CBD	682	718	36	+5.28
CBC[1]	1325	1311	-14	-1.06
CBB	621	579	-42	-6.76
CBA	1089	1107	18	+1.65
SBB	1107	1137	30	+2.71
SBA	1051	1014	-37	-3.52
Total	5875	5866	-9	-.15

The acceptance criteria for rod worth measurements are:

(1) Reference bank within +/- 10% of design, and

(2) Individual banks within +/- 15% or +/- 100 pcm of design whichever is greater, and

(3) Sum of all measured banks within +/- 10% of design.

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HOT ZERO POWER
DIFFERENTIAL AND INTEGRAL BANK WORTH
VS.
BANK POSITION

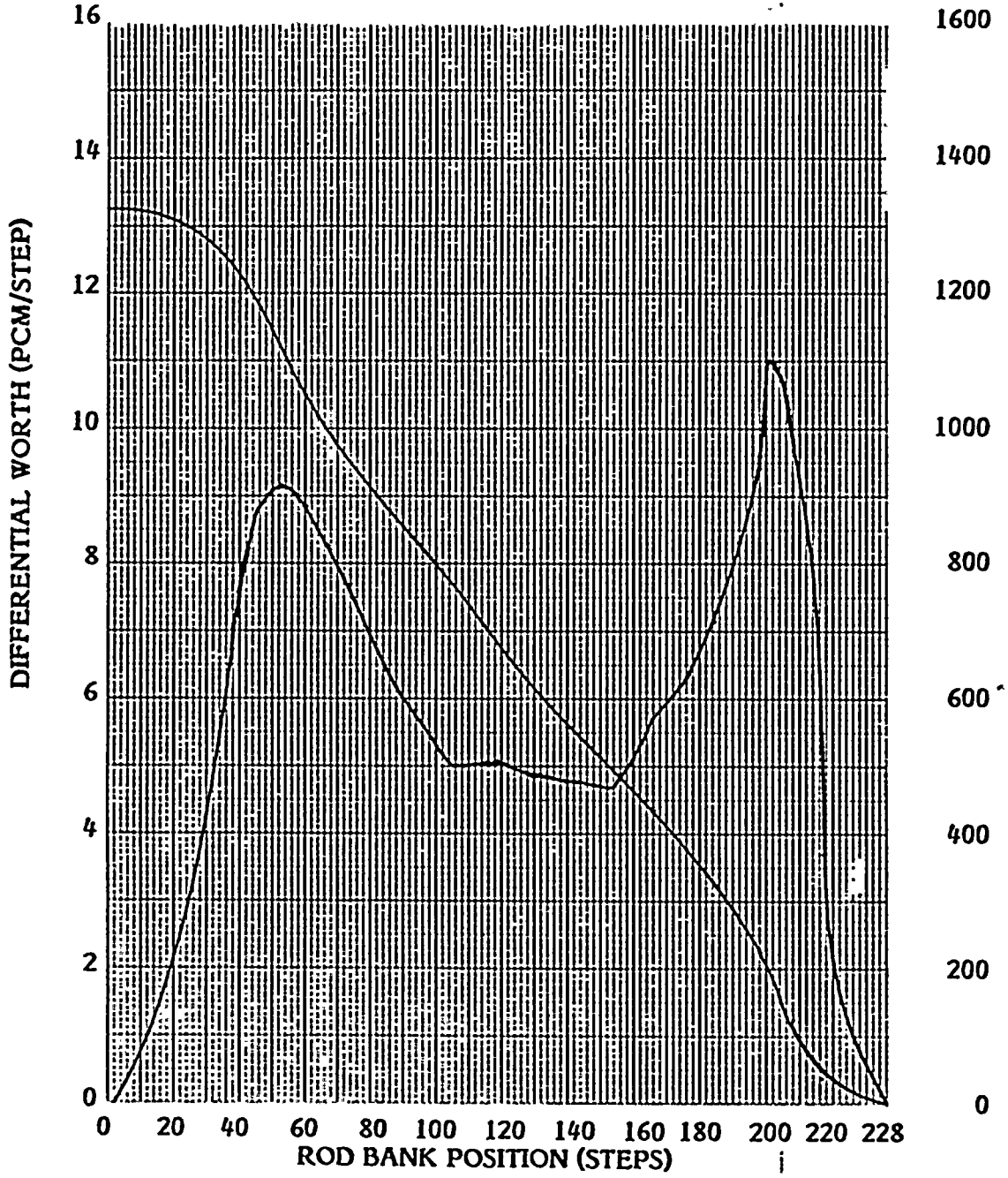


FIGURE 5

UNIT 3
CYCLE XI
EXPOSURE 0.0 MWD/MTU
BANK CBC

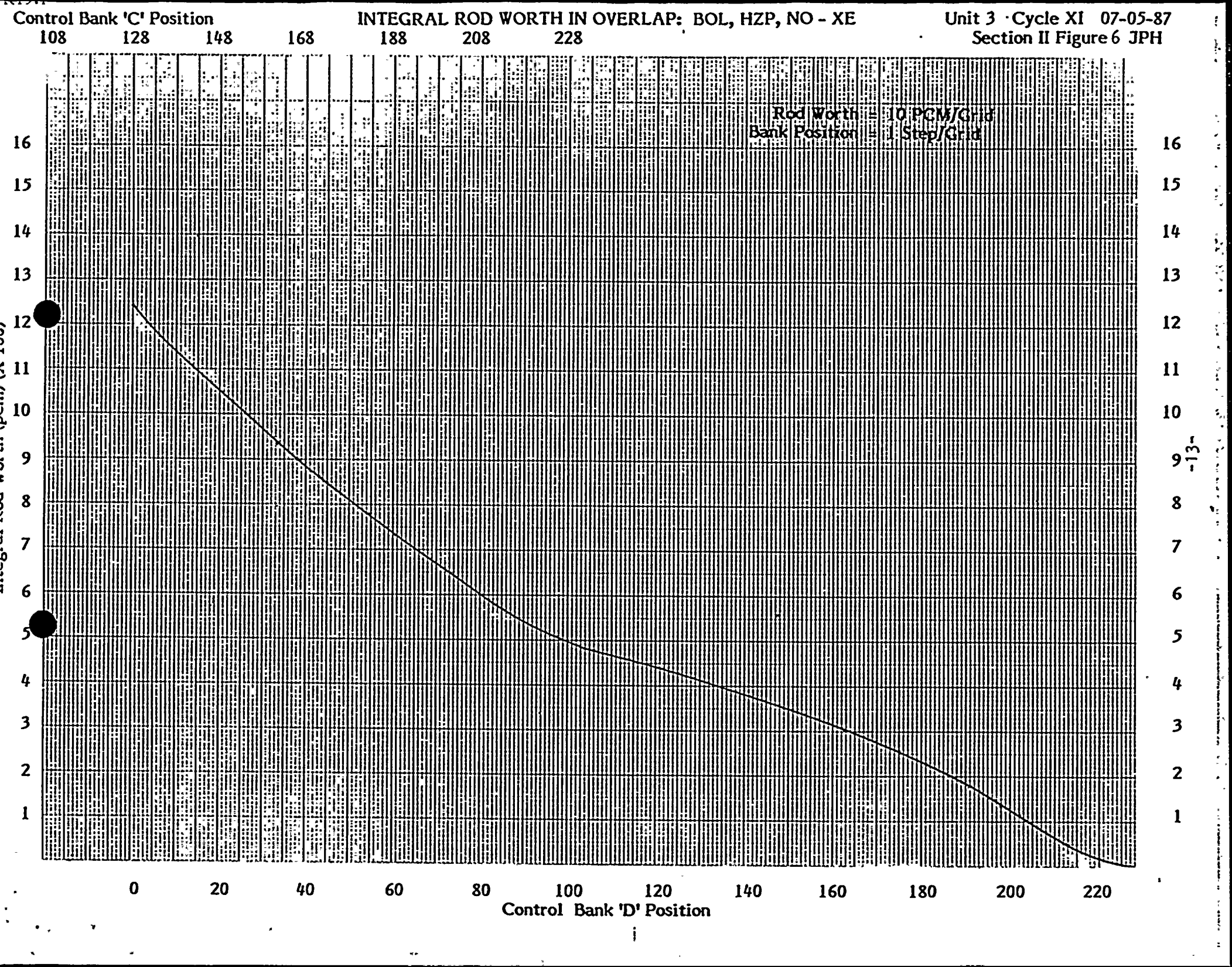
BANK POSITIONS

	OUT	IN	MOVING
SBA	[X]	[ ]	[ ]
SBB	[X]	[ ]	[ ]
CBA	[X]	[ ]	[ ]
CBB	[X]	[ ]	[ ]
CBC	[ ]	[ ]	[X]
CBD	[X]	[ ]	[ ]

TEST METHOD

DILUTION [X]
BORATION [ ]

R1:2


Control Bank 'C' Position
108 128 148 168 188 208 228
INTEGRAL ROD WORTH IN OVERLAP: BOL, HZP, NO - XE
Unit 3 · Cycle XI 07-05-87
Section II Figure 6 JPH
Rod Worth = 10 PCM/Grid
Bank Position = 1 Step/Grid
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
0 20 40 60 80 100 120 140 160 180 200 220
Control Bank 'D' Position
-13-

3.6 TEMPERATURE COEFFICIENT

The isothermal and moderator temperature coefficients were determined using Appendix B in Operating Procedure 0204.5, Nuclear Design Check Tests During Startup After Refueling.

The values determined for this testing sequence (in pcm/°F) are:

TABLE 3.6.1

ISOTHERMAL TEMPERATURE COEFICIENT (PCM/°F)

Rods	Measured[1]	Design Westinghouse	Diff
D/215	+.96	+1.1	.14

Acceptance Criteria is +/- 2 pcm/°F (design, minus measured)

TABLE 3.6.2

MODERATOR TEMPERATURE COEFFICIENT (PCM/°F)

Rods	Measured[1]	Design[2] Westinghouse	Diff
D/215	+2.86	+2.76	-.1

Acceptance Criteria on measured value is $\leq$ + 5 pcm/°F.

[1]This is the average of one heat up and one cool down measurement.
[2]This value has been adjusted for boron and temperature sensitivity.

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3.7. HZP DIFFERENTIAL BORON WORTH

The Hot Zero Power (HZP) Differential Boron worth was measured using Control Bank C, which had a bank worth of 1325 pcm. The value obtained for this test was:

TABLE 3.7.1

HZP DIFFERENTIAL BORON WORTH (PCM/PPM)

Measured	Westinghouse	% Diff
7.57	8.44	11.49

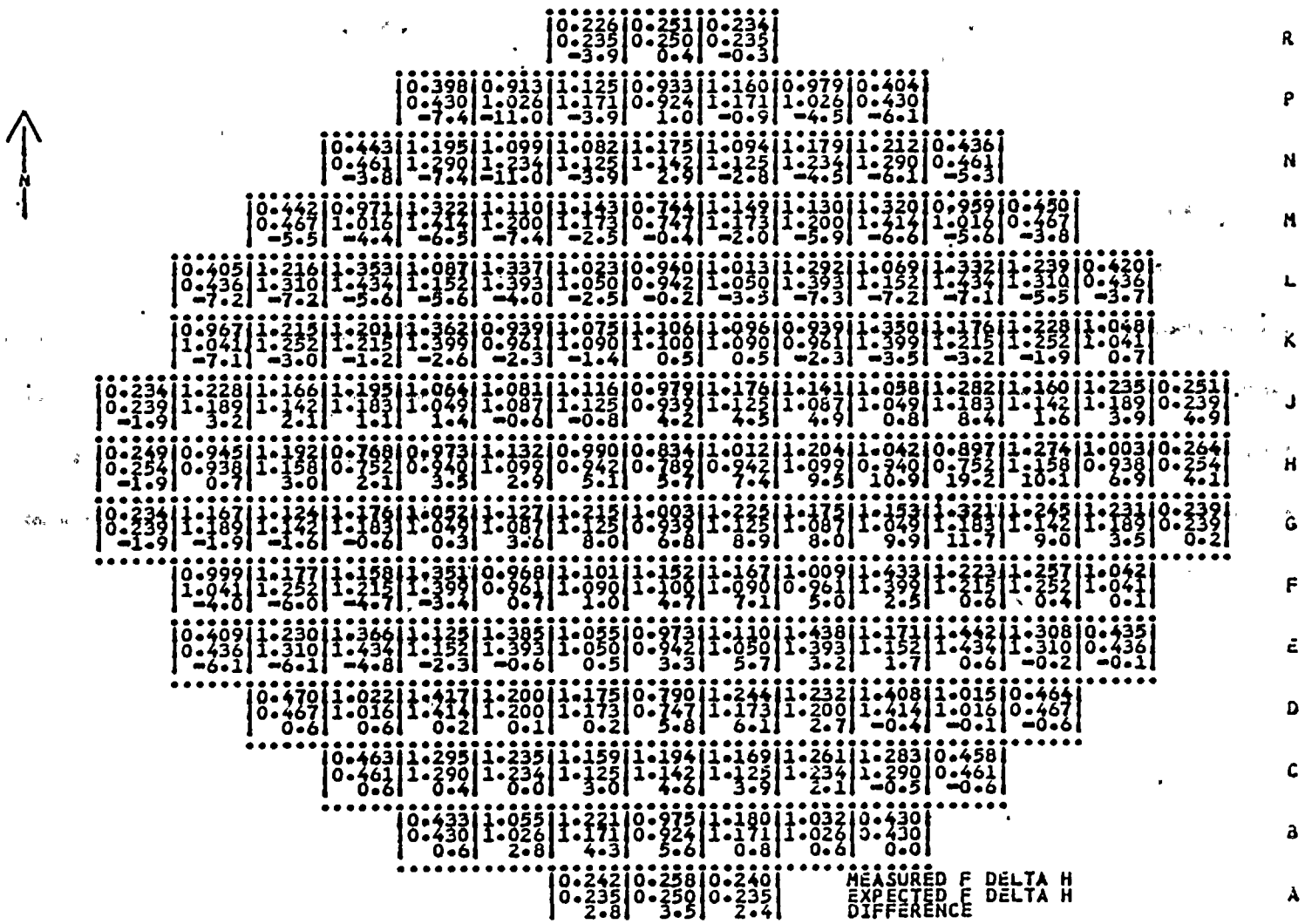
Acceptance criteria is $\leq$ +/- 15%.

4.0 SHUTDOWN MARGIN

The Shutdown Margin was calculated prior to power escalation to verify adequate shutdown capability. For this calculation, design rod worths were reduced by 10%, and the results show adequate shutdown margin at BOC and EOC. The following is a summary of the results:

	Cycle XI	
	BOC	EOC
Control Rod Worth (%Δρ)		
All Rods Inserted Less Worst Stuck Rod	6.41	6.50
(1) Less 10%	5.77	5.85
Control Rod Requirements (%Δρ)		
Reactivity Defects (Doppler, T_{avg}, Void, Redistribution)	1.69	2.89
Rod Insertion Allowance	1.35	0.50
(2) Total Requirements	3.04	3.39
Shutdown Margin (1) - (2) %Δρ	2.73	2.46
Required Shutdown Margin (%Δρ)	1.00	1.77

Source: WCAP 11454



ROD POSITION

Bank	Location in Steps
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	135

Classification

Map No. FM3XI2

Power % 28.89

Axial Offset 1.08

Max $F_{\Delta H}^{N}$ 1.659

Max F_{Q}^{N} 1.930

INCORE TILT

N

0.9712	0.9890
1.0013	1.0385

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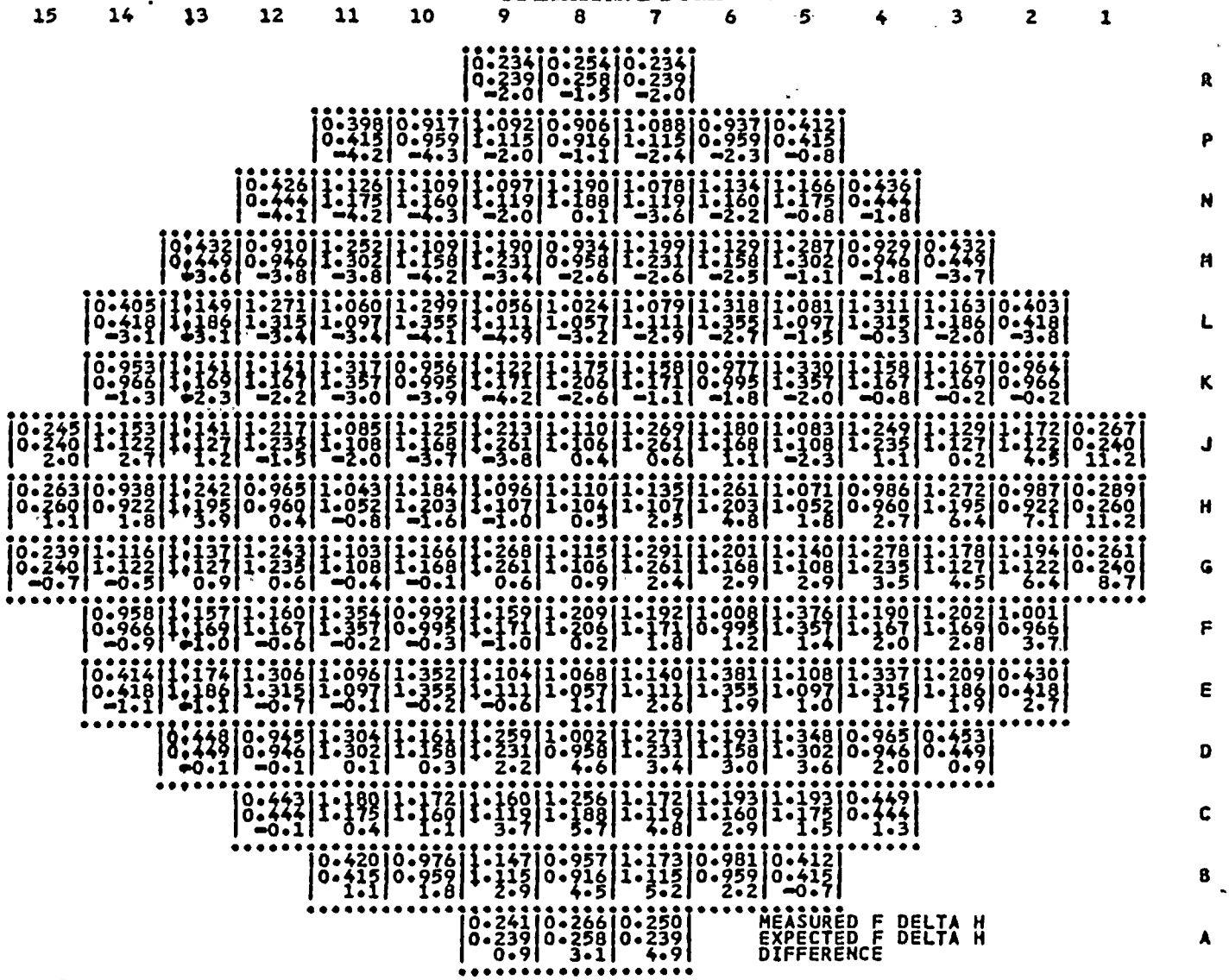
FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3
OPERATING SUMMARY



ROD POSITION

Bank	Location in Steps
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	178

Classification

Map No. FM3XI3

Power % 73.90

Axial Offset 4.62

Max F N
Δ H 1.513

Max F N
Q 1.835

INCORE TILT

N

0.9746	0.9930
1.0040	1.0284

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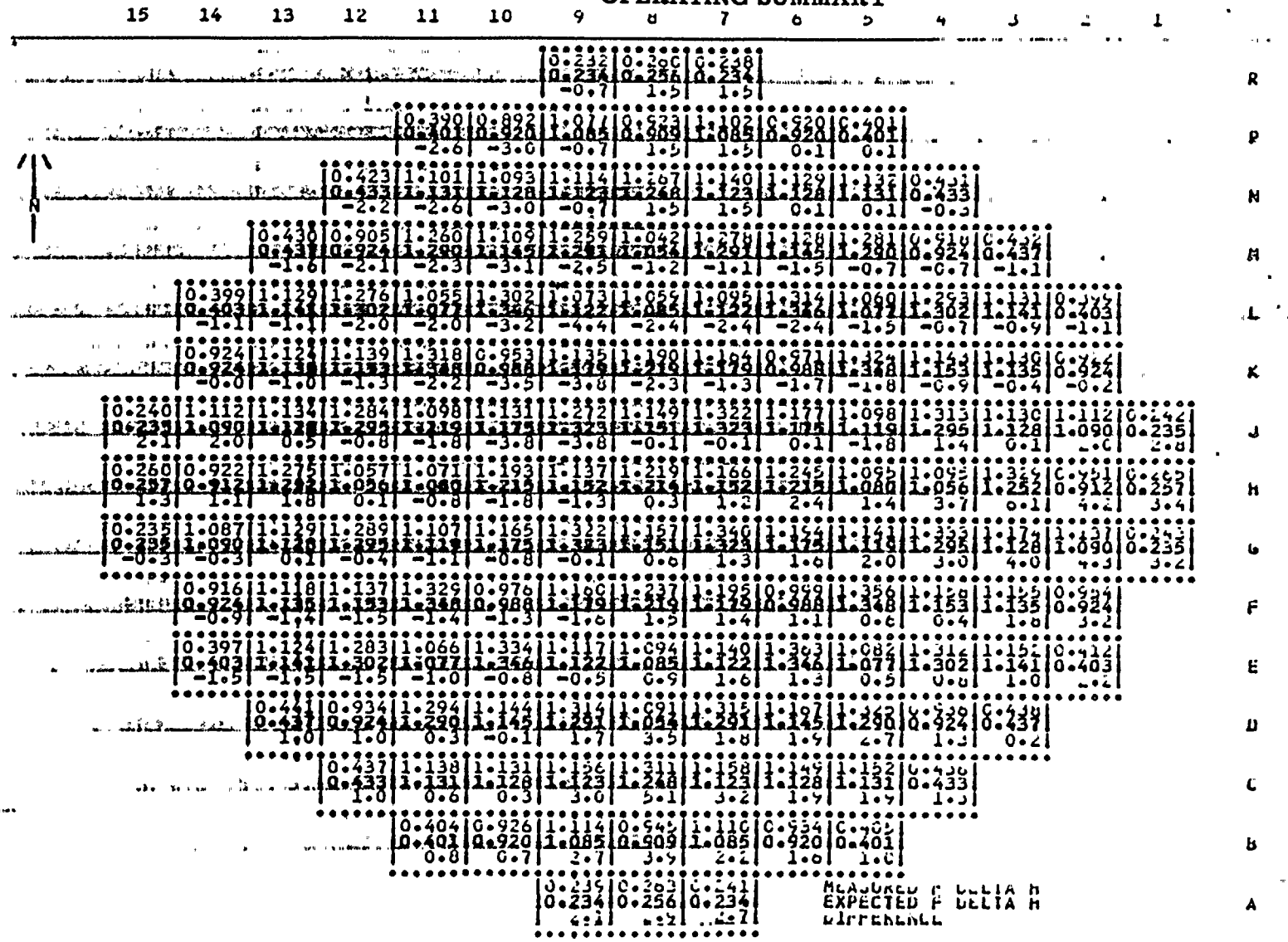
FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNIT 3
OPERATING SUMMARY



ROD POSITION

Bank	Location in Steps
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	228

Classification

Map No. FM3XI6

Power % 100.45

Axial Offset 4.18

Max F N Δ H 1.457

Max F N Q 1.769

INCORE TILT

N

0.9823	0.9981
1.0001	1.0196

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6.0 CRITICAL BORON CONCENTRATION

Unit 3 Cycle XI

The critical boron concentration was calculated by adjusting a measured boron concentration to the equilibrium hot full power, all rods out condition. For Unit 3 Cycle XI this calculation was performed at 950 MWD/T.

The following is a summary of the results in PPM:

MEASURED BOL	WESTINGHOUSE	DIFF
1215	1237	22 PPM

Acceptance Criteria is +/- 50 ppm

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