DUKE POWER COMPANY

McGUIRE NUCLEAR STATION

UNIT 1 CYCLE 8

STARTUP REPORT

Jevision	Date
Original issue	January 24, 1992
Revision 1 (pp. 18, 19, 21, 26, 27)	March 11, 1992

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Core loading for McGuire Unit 1 Cycle 8 was started on November 16, 1991, and was completed November 19. The core for McGuire 1 Cycle 8 consists of 117 Westinghouse optimized fuel assemblies and 76 Babcock & Wilcox Mark-BW fuel assemblies. To control power peaking and maximize cycle length, 64 Burnable Absorber inserts are used. Figure 1 gives the Unit 1 Cycle 8 core loading pattern.

Criticality, Zero Power Physics Testing (ZPPT) and Power Escalation Testing (PET) began December [illegible] 1991. The unit reached 100% power on December 15, 1991.

Figure 1

McGuire Nuclear Station
Unit 1 Cycle 8

Core Loading Pattern

ASM#
INS #

QUADRANT

1	2
4	3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
A					J51 278KT	K12 304KT	J47 284KT	K38 306KT	J10 329KT	K68 265KT	J29 65					A
B			J32 317KT	J26 R35	K76 B6LW	J52 R47	K07 B6MB	H12 R52	K17 B6MA	J69 R34	K73 B6LY	J50 R48	J37 316KT			B
C		J70 234KT	J65 257KT	K28 B6M6	J40 R156	K66 B6MY	H54 R49	J74 291KT	H49 R51	K53 B6MR	J75 R50	K45 B6MD	J67 269KT	J55 245KT		C
D		J05 R58	K41 B6M4	H53 R16	K52 B6MU	H39 293KT	K75 B6N3	J19 R28	K40 B6ND	H37 333KT	K27 B6NL	H15 R06	K61 B6MF	J03 R36		D
E	J43 236KT	K71 B6LU	J46 R59	K54 B6MP	J27 279KT	J20 273KT	H26 268KT	K23 B6N7	H33 321KT	J54 294KT	J08 276KT	K49 B6NR	J49 R41	K42 B6MO	J13 298KT	E
F	K36 310KT	J33 R19	K50 B6MK	H21 295KT	J21 261KT	J63 R44	K65 B6N2	H20 R02	K67 B6NC	J11 R03	J31 243KT	H03 250KT	K05 B6NU	J35 R39	K25 272KT	F
G	J73 326KT	K03 B6M2	H51 R46	K01 B6MN	H16 262KT	K14 B6MX	H43 237KT	K11 B6N6	H55 275KT	K19 B6NG	G19 307KT	K24 B6NP	H27 R25	K21 B6MH	J62 288KT	G
H	K31 327KT	H10 R17	J25 885	J14 R24	K62 B6MT	H62 R22	K63 B6N1	G72 R11	K44 B6NA	H02 R57	K02 B6NK	J09 R10	J06 886	H66 R33	K58 267KT	H
J	J02 256KT	K57 B6M7	H64 R38	K33 B6MM	H44 232KT	K60 B6MW	H42 239KT	K22 B6N5	H71 247KT	K09 B6NF	H75 260KT	K26 B6NN	H68 R26	K34 B6MQ	J15 248KT	J
K	K06 231KT	J41 R14	K48 B6MJ	H34 259KT	J58 325KT	J22 R43	K39 B6NO	H76 R21	K56 B6N9	J44 R32	J57 319KT	H57 336KT	K18 B6NT	J24 R42	K70 282KT	K
L	J61 244KT	K55 B6LT	J30 R15	K30 B6ML	J23 255KT	J72 251KT	H24 274KT	K08 B6N4	H01 335KT	J76 287KT	J64 253KT	K72 B6NM	J45 R23	K43 B6LZ	J71 252KT	L
M		J34 R27	K13 B6M3	H73 R07	K64 B6MR	H07 281KT	K59 B6MZ	J60 R20	K16 B6N8	H67 324KT	K04 B6NJ	H47 R54	K35 B6ME	J48 R40		M
N		J42 297KT	J39 233KT	K46 B6M5	J16 R18	K47 B6MV	H30 R53	J38 336KT	H72 R08	K10 B6NE	J59 R01	K69 B6MC	J56 332KT	J36 254KT		N
P			J07 290KT	J18 R05	K15 B6LV	J28 R55	K32 B6M7	H29 R31	K37 B6M9	J04 R56	K20 B6LX	J01 R04	J17 277KT			P
R					J12 337KT	K51 330KT	J66 311KT	K74 241KT	J53 258KT	K29 314KT	J68 235KT					R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

1.1 Prestartup NIS Realignment Following Refueling - PT/0/A/4600/78

This procedure was performed on November 25, 1991.

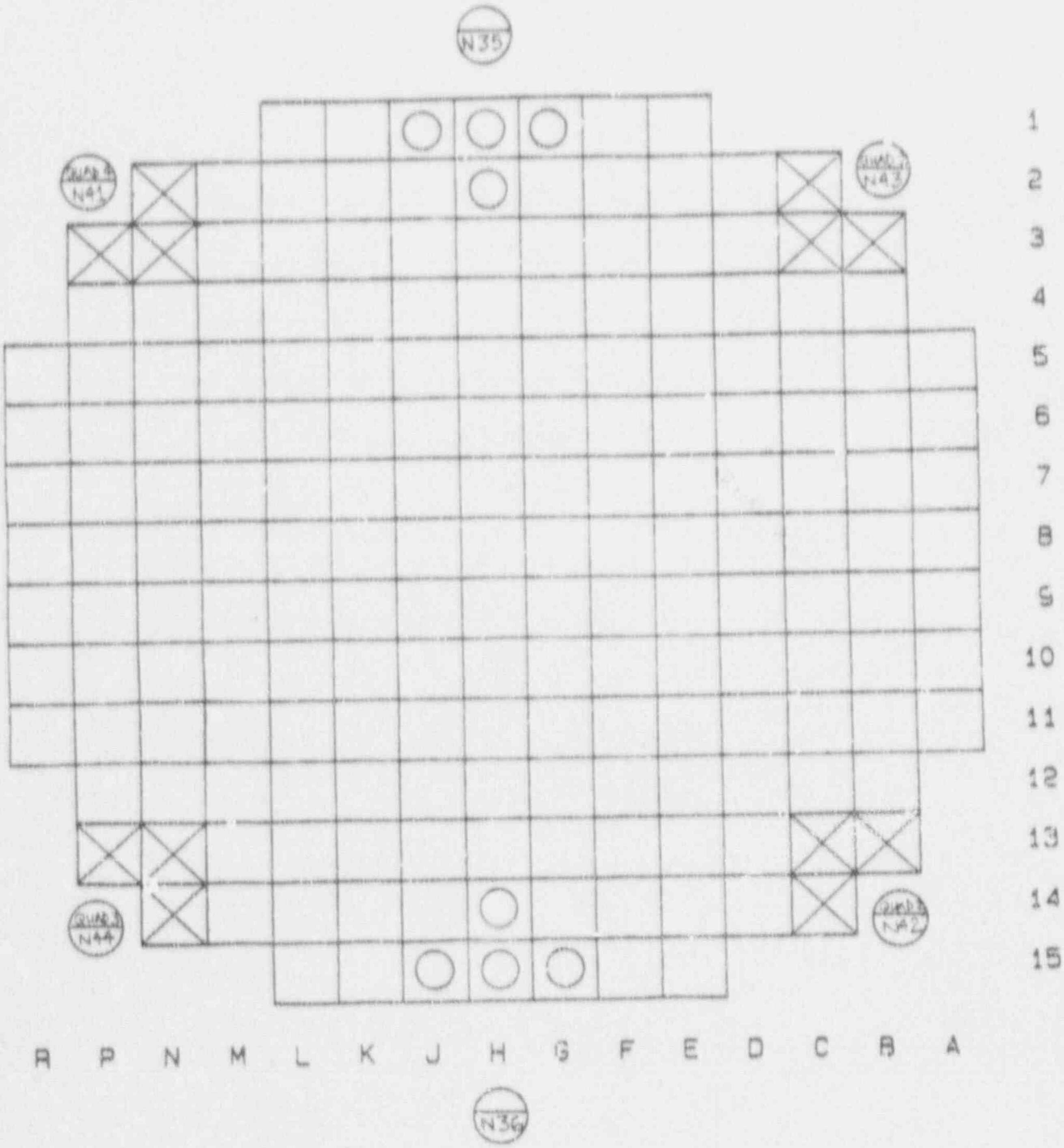
This test was used to calculate preliminary calibration data for the intermediate range (IR) and power range (PR) detectors following refueling.

The set of Cycle 8 preliminary calibration data was determined by taking the End of Cycle 7 (EOC7) calibration data and adjusting it by a weighted average of the ratio of the sum of the predicted assembly powers for the Cycle 8 loading to the sum of the measured assembly powers from the last Cycle 7 Incore/Excore calibration. The core locations used to calculate the ratio of the predicted Beginning of Cycle 8 (BOC8) assembly powers to the measured EOC7 values are shown in Figure 2.

The average predicted BOC8-to-EOC7 IR ratio was ~1.07; the average predicted BOC8-to-EOC7 PR ratio was ~0.81. Based on these results, the IR and PR currents were adjusted prior to Cycle 8 Initial Criticality.

Figure 2

Assemblies to Use for Calculating
IR and PR Calibration Setpoints



Core locations used for
PR calibration

Core locations used for
IR calibration

2.0 **Criticality Following a Change in Core Nuclear Characteristics - PT/0/A/4150/28**

On December 7, 1991, boron samples were taken in preparation for the approach to criticality. These samples indicated reactor coolant boron on be 2116 ppm. Since it was desired to achieve criticality with either:

(a) ~500 pcm of Control Bank D inserted, OR

(b) the lowest allowable boron concentration while maintaining 1.0% Shutdown Margin,

a target value of 1660 ppm was chosen for reactor coolant boron concentration. This represented part (b) of 1560 ppm used plus 100 ppm conservatism. Calculations using the unit Data Book (OP/1/A/6100/22) indicated a volume of 14815 gallons of demineralized water should be added to the system to dilute from 2116 ppm to 1660 ppm. On December 7, 1991, this dilution of the Reactor Coolant System was started. The dilution was secured after 14815 gallons of demineralized water had been added to the system. After adequate system mixing, Chemistry samples indicated Reactor Coolant System boron was 1670 ppm.

On December 8, 1991, rod withdrawal commenced starting the Shutdown Bank A. As rods were withdrawn, both source range detectors were observed and rod motion was stopped each time either flux level doubled or any control rod bank was fully withdrawn. At these points a set of counts was taken on each source range detector and Inverse Count Rate Ratio (ICRR) was plotted to monitor the approach to criticality. The unit achieved criticality at 1533 hours on December 8, 1991, with Control bank D at 205 steps withdrawn. The predicted critical position per OP/0/A/6100/06, Reactivity Balance Calculation was 180 steps withdrawn on Control Bank D. This represented a reactivity difference of 88 pcm based on the predicted HZP, No Xenon Integral Rod Worths.

3.0 Zero Power Physics Testing - (ZPPT)

Zero Power Physics Testing for McGuire 1 Cycle 8 started December 8, 1991, and was completed December 10, 1991. The output of Power Range Detector N42 was used as input to the reactivity computer for Zero Power Physics Testing. All acceptance criteria for ZPPT were met.

A minimum of one decade of overlap between the source range and the intermediate range detectors was verified on December 8, 1991, via the Control Board indication, the NIS panel, and the Operator Aid Computer (OAC). The results shown on table 1 reflect the data from the OAC.

The point of adding nuclear heat was determined December 8, 1991. This was done by establishing a slow positive startup rate and observing a change in plant parameters such as an increase in the reactivity trace and an increase in pressurizer level. The test was performed twice to establish repeatability of the data. Table 2 gives the results of the two trials which were used to determine an average nuclear heat reading.

Nuclear heat was determined to be at an average flux level of 3.920×10^{-7} amps on the reactivity computer picoammeter (N42) and 3.347×10^{-7} amps on Intermediate Range Detector N35 and 3.849×10^{-7} amps on Intermediate Range Detector N36. From these results the test band for ZPPT was determined to be 10^{-8} to 10^{-7} amps on the reactivity computer.

On December 8/9, 1991, an on line checkout of the reactivity computer was performed. This was done by withdrawing Control Bank D until a positive reactivity insertion of ~+25 pcm was indicated on the reactivity computer. The time for the flux level to double was measured and from this doubling time (DT), the reactor period was calculated (period = DT/0.693). Using the reactor period, the amount of reactivity was determined using the predicted data. This reactivity was compared to the reactivity computer indication. The test was repeated for a reactivity insertion of ~+40 pcm. An on-line negative reactivity checkout on the reactivity computer was also performed. This was done by inserting Control Bank D until a negative reactivity change of ~-40 pcm was indicated on the reactivity computer. The time for the flux level to halve was measured and from this halving time (HT), the reactor period was calculated (period = HT/0.693). Using the reactor period, the amount of reactivity was determined using predicted data. This reactivity was compared to the reactivity computer indication. The test as repeated for a reactivity change of ~-25 pcm. The final results met all acceptance criteria and are given in Table 3.

An electronics only negative reactivity insertion test was also completed satisfactorily as part of PT/0/B/4600/55, Reactivity Computer Periodic Test.

TABLE 1

Overlap Data
on December 8, 1991
via the OAC

	Source Range cps		Intermediate Range amps	
	N31	N32	N35	N36
When IR on scale:	528	647	1.42×10^{-11}	1.3×10^{-11}
After 1 decade increase on IR:	7880	15395	1.3×10^{-10}	1.5×10^{-10}
When SR blocked:	7880	15395	1.3×10^{-10}	1.5×10^{-10}

TABLE 2

Nuclear Heat

	Reactivity Computer	Intermediate Range	
	N42	N35	N36
Trial 1	3.880×10^{-7}	3.580×10^{-7}	4.135×10^{-7}
Trial 2	3.976×10^{-7}	3.113×10^{-7}	3.563×10^{-7}
Average	3.928×10^{-7} amps	3.347×10^{-7} amps	3.849×10^{-7} amps

Test Band: 10^{-8} to 10^{-7} amps on N42.

TABLE 3

Results on December 8/9, 1991 — Reactivity Computer Checkout

Initial Flux Level (Amps) Reactivity Computer	Period (Seconds)	Doubling or Halving Time (Seconds)	Reactivity Computer ($\Delta\rho$) (pcm)	Reactivity from DT or HT ($\Delta\rho_c$) (pcm)	* $\Delta\rho$ % Error
3.31×10^{-8}	233.33	161.73	27.91	28.35	1.58
4.02×10^{-8}	176.66	122.45	35.67	36.11	1.21
5.98×10^{-8}	-233.22	-213.29	-27.27	-27.96	2.47
4.00×10^{-8}	-269.15	-186.52	-33.17	-32.68	1.51

6

$* \left|\frac{\Delta\rho - \Delta\rho_c}{\Delta\rho_c}\right| x\ 100$

3.1 **Boron Endpoint Measurement - PT/0/A/4150/10**

This test was performed December 9, 1991. Three sets of data were obtained. In the first set, Control Bank D was initially at 215 steps withdrawn, the Reactor Coolant System boron concentration was 1669 ppm and the Pressurizer boron concentration as 1673 ppm.

Control Bank D was pulled to the All Rods Out (ARO) Configuration and the resulting reactivity change was converted to equivalent boron using the predicted Differential Boron Worth. Control Bank D was then reinserted to the just critical condition and the test was performed two more times.

The results of these reactivity changes were each added to the initial Reactor Coolant System boron concentration to give the ARO Boron Endpoint. The values were averaged to give the final result of 1670 ppm. This value met the acceptance criterion of the Hot Zero Power (HZP) ARO Critical Boron concentration of 1686 ±50 ppm.

3.2 Isothermal Temperature Coefficient Measurement - PT/0/A/4150/12

This test was performed on December 9, 1991. The test measures Isothermal Temperature Coefficient (ITC) by plotting Reactivity versus Average Reactor Coolant System Temperature. The Moderator Temperature Coefficient (MTC) is found using the relationship was follows:

MTC (pcm/°F) = ITC - Doppler Temperature Coefficient

The acceptance criterion on the ARO ITC was 0.62 $\pm$2.0 pcm/°F. The predicted Doppler Temperature Coefficient was -1.45 pcm/°F.

The Reactor Coolant System boron concentration was 1679 ppm at the start of the test. A heatup/cooldown was performed while keeping rod position and boron constant to determine reactivity change versus temperature. The heatup/cooldown was performed a second time to establish repeatability of the data. The results are shown in Figures 3 and 4. The average ARO ITC was found to be -0.29 pcm/°F. This fell within the acceptance criterion band. This gave an ARO MTC of +1.16 pcm/°F which was within acceptable Technical Specification limits.

Following the completion of this test, PT/0/A/4150/31, Determination of Rod Withdrawal Limits to Ensure Moderator Temperature Coefficient Within Limits of Technical Specifications was performed. The results of this test indicated there were no rod withdrawal limits needed for Unit 1 Cycle 8.

Figure 3

ITC Heatup and Cooldown Data: First Run

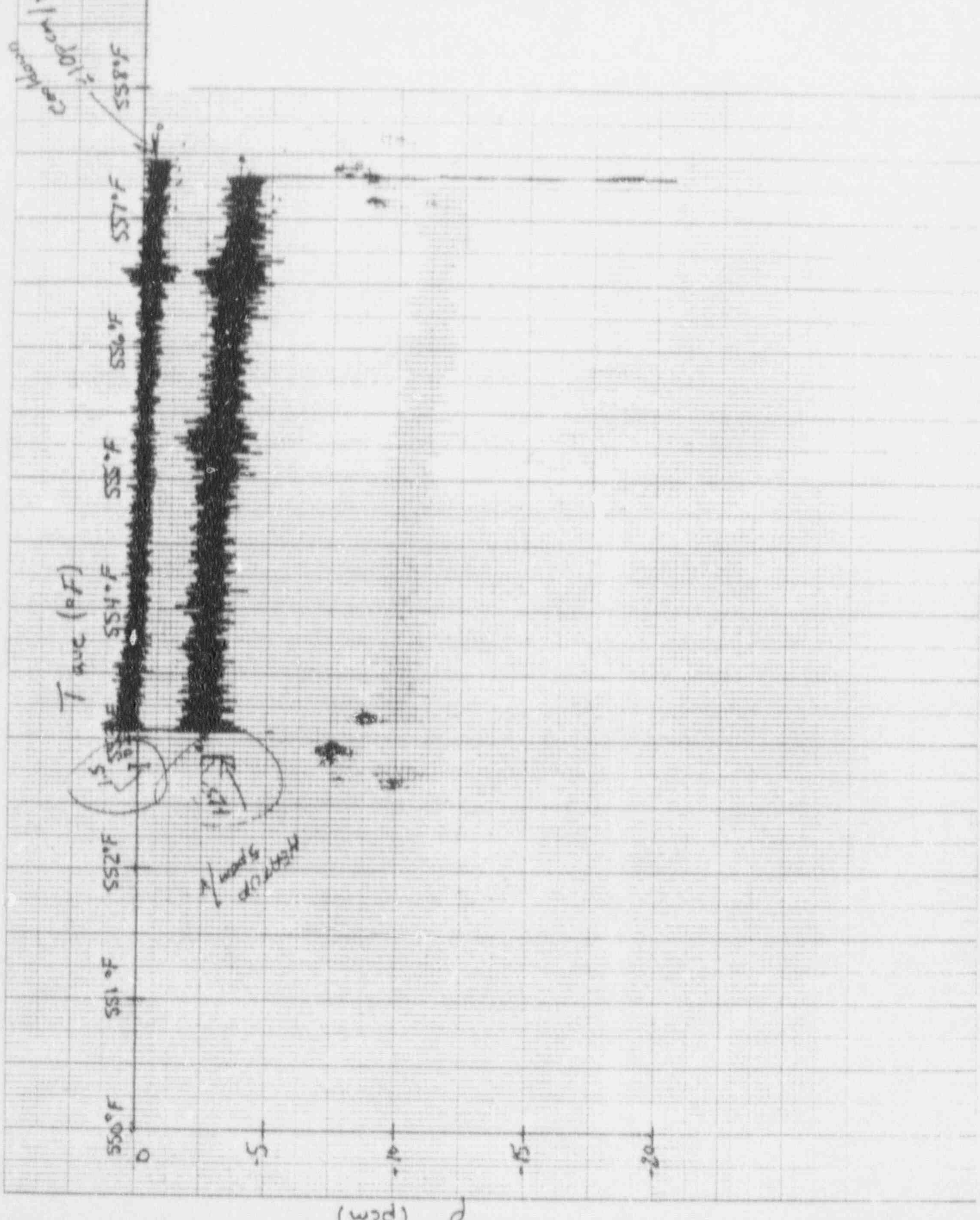
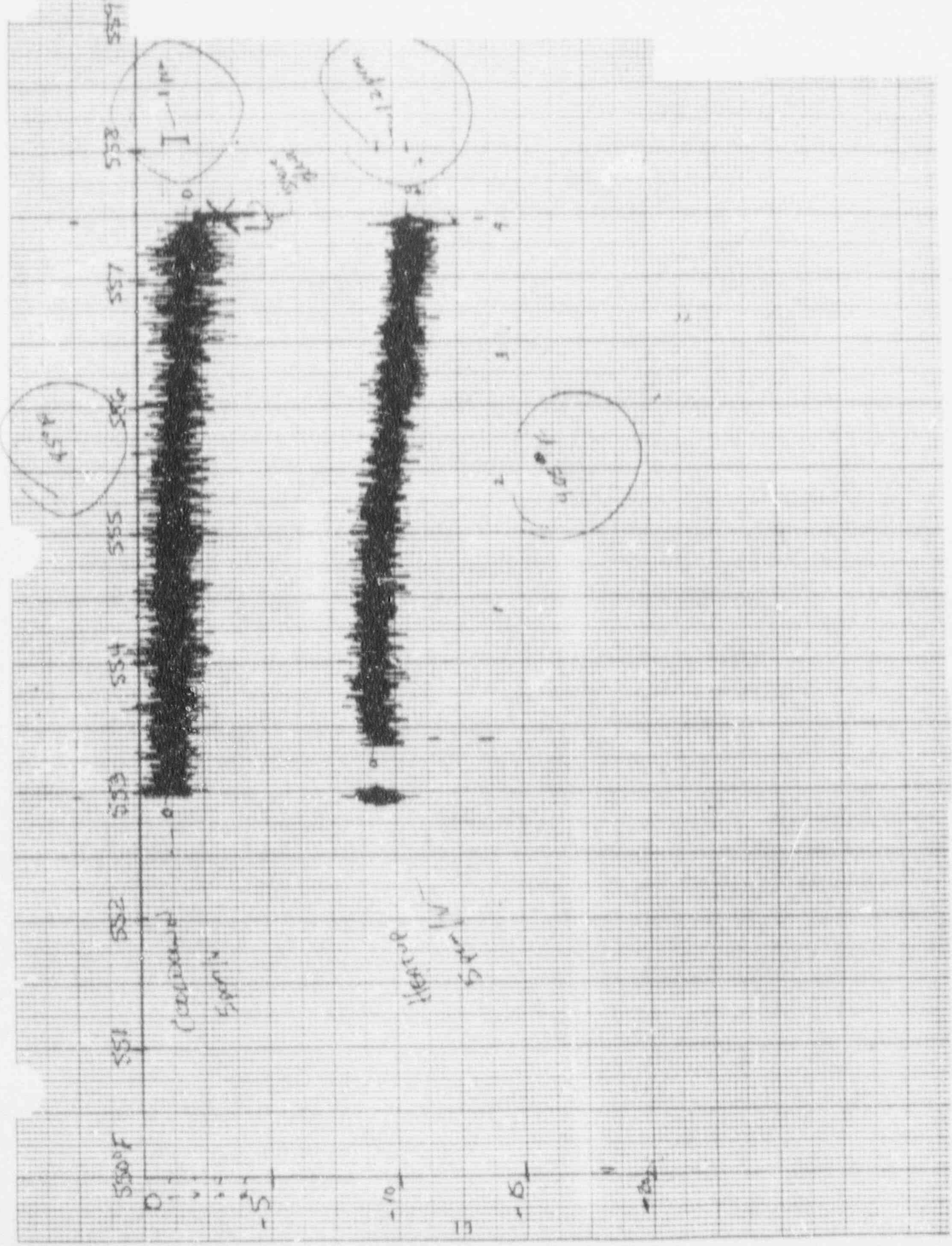


Figure 4

ITC Heatup and Cooldown Data: Second Run

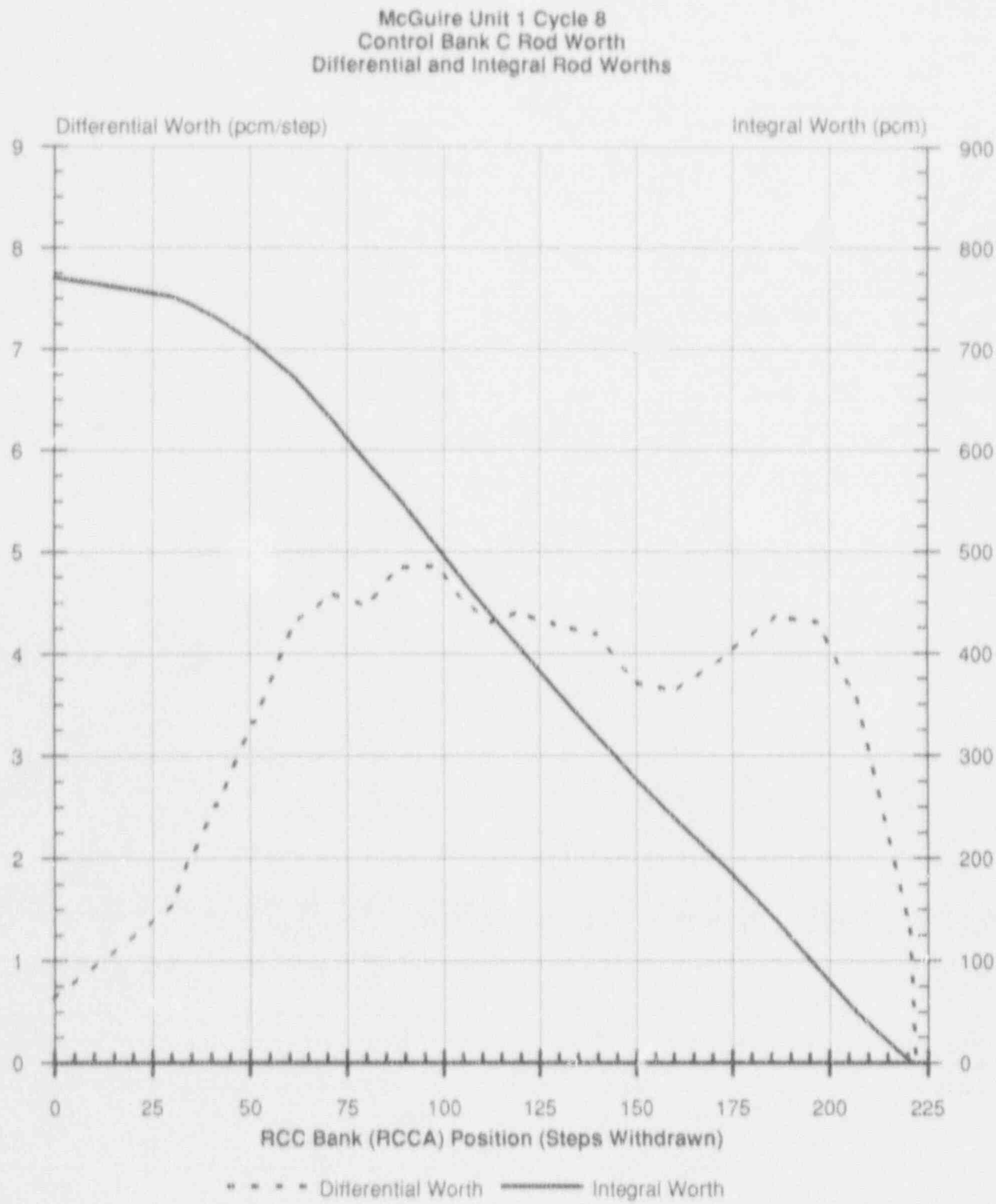


3.3 Control Rod Worth Measurement - PT/0/A/4150/11

On December 9/10, 1991, Control Bank C rod worth was measured using the established boration/dilution method. There were no other rods in the core at the time. Control Bank C was predicted to be the highest worth bank and was measured using this method so as to serve as the reference bank for Control Rod Worth Measurements by Rod Swap.

The measured worth of Control Bank C was 771 pcm. The predicted worth was 824 pcm with an allowable band of ±124 pcm. This represented an error of 6.9% and was within the acceptance criterion of ±15%. Figure 5 shows the measured integral and differential rod worths for Control Bank C.

Figure 5


McGuire Unit 1 Cycle 8
Control Bank C Rod Worth
Differential and Integral Rod Worths
Differential Worth (pcm/step)
Integral Worth (pcm)
9
8
7
6
5
4
3
2
1
0
900
800
700
600
500
400
300
200
100
0
0
25
50
75
100
125
150
175
200
225
RCC Bank (RCCA) Position (Steps Withdrawn)
Differential Worth
Integral Worth

3.4 Control ▸ Worth Measurement: Rod Swap - PT/0/A/4150/11A

On December 9, 1991, the rod swap method of control rod worth measurement was begun. Control Bank C was used as the reference bank and its worth was measured by the boration/dilution method (see Section 3.3).

With the reference bank essentially all the way in and the reactor just critical, each control and shutdown bank was measured via rod exchange. The integral worth of the bank being measured (i.e., the test bank) was determined from the difference in the critical rod position of the reference bank with and without the test bank in the core.

The measured bank worths were compared with predicted worths and all banks were within the acceptance criteria of ±30% or ±200 pcm whichever was greater. The measured total rod worth was >90% of the predicted worth which met the acceptance criteria. In addition, all review criteria were met.

The results of the rod exchange test are given on Table 4.

TABLE 4

Control Rod Worth Measurement: Rod Swap

Bank Identification	Predicted Worth pcm	Measured Worth pcm ++	Percent + Difference
Control Bank C (predicted reference bank)	824	771 *	6.9
Control Bank A	311	343	9.3
Control Bank B	675	615	9.8
Control Bank D	490	469	4.5
Shutdown Bank A	265	268	1.1
Shutdown Bank B	804	793	1.4
Shutdown Bank C	408	392	4.1
Shutdown Bank D	408	392	4.1
Shutdown Bank E	459	476	3.6
Total Rod Worth	**4644**	**4519**	**2.8**

* Measured by boration / dilution method

$$+ \left| \frac{Predicted}{Measured} - 1 \right| \times 100$$

++ Rounded to nearest pcm

4.0 Power Escalation Testing

McGuire Unit 1 Cycle 8 Power Escalation testing started December 10, 1991, at the conclusion of ZPPT and was completed December 31, 1991.

The unit went on line December 10 at 1706 hours. The unit experienced some holds during power escalation which were scheduled to allow testing per PT/0/A/4150/21, Post Refueling Controlling Procedure for Criticality, Zero Power Physics, and Power Escalation Testing, and to allow Chemistry testing.

At ~38% power on December 12, 1991, TT/1/A/9200/289, M1C8 Core Power Distribution, was performed. On March 3, 1992, PT/0/A/4150/02A, Core Power Distribution and Incore /NIS Correlation Check, was performed again due to LER 369/92-02. Table 5 shows the full core flux map results based on PT/0/A/4150/02A. The results from the full core flux map taken were used to project a "limiting" power at which F_Q or $F_{\Delta H}$ Tech Spec peaking factor margin would be maintained. This projection indicated that the F_Q Tech Spec peaking factor margin would be maintained to 94.5% power. TT/1/A/9200/293, M1C8 Incore and Nuclear Instrumentation Systems Interim Recalibration, was also performed at ~38% power. The results of this test were used as calibration data for the Power Range excore detectors. Table 6 shows the test results.

At ~78% power on December 14, 1991, TT/1/A/9200/289, M1C8 Core Power Distribution, was performed. On March 3, 1992, PT/0A/4150/02A, Core Power Distribution and Incore/NIS Correlation Check, was performed again due to LER 369/92-02. The test results are given in Table 7. All test acceptance criteria were met. The results from the full core flux map taken were used to project a "limiting" power at which F_Q or $F_{\Delta H}$ Tech Spec peaking factor margin would be maintained. This projection indicated that both the $F_{\Delta H}$ Tech Spec peaking factor margin and the F_Q Tech Spec peaking factor margin would be maintained for power levels up to 100% power.

TT/1/A/9200/282, M1C8 Incore and Nuclear Instrumentation System Correlation Check, was also performed at ~78% power. The results of this test indicated that the maximum absolute difference between the axial flux difference (AFD) from any Power Range excore detector channel and the indicated incore AFD from the full core flux map was <2%. Based on the guidance given in PT/0/A/4150/21, no further calibration of the excore detectors was needed until achieving 100% equilibrium conditions.

Power escalation then resumed at a rate of ~2.5%/hr. Upon achieving ~90%, PT/0/A/4150/03, Thermal Power Output Measurement, was performed (see Section 4.1). The remaining tests designated for Hot full Power Equilibrium Conditions were performed on December 18-19, 1991. The tests and their results are described in Sections 4.2 - 4.5.

TABLE 5

M1C8 Core Power Distribution Results
38% Full Power

NOTE: Axial location 1 is the bottom of the core.
Axial location 61 is the top of the core.

Unit 1 Cycle 8	Map FCM/1/08/001
Date/Time Map Taken	12/12/92 0713 hours
Power Level	38.6%
Cycle Burnup	0.2 EFPD 8.1 MWD/MTU
Boron Concentration	1639 ppm
Control Rod Position	Control Bank D at 202 steps withdrawn
Maximum F^Q SUB Q	1.7462 at Axial Loc. 43, Horiz. Loc. E-04
Maximum pin F^N SUB ΔH	1.4305 at Horiz. Loc. E-05
Maximum error F^N SUB ΔH (from predicted)	5.42% at Horiz. Loc. B-13
Minimum F-SUB-Q-OP Margin -34.2109%*	Location D-04
Minimum F-SUB-Q-RPS Margin -46.7950%*	Location D-04
Minimum F-DELTA-H Margin 32.6343%	Location D-03
Total Incore Axial Offset	7.747%

Incore Tilts:

Upper Core		Lower Core	
Quadrant 1:	1.151%	Quadrant 1:	0.573%
Quadrant 2:	-0.271%	Quadrant 2:	1.124%
Quadrant 3:	0.562%	Quadrant 3:	-0.203%
Quadrant 4:	-1.442%	Quadrant 4:	-1.494%

* Not required surveillance for maps during power escalation.

Table 6

M1C8 Incore and NIS Interim Recalibration Results

Excore Currents and Voltages
Correlated to 100% Full Power
at Various Axial Offsets

Unit 1 Cycle 8

FULL POWER DETECTOR CURRENTS (MICROAMPS) CORRESPONDING TO VARIOUS INCORE AXIAL OFFSETS

INCORE AXIAL OFFSET	DETECTOR N-41 T	DETECTOR N-41 B	DETECTOR N-42 T	DETECTOR N-42 B	DETECTOR N-43 T	DETECTOR N-43 B	DETECTOR N-44 T	DETECTOR N-44 B
30.0	231.8	165.4	252.0	178.5	246.0	180.5	240.5	178.4
20.0	217.8	179.5	236.6	193.9	231.5	197.2	226.1	194.7
10.0	203.8	193.7	221.2	209.4	217.1	213.9	211.8	210.9
0.0	189.7	207.8	205.8	224.8	202.6	230.5	197.4	227.2
-10.0	175.7	222.0	190.5	240.3	188.2	247.2	183.1	243.5
-20.0	161.7	236.1	175.1	255.7	173.7	263.9	168.7	259.7
-30.0	147.7	250.3	159.7	271.2	159.3	280.6	154.4	276.0
r^2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

NORMALIZED DETECTOR VOLTAGES (VOLTS) AT VARIOUS AXIAL OFFSETS

INCORE AXIAL OFFSET	DETECTOR N-41 T	DETECTOR N-41 B	DETECTOR N-41 T-B	DETECTOR N-42 T	DETECTOR N-42 B	DETECTOR N-42 T-B	DETECTOR N-43 T	DETECTOR N-43 B	DETECTOR N-43 T-B	DETECTOR N-44 T	DETECTOR N-44 B	DETECTOR N-44 T-B
30.0	10.176	6.629	3.547	10.198	6.613	3.585	10.112	6.522	3.590	10.146	6.541	3.605
20.0	9.561	7.196	2.365	9.575	7.185	2.390	9.518	7.124	2.394	9.541	7.137	2.404
10.0	8.945	7.763	1.182	8.953	7.758	1.195	8.924	7.727	1.197	8.935	7.734	1.202
0.0	8.330	8.330	0.000	8.330	8.330	0.000	8.330	8.330	0.000	8.330	8.330	0.000
-10.0	7.715	8.897	-1.182	7.707	8.902	-1.195	7.736	8.933	-1.197	7.725	8.926	-1.202
-20.0	7.099	9.464	-2.365	7.085	9.475	-2.390	7.142	9.536	-2.394	7.119	9.523	-2.404
-30.0	6.484	10.031	-3.547	6.462	10.047	-3.585	6.548	10.138	-3.590	6.514	10.119	-3.605

AFD INCORE/EXCORE RATIOS FOR QUADRANTS 1 - 4

QUAD 4 N-41	QUAD 2 N-42	QUAD 1 N-43	QUAD 3 N-44
M = 1.409	M = 1.394	M = 1.392	M = 1.386

TABLE 7

M1C8 Core Power Distribution Results
78% Full Power

NOTE: Axial location 1 is the bottom of the core.
Axial location 61 is the top of the core.

Unit 1 Cycle 8	Map FCM/1/08/002
Date/Time Map Taken	12/13/91 2209 hours
Power Level	78%
Cycle Burnup	1.27 EFPD 51 MWD/MTU
Boron Concentration	1439 ppm
Control Rod Position	Control Bank D at 203 steps withdrawn
Maximum F^T SUB Q	1.6181 at Axial Loc. 32, Horiz. Loc. D-09
Maximum pin F^N SUB ΔH	1.4153 at Horiz. Loc. G-12
Maximum error F^N SUB ΔH (from predicted)	5.05% at Horiz. Loc. R-08
Minimum F-SUB-Q-OP Margin -1.7720%*	Location D-04
Minimum F-SUB-Q-RPS Margin 1.0576%*	Location D-04
Minimum F-DELTA-H Margin 16.6212%	Location G-12
Total Incore Axial Offset	0.127%

Incore Tilts:

Upper Core	Lower Core
Quadrant 1: 1.011%	Quadrant 1: -0.239%
Quadrant 2: 0.105%	Quadrant 2: 1.168%
Quadrant 3: 0.520%	Quadrant 3: -0.049%
Quadrant 4: -1.646%	Quadrant 4: -0.881%

* Not required surveillance for maps during power escalation.

4.1 **Thermal Power Output Measurement - PT/0/A/4150/03**

This test was used to verify that the primary and secondary heat balances on the plant computer were consistent with primary and secondary heat balances on a benchmarked offline computer. The test was run on December 14, 1991, at ~90% F.P. The results are shown in Table 7.

The acceptance criterion of 1% difference between the offline computer and the plant computer was met.

TABLE 8

Thermal Power Output Measurement Results

	Plant Computer		Off-Line Computer	
	%	MW_t	%	MW_t
Primary Heat Balance	88.69	3025.23	89.14	3040.57
Secondary Heat Balance	89.86	3065.30	89.87	3065.47

4.2 Reactivity Anomalies Calculation - PT/0/A/4150/04

This test compared the actual core reactivity to the predicted core reactivity by taking into account the actual Reactor Coolant System boron concentration, Xenon and Samarium worths, rod positions and power level and adjusting these to the ARO, Hot Full Power (HFP), equilibrium Xenon and Samarium conditions. Theoretical and actual Reactor Coolant System boron concentration for these conditions were then compared.

The test, performed at ~100% on December 18, 1991, indicated that the actual ARO, HFP, equilibrium Xenon and Samarium condition boron concentration was 1168.8 ppm. This compares to a predicted value of 1171 ppm. The 2.2 ppm difference translated into a 17.3 pcm error between actual and predicted reactivity worths. This was within the acceptance criterion for the test of ±1000 pcm.

4.3 **M1C8 Incore and Nuclear Instrumentation System Correlation Check - TT/1/A/9200/292**

This test was used to compare the incore axial flux difference as indicated by a full core flux map to the axial flux difference indicated on the plant computer by the excore detectors.

The test was performed at ~100% on December 18, 1991. The indicated incore axial flux difference (AFD) from flux map FCM/1/08/004 was -1.695%. The results of this test indicated that the maximum absolute difference between the AFD from any Power Range excore detector channel and the indicatd incore AFD from the full core flux map was <3%

4.4 M1C8 Core Power Distribution - TT/1/A/9200/289

On December 18, 1991, TT/1/A/9200/289, M1C8 Core Power Distribution, was performed to verify the Core Power Distribution Technical Specification Limits for operation would not be violated. The reactor was at ~100% Full Power and equilibrium conditions.

On February 24, 1992, PT/0/A/4150/02A, Core Power Distribution and and Incore/NIS Correlation Check, was performed for FCM/1/08/004 with the revised SNA-CORE computer code as described in LER 369/92-02. The results of this test indicated that the minimum F_Q - operational margin was -0.8576%. This negative value indicates that the AFD limits given in the M1C8 Core Operating Limits Report should be reduced by 0.8576%. However, the AFD limits were not reduced resulting in LER 369/92-02. Table 9 gives the test results based on the February 24, 1992 run.

TABLE 9

M1C8 Core Power Distribution Results
-100% Full Power

NOTE: Axial location 1 is the bottom of the core.
Axial location 61 is the top of the core.

Unit 1 Cycle 8	Map FCM/1/08/004
Date/Time Map Taken	2/18/91 1031 hours
Power Level	-100%
Cycle Burnup	5.4 EFPD 219 MWD/MTU
Boron Concentration	1168 ppm
Control Rod Position	Control Bank D at 217/218 steps withdrawn
Maximum F^T SUB Q	1.602 at Axial Loc. 31, Horiz. Loc. D-09
Maximum pin F^N SUB ΔH	1.401 at Horiz. Loc. D-09
Maximum error F^N SUB ΔH (from predicted)	5.72% at Horiz. Loc. R-08
Minimum F-SUB-Q-OP Margin -0.8576%	Location H-13
Minimum F-SUB-Q-RPS Margin 15.1529%	Location D-03
Minimum F-DELTA-H Margin 3.2429%	Location D-09
Total Incore Axial Offset	-1.695%

Incore Tilts:

Upper Core		Lower Core	
Quadrant 1:	0.480%	Quadrant 1:	0.422%
Quadrant 2:	0.756%	Quadrant 2:	1.238%
Quadrant 3:	0.225%	Quadrant 3:	-0.381
Quadrant 4:	-1.461%	Quadrant 4:	-1.280%

4.5 M1C8 Incore and Nuclear Instrumentation Systems Recalibration - TT/1/A/9200/2[illegible]0

This test was performed on December 18-19, 1991, to obtain recalibration data for the excore detectors based on the incore axial offsets. The NIS amplifier gains, the f(ΔI) reset function for the over-power differential temperature protective setpoints, and the OAC excore power distribution monitor were all calibrated on December 21, 1991. The results of the test are given in Table 10.

Table 10

M1C8 Incore and NIS Recalibration Results
100% Full Power

Correlated to 100% Full Power
at Various Axial Offsets

Unit 1 Cycle 8

FULL POWER DETECTOR CURRENTS (MICROAMPS) CORRESPONDING TO VARIOUS INCORE AXIAL OFFSETS

INCORE AXIAL OFFSET	DETECTOR N-41		DETECTOR N-42		DETECTOR N-43		DETECTOR N-44	
	T	B	T	B	T	B	T	B
30.0	246.9	169.4	271.4	185.9	263.6	187.3	260.4	164.6
20.0	233.7	186.0	257.0	203.6	249.9	206.1	245.8	203.1
10.0	220.5	202.6	242.3	221.3	236.2	224.6	231.2	221.7
0.0	207.2	219.2	228.1	239.1	222.5	243.6	216.7	240.3
-10.0	194.0	235.8	213.6	256.8	208.8	262.3	202.1	258.8
-20.0	180.8	252.4	199.1	274.5	195.1	281.1	187.5	277.4
-30.0	167.5	269.0	184.7	292.3	181.4	299.8	173.0	295.9
r^2	0.9981	0.9873	0.9967	0.9857	0.9960	0.9865	0.9989	0.9875

NORMALIZED DETECTOR VOLTAGES (VOLTS) AT VARIOUS AXIAL OFFSETS

INCORE AXIAL OFFSET	DETECTOR N-41			DETECTOR N-42			DETECTOR N-43			DETECTOR N-44		
	T	B	T-B	T	B	T-B	T	B	T-B	T	B	T-B
30.0	9.925	6.438	3.487	9.914	6.477	3.438	9.868	6.407	3.462	10.011	6.399	3.611
20.0	9.394	7.069	2.325	9.386	7.094	2.292	9.305	7.048	2.300	9.450	7.043	2.408
10.0	8.862	7.699	1.162	8.858	7.712	1.146	8.843	7.689	1.154	8.890	7.686	1.204
0.0	8.330	8.330	0.000	8.330	8.330	0.000	8.330	8.330	0.000	8.330	8.330	0.000
-10.0	7.798	8.961	-1.162	7.802	8.948	-1.146	7.817	8.971	-1.154	7.770	8.974	-1.204
-20.0	7.266	9.591	-2.325	7.274	9.566	-2.292	7.305	9.612	-2.308	7.210	9.617	-2.408
-30.0	6.735	10.222	-3.487	6.746	10.183	-3.438	6.792	10.253	-3.462	6.649	10.261	-3.611

AFD INCORE/EXCORE RATIOS FOR QUADRANTS 1 - 4

QUAD 4	QUAD 2	QUAD 1	QUAD 3
N-41	N-42	N-43	N-44
M = 1.433	M = 1.454	M = 1.444	M = 1.384