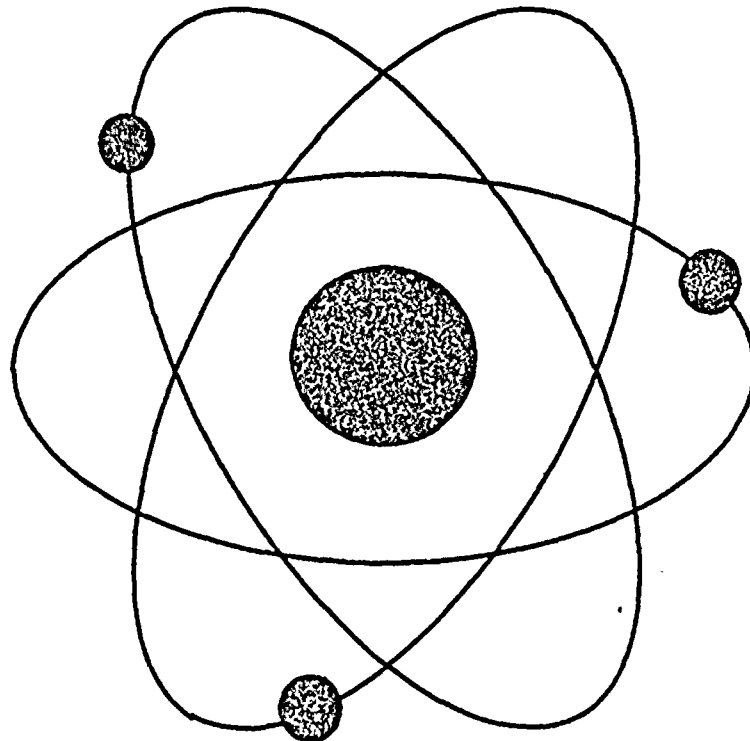


FLORIDA POWER AND LIGHT COMPANY

TURKEY POINT PLANT

UNIT 3 CYCLE XI

STARTUP REPORT



8712110249 871207
PDR ADDCK 05000250
P PDR

Introduction

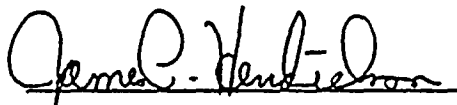
This report contains the official summary of the Startup Physics Tests performed on Turkey Point Unit 3 at the beginning of Cycle XI. The testing program was conducted in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, and Operating Procedure 0204.5, Nuclear Design Check 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 September 6, 1987, at 0300.

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.

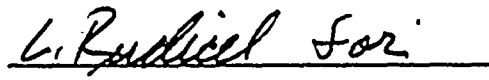
Author:


J. P. Hendrickson
Reactor Engineer

Reviewed by:


G. L. Marsh
Reactor Engineer

Reviewed by:


J. L. Perryman
Reactor Support Supervisor

Approved by:



Vito A. Kaminskas
Reactor Supervisor PTN

TABLE OF CONTENTS

	<u>PAGE</u>
Acknowledgements	i
Introduction	ii
1.0 Unit 3 Cycle XI Core	1
1.1 Loading Pattern	2
1.2 Rod Pattern	3
1.3 Rod Drop Times	4
2.0 Initial Criticality	5
2.1 ICRR Vs. Dilution	6
3.0 Summary of Tests	7
3.1 Nuclear Heating	8
3.2 Reactivity Vs. Period	9
3.3 Boron Endpoint, Most Reactive Bank	10
3.4 Rod Worth (PPM), Most Reactive Bank	11
3.5 Rod Worth (PCM)	11
3.6 Temperature Coefficient	14
3.7 HZP Differential Boron Worth	15
4.0 Shutdown Margin	16
5.0 Power Distribution Maps	
5.1 29% Flux Map	17

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.

TURKEY POINT PLANT UNIT NO. 3

Assy. ID

Insert ID

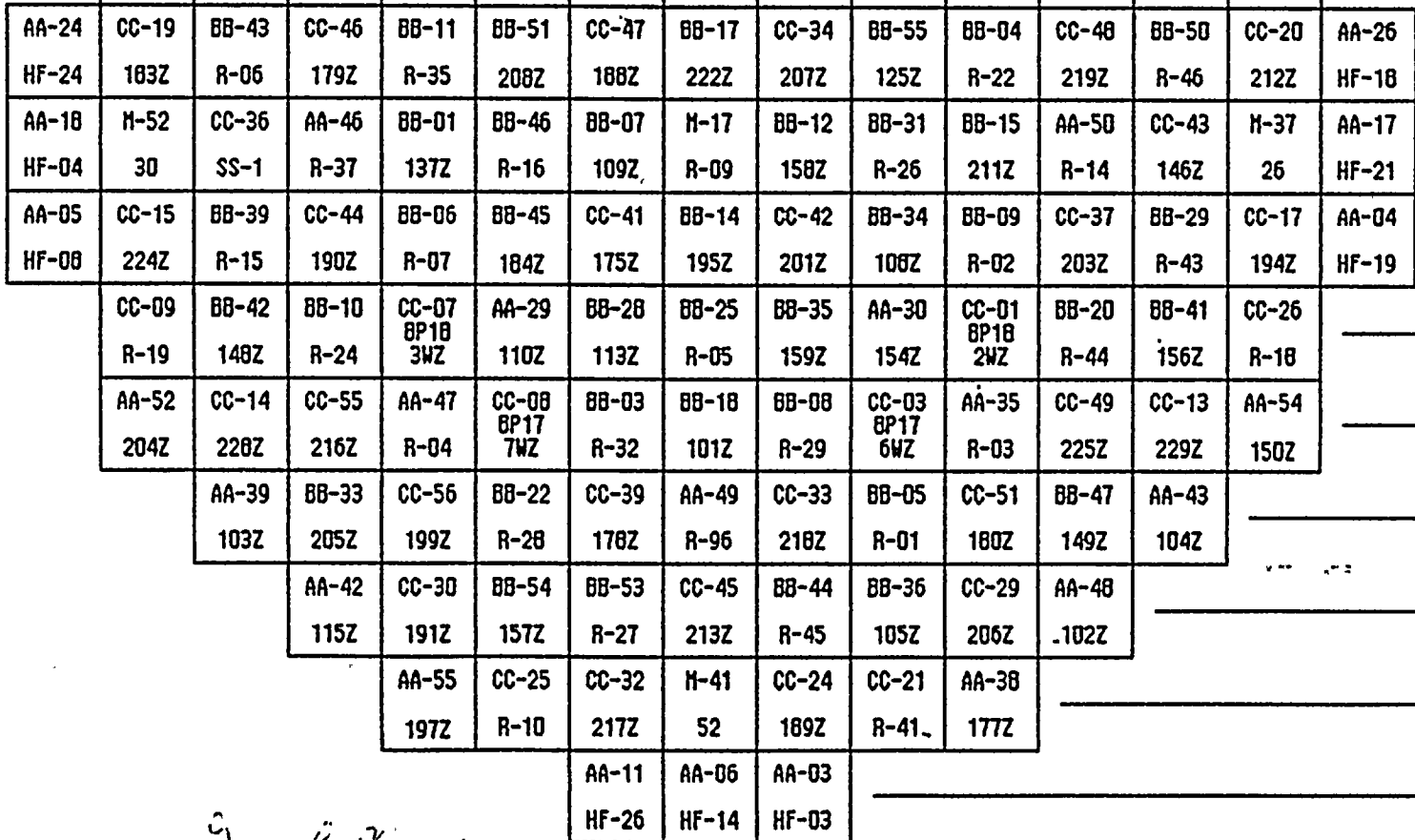
Legend

XX-XX

22

ZZZZ

FIGURE 1

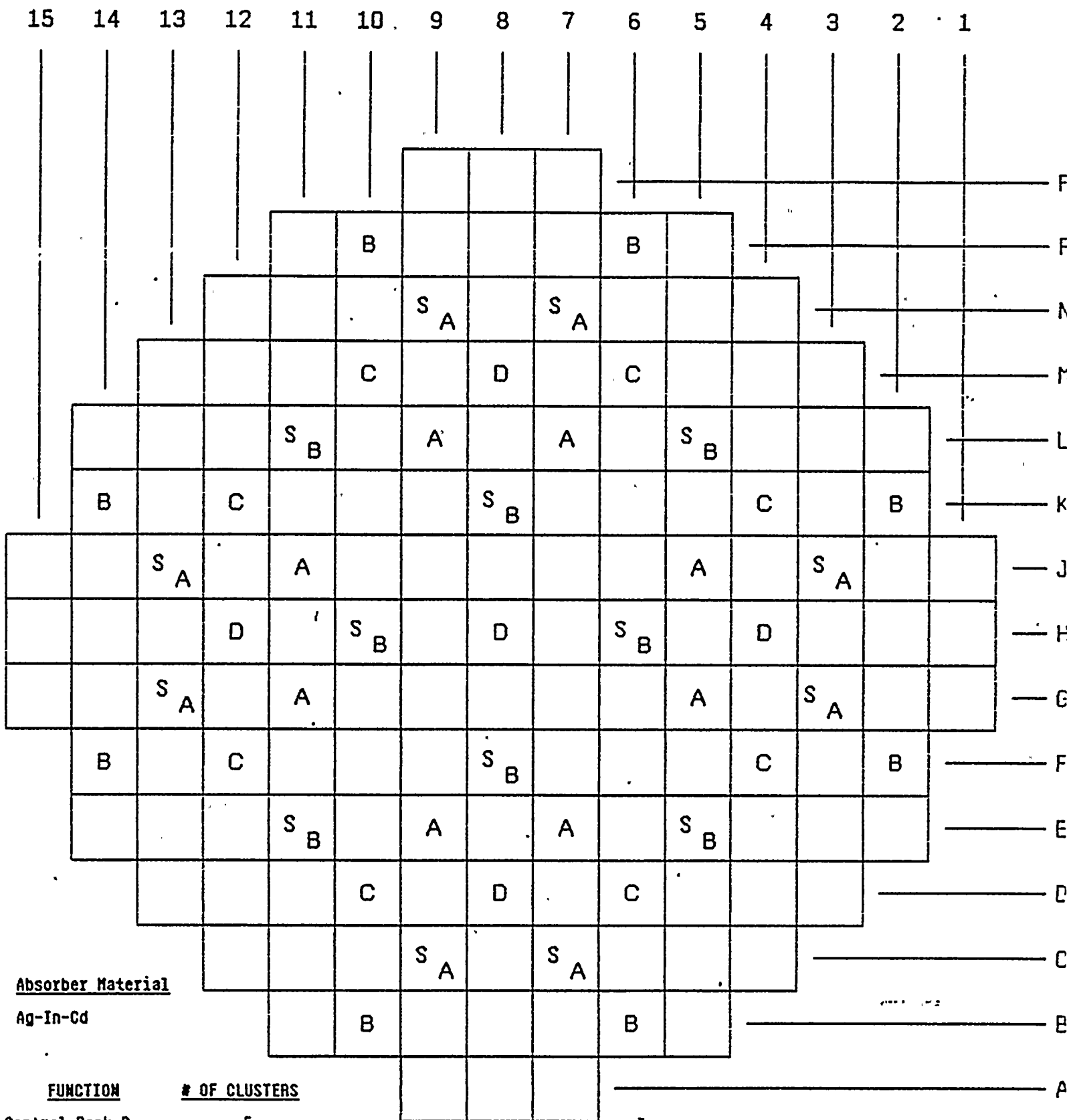


Date 5-21-87

CONTROL ROD BANK LOCATION
TURKEY POINT PLANT UNIT NO. 3

CYCLE NO. XI

FIGURE 2



Absorber Material

Ag-In-Cd

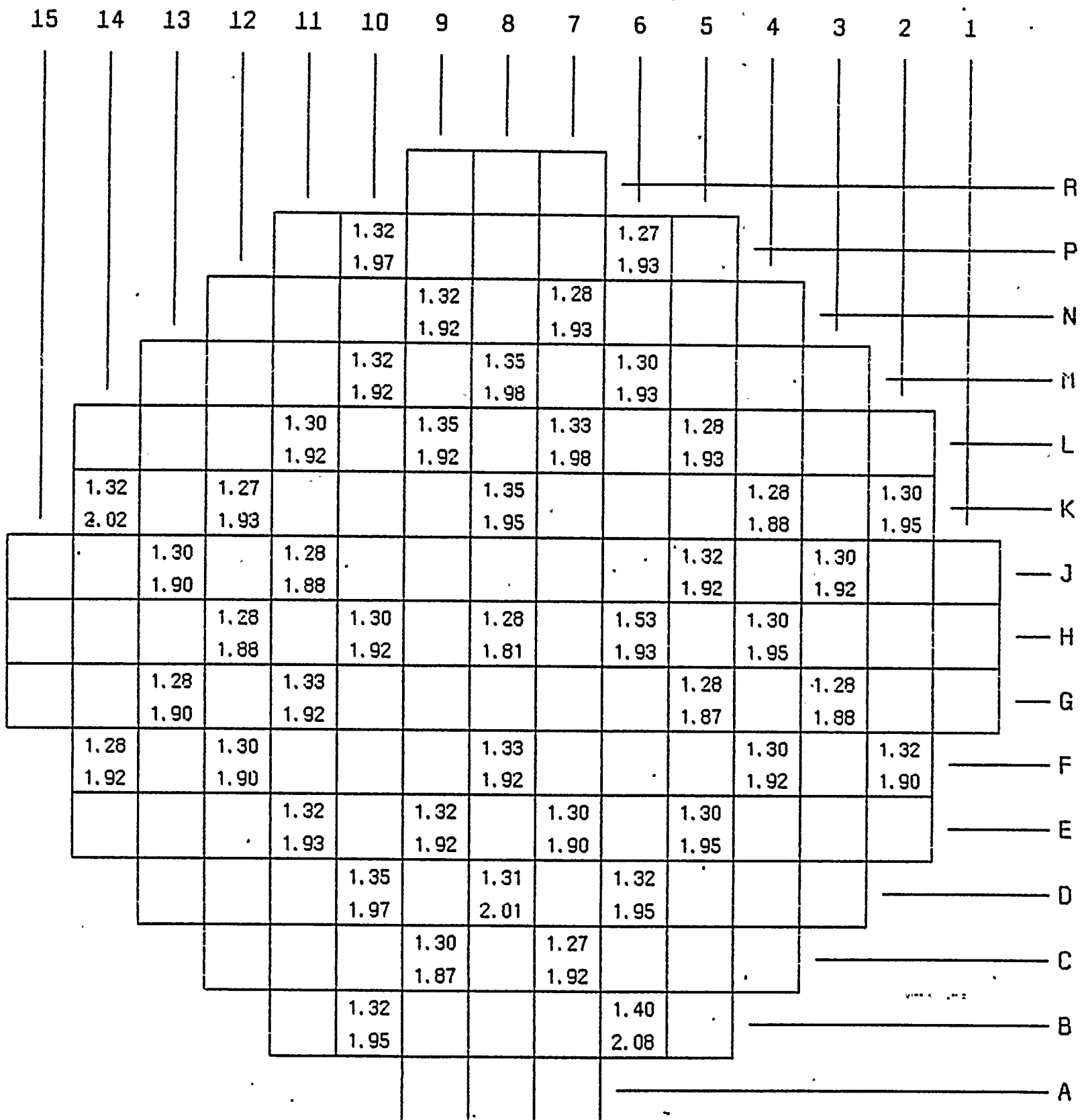
FUNCTION

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

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

FIGURE 3



LEGEND

<div style="border: 1px solid black; width: 20px; height: 10px; display: inline-block;"></div>	Time to Dashpot
<div style="border: 1px solid black; width: 20px; height: 10px; display: inline-block;"></div>	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 1×10^{-8} amps on the intermediate range to obtain critical data.

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

TABLE 2.1

FLUX

Picoammeter

1×10^{-8} amps

N-35

EOOS

N-36

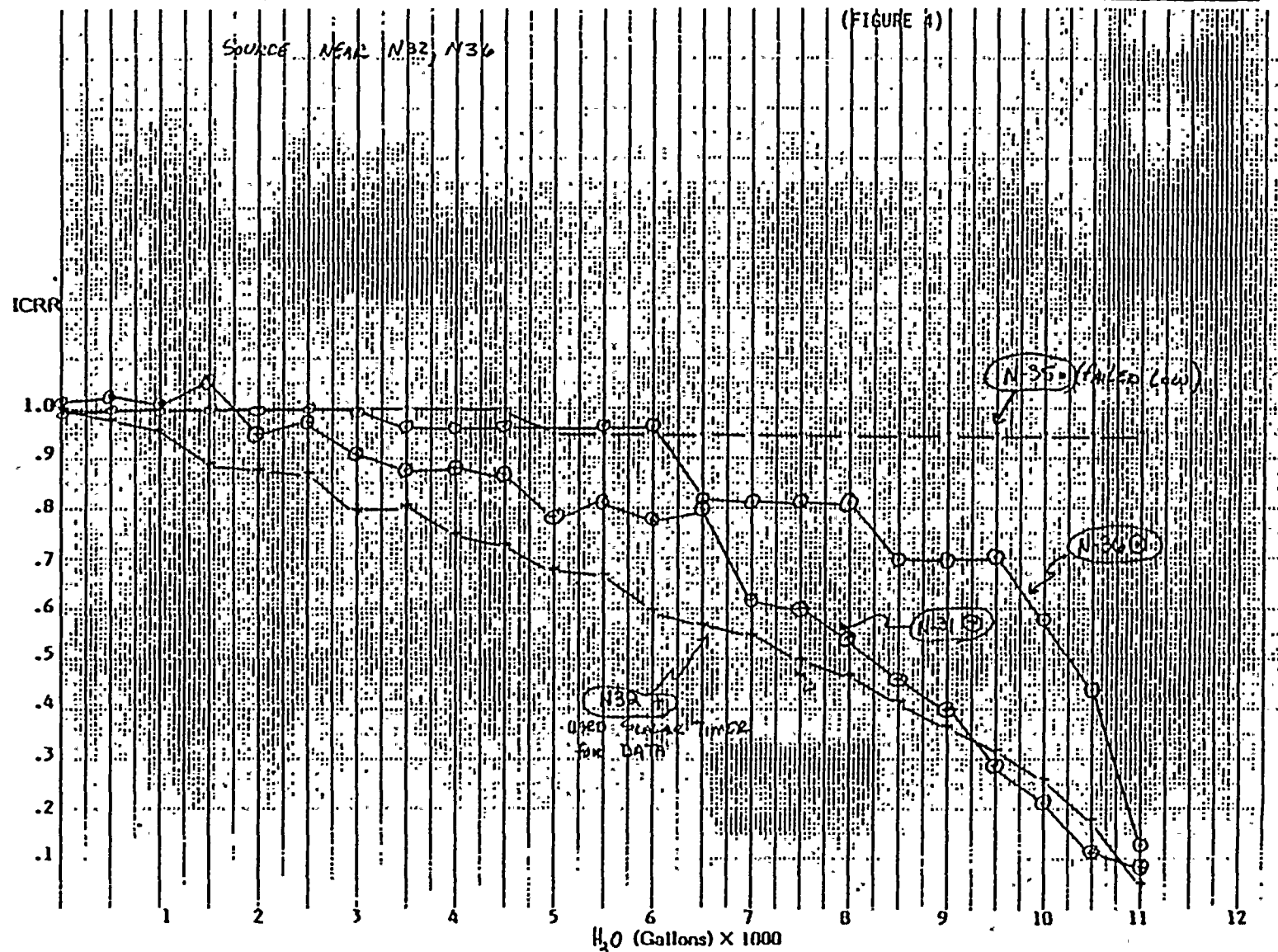
1.5×10^{-8} amps

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

+ → N32 N31 ○
 • → N35 N36 ○

ICRR VS. DILUTION H₂O
 OP 0204.3

Unit 3 Cycle XI
 Date: 9/4/87



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 difference¹ and percent difference². For each test, the acceptance criteria is listed at the bottom of the table.

¹The difference = predicted - measured.

²For calculating the percent difference, the equation is:

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

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)

<u>Picoammeter</u>	<u>N-36</u>
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

<u>Period (sec)</u>	<u>Reactivity (pcm)</u>	<u>Reactivity (design)</u>	<u>Diff (%)</u>
-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 $\pm 10.0\%$.

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)

	<u>Measured</u>	<u>Westinghouse</u>	<u>Comparison</u>
¹ ARO	1711	1744	33 PPM
² CBC In	1536	1592	3.65%

¹Acceptance Criteria is +/- 50 ppm

²Acceptance Criteria is +/- 10%

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)

	<u>Measured</u>	<u>Westinghouse</u>
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)

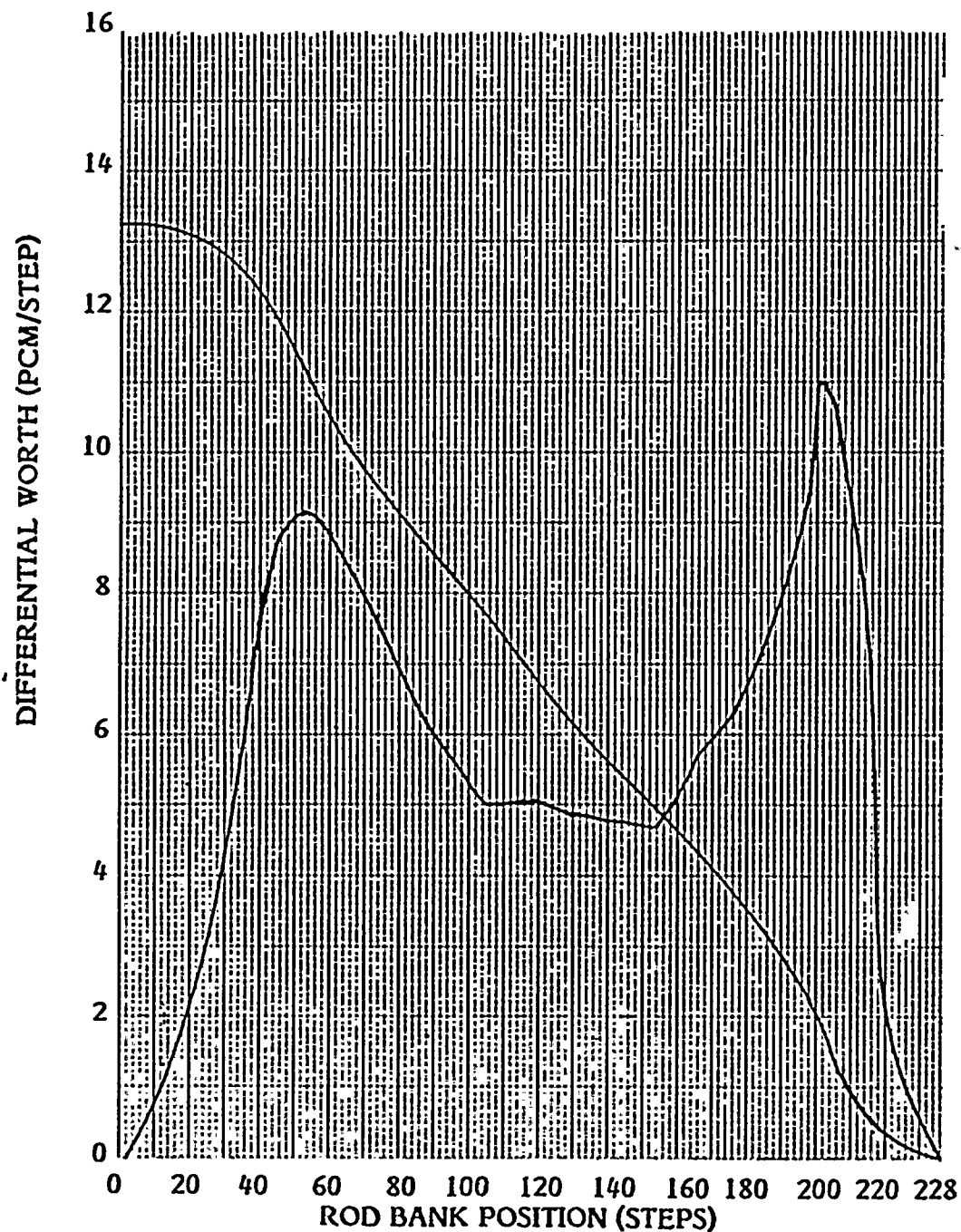
	<u>Measured</u>	<u>Westinghouse</u>	<u>Diff (PCM)</u>	<u>% Diff</u>
CBD	682	718	36	+5.28
CBC ¹	1325	1311	-14	-1.06
CBB	621	579	-42	-6.76
CBA	1089	1107	18	+1.65
SBB	1107	1137	30	+2.71
SBA	1051	1014	-37	-3.52
Total	5875	5866	-9	-.15

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.

FIGURE 5

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



1600

1400

1200

1000

800

600

400

200

0

INTEGRAL WORTH (PCM)

UNIT 3
CYCLE XI
EXPOSURE 0.0 MWD/MTU
BANK CBC

BANK POSITIONS

	OUT	IN	MOVING
SBA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SBB	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CBA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CBB	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CBC	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
CBD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

TEST METHOD

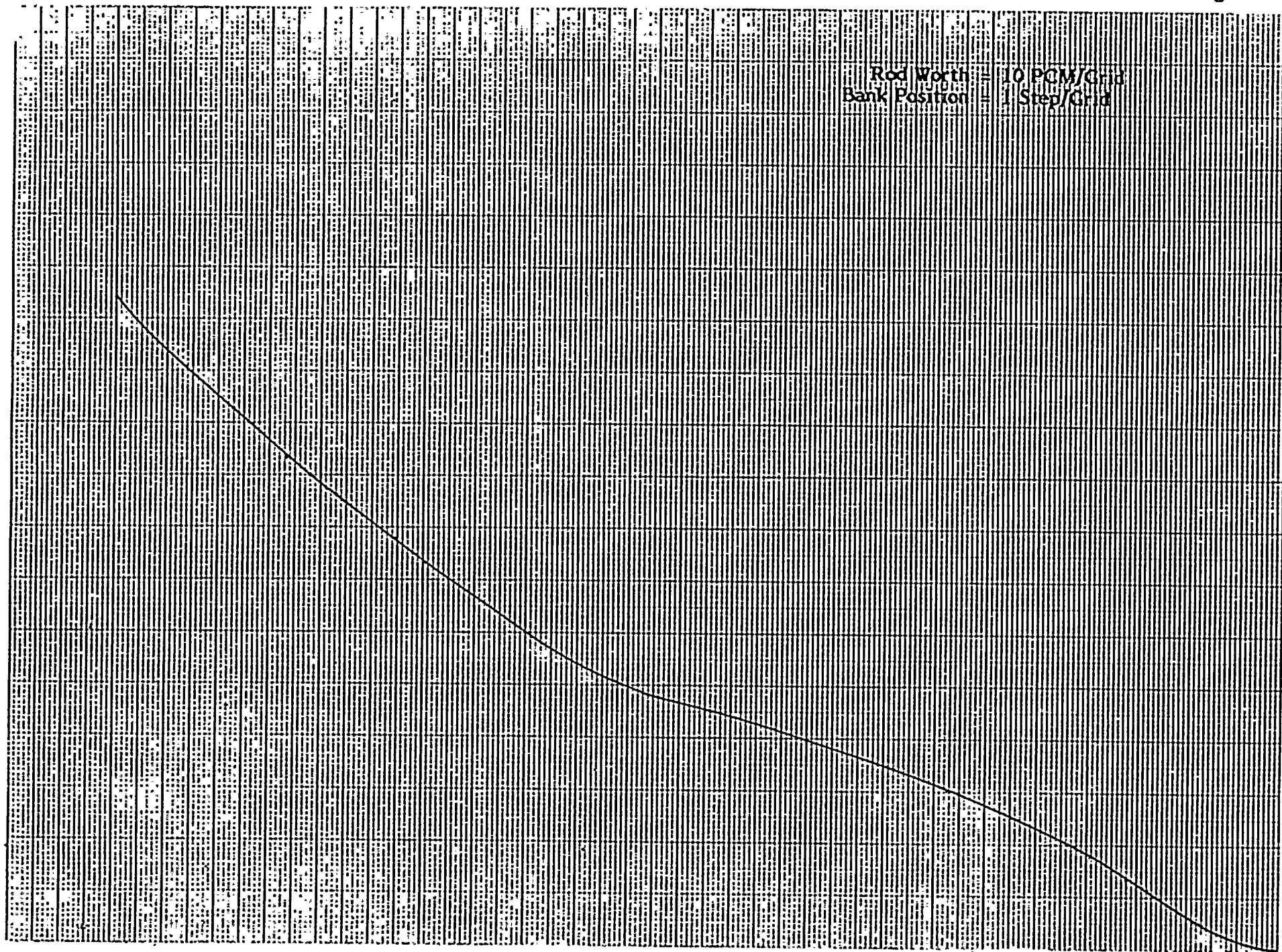
DILUTION	<input checked="" type="checkbox"/>
BORATION	<input type="checkbox"/>

Integral Rod Worth (x 100)

16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

Rod Worth = 10 PCM/Grid
Bank Position = 1 Step/Grid



Control Bank 'D' Position

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 COEFFICIENT (PCM/°F)

<u>Rods</u>	<u>Measured</u> ¹	<u>Design</u> <u>Westinghouse</u>	<u>Diff</u>
D/215	+ .96	+ 1.1	.14

Acceptance Criteria is +/- 2 pcm/°F of design.

TABLE 3.6.2
MODERATOR TEMPERATURE COEFFICIENT (PCM/°F)

<u>Rods</u>	<u>Measured</u> ¹	<u>Design</u> ² <u>Westinghouse</u>	<u>Diff</u>
D/215	+ 2.86	+ 2.76	-.1

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

¹This is the average of one heat up and one cool down measurement.

²This value has been adjusted for boron and temperature sensitivity.

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)

<u>Measured</u>	<u>Westinghouse</u>	<u>% Diff</u>
7.57	8.44	11.49

Acceptance criteria is $\leq \pm 15\%$.

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:

	<u>Cycle XI</u>	
	<u>BOC</u>	<u>EOC</u>
<u>Control Rod Worth (%$\Delta\rho$)</u>		
All Rods Inserted Less Worst Stuck Rod	6.41	6.50
(1) Less 10%	5.77	5.85
<u>Control Rod Requirements (%$\Delta\rho$)</u>		
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) % $\Delta\rho$	2.73	2.46
Required Shutdown Margin (% $\Delta\rho$)	1.00	1.77

Source: WCAP 11454

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

★ R1:1-md

