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Kewaunee Nuclear Power Plant
Cycle 13 Startup Report

In accordance with WPSC's practice of reporting the results of physics tests, enclosed is a copy of the Kewaunee Nuclear Power Plant Cycle 13 Startup Report.

Sincerely,

D. C. Hintz
Vice President - Nuclear Power

KAH/jms

Enc.

cc - Mr. Robert Nelson, US NRC - w/attach.
US NRC, Region III - w/attach.

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KEWAUNEE NUCLEAR POWER PLANT

CYCLE 13
STARTUP REPORT
MAY, 1987

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KEWAUNEE NUCLEAR POWER PLANT

STARTUP REPORT

CYCLE 13

MAY 1987

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TABLE OF CONTENTS

1.0 Introduction, Summary and Conclusion. 1
  1.1 Introduction 1
  1.2 Summary. 2
  1.3 Conclusion 3

2.0 RCCA Measurements 6
  2.1 RCCA Drop Time Measurements. 6
  2.2 RCCA Bank Measurements .6
    2.2.1 Rod Swap Results. 6
  2.3 Shutdown Margin Evaluation 7

3.0 Boron Endpoints and Boron Worth Measurements. 13
  3.1 Boron Endpoints. 13
  3.2 Differential Boron Worth 13
  3.3 Boron Letdown. 14

4.0 Isothermal Temperature Coefficient. 18

5.0 Power Distribution. 20
  5.1 Summary of Power Distribution Criteria 20
  5.2 Power Distribution Measurements. 21

6.0 Reactor Startup Calibrations. 33
  6.1 Rod Position Calibration 33
  6.2 Nuclear Instrumentation Calibration. 34

7.0 References. 35

LIST OF TABLES

Table 1.1 Chronology of Tests 4
Table 2.1 RCCA Drop Time Measurements 8
Table 2.2 RCCA Bank Worth Summary 9
Table 2.3 Shutdown Margin Analysis. .12
Table 3.1 RCCA Bank Endpoint Measurements 15
Table 3.2 Differential Boron Worth. .16
Table 4.1 Isothermal Temperature Coefficient. 19
Table 5.1 Flux Map Chronology and Reactor Characteristics 22
Table 5.2 Verification of Acceptance Criteria 23
Table 5.3 Verification of Review Criteria 24

LIST OF FIGURES

Figure 1.1 Core Loading Map. 5
Figure 2.1 RCCA Bank C Integral Worth. .10
Figure 2.2 RCCA Bank C Differential Worth. 11
Figure 3.1 Boron Concentration vs. Burnup. 17
Figure 5.1 Power Distribution for Flux Map 1301. 25
Figure 5.2 Power Distribution for Flux Map 1302. 26
Figure 5.3 Power Distribution for Flux Map 1303. 27
Figure 5.4 Power Distribution for Flux Map 1304. 28
Figure 5.5 Power Distribution for Flux Map 1305. 29
Figure 5.6 Power Distribution for Flux Map 1306. 30
Figure 5.7 Power Distribution for Flux Map 1307. 31
Figure 5.8 Power Distribution for Flux Map 1308. 32

1.0 INTRODUCTION, SUMMARY AND CONCLUSION

1.1 Introduction

This report presents the results of the physics tests performed during startup of Kewaunee Cycle 13. The core design and reload safety evaluation were performed by Wisconsin Public Service Corporation (1) using methods previously described in WPS topical reports (2,3). The results of the physics tests were compared to WPS analytical results to confirm calculated safety margins. The tests performed and reported herein satisfy the requirements of the Reactor Test Program (4).

During Cycle 12-13 refueling, 40 of the 121 fuel assemblies in the core were replaced with fresh assemblies of Advanced Nuclear Fuels Design(5), enriched to 3.4 w/o U235. The Cycle 13 core consists of the following regions of fuel:

Region	Vendor	Initial U235 W/O	Number of Previous Duty Cycles	Number of Assemblies
10	ENC	3.2	3	1
10	ENC	3.2	2	8
12	ENC	3.2	2	8
13	ENC	3.4	2	32
14	ENC	3.4	1	32
15	ENC	3.4	0	40(Feed)

The core loading pattern, assembly identification, RCCA bank identification, instrument thimble I.D., thermo-couple I.D., and burnable poison rod configurations for Cycle 13 are presented in Figure 1.1.

On April 1, 1987 at 0220 hours, initial criticality was achieved on the Cycle 13 core. The schedule of physics tests and measurements is outlined in Table 1.1.

1.2 Summary

RCCA measurements are shown in Section 2. All RCCA drop time measurements were within Technical Specification limits. RCCA bank worths were measured using the rod swap reactivity comparison technique previously described (4,6). The reactivity comparison was made to the reference bank, Bank C, which was measured using the boration/dilution technique. All results were within the established acceptance criteria (4), and thereby demonstrated adequate shutdown margin.

Section 3 presents the boron endpoint and boron worth measurements. The endpoint measurements for ARO and "Bank C In" core configurations were within the acceptance criteria (4). The available boron letdown data covering the first month of reactor operation is also shown. The agreement between measurements and predictions meets the review and acceptance criteria (4).

Section 4 shows the results of the isothermal temperature coefficient measurements. The differences between measurements and predictions were within the acceptance criteria (4).

Power distributions were measured via flux maps using the INCORE code for beginning of cycle (BOC) core conditions covering power escalation to 100 percent full power equilibrium xenon. The results indicate compliance with Technical Specification limits (7) and are presented in Section 5. Section 6 discusses the various calibrations performed during the startup of Cycle 13.

1.3 Conclusion

The startup testing of Kewaunee's Cycle 13 core verified that the reactor core has been properly loaded and the core characteristics satisfy the Technical Specifications (7) and are consistent with the parameters used in the design and safety analysis (1).

TABLE 1.1

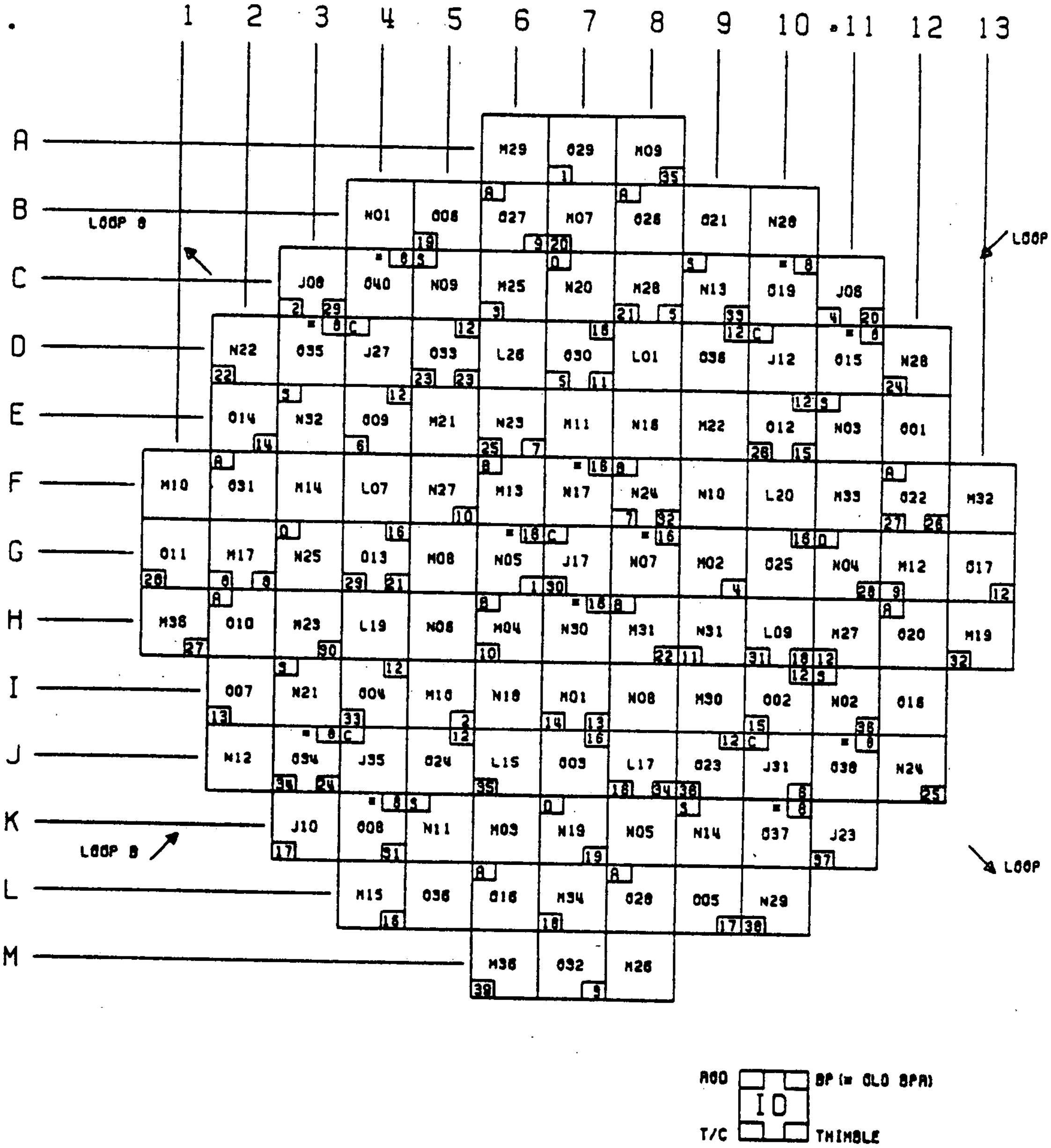
Kewaunee Nuclear Power Plant

BOL Cycle 13 Physics Test

Test	Date Completed	Time Completed	Plant Conditions
Control Rod Operability Test	3/29/87	1540	Cold SD
Hot Rod Drops	3/30/87	1130	HSD
RPI Calibrations	3/31/87	1625	HSD
Initial Criticality	4/01/87	0220	HZP
Reactivity Computer Checkout	4/01/87	0335	HZP
ARO Endpoint	4/01/87	0427	HZP
Bank C Worth (Dilution)	4/01/87	0551	HZP
Bank C In-ORO Endpoint	4/01/87	0646	HZP
ITC Determination	4/01/87	1638	HZP
Power Ascension Flux Map 1301	4/04/87	0914	28%
Power Ascension Flux Map 1302	4/05/86	1349	43%
Power Ascension Flux Map 1303	4/07/86	0938	69%
Power Ascension Flux Map 1304	4/09/86	0704	90%
Power Ascension Flux Map 1305	4/10/86	1429	98%
Power Ascension Flux Map 1306	4/13/86	0842	98%
Power Ascension Flux Map 1307	4/22/86	0854	97%
Power Ascension Flux Map 1308	4/27/86	0936	100%

FIGURE 1.1

Kewaunee Cycle 13
Core Loading Map



CYCLE THIRTEEN

2.0 RCCA MEASUREMENTS

2.1 RCCA Drop Time Measurements

RCCA drop times to dashpot and rod bottom were measured at hot shutdown core conditions. The results of the hot shutdown measurements are presented in Table 2.1. The acceptance criterion (4) of 1.8 seconds to dashpot is adequately met for all fuel.

2.2 RCCA Bank Measurements

During Cycle 13 startup the reactivity of the reference bank (Bank C) was measured using the boration/dilution technique and the reactivity worth of the remaining banks was inferred using rod swap reactivity comparisons to the reference bank.

2.2.1 Rod Swap Results

The measured worth of the reference bank, Bank C, differed from the WPS predicted Bank C worth by 47.0 pcm or 4.9 percent, which is within the 10 percent review criterion. Plots comparing measured to predicted reference bank integral and differential worth are presented in Figures 2.1 and 2.2, respectively.

Rod swap results for the remaining banks are presented in Table 2.2. The measured to predicted total rod worth difference is 2.1 percent which is within the acceptance criteria of 10.0 percent. All individual bank worths adequately met the 15.0 percent measured to predicted review criterion except Bank B which differed by approximately 21 percent. As required by the Reactor Test Program (4) the Bank B worth discrepancy was reviewed and the results were presented to the Plant Operations Review Committee (PORC meeting 87-064) before reaching 100 percent power.

The review consisted of detailed examinations of model design inputs, rod worth calculations, reload safety evaluation conclusions, and measured to predicted power distribution comparisons. No modeling or calculational errors were discovered during the review, however, the Cycle 13 minimum shutdown margin was re-evaluated to account for the larger stuck rod worth of the Bank B rod. Results of the reanalyzed shutdown margin are presented in Table 2.3. In addition, power distribution comparisons were monitored during the ascension to power and the observed power differences confirmed the rod swap results. (See Section 5.2)

Since the conclusions of the Reload Safety Evaluation remained valid no further analyses were performed and the plant was taken to 100 percent power.

2.3 Shutdown Margin Evaluation

Prior to power escalation a shutdown margin evaluation was made to verify the existence of core shutdown capability. The minimum shutdown margins at beginning and end of cycle, including the reanalyzed end of cycle, are presented in Table 2.3. A 10 percent uncertainty in the calculation of rod worth is allowed for in these shutdown margin analyses. Since the measured rod worths resulted in less than a 10 percent difference from predicted values, the analysis in Table 2.3 is conservative and no additional evaluations were required.

TABLE 2.1

Kewaunee Cycle 13

RCCA Drop Time Measurements

Hot Zero Power

	All Fuel
Average Dashpot Delta T (Sec)	1.309
Standard Deviation	0.033
Average Rod Bottom Delta T (Sec)	1.873
Standard Deviation	0.040

TABLE 2.2

Kewaunee Cycle 13

RCCA Bank Worth Summary

Rod Swap Method RCCA Bank	Measured Worth (PCM)	WPS Predicted Worth (PCM)	Difference (PCM)	Percent Difference
D	646.0	671.0	-25.0	-3.7
C*	1004.0	957.0	47.0	4.9
B	891.0	733.0	158.0	21.5
A	885.0	899.0	-14.0	-1.6
SA	685.0	714.0	-29.0	-4.0
SB	673.0	714.0	-41.0	-5.7
Total	4784.0	4688.0	96.0	2.1

* Reference bank measured by boron dilution.

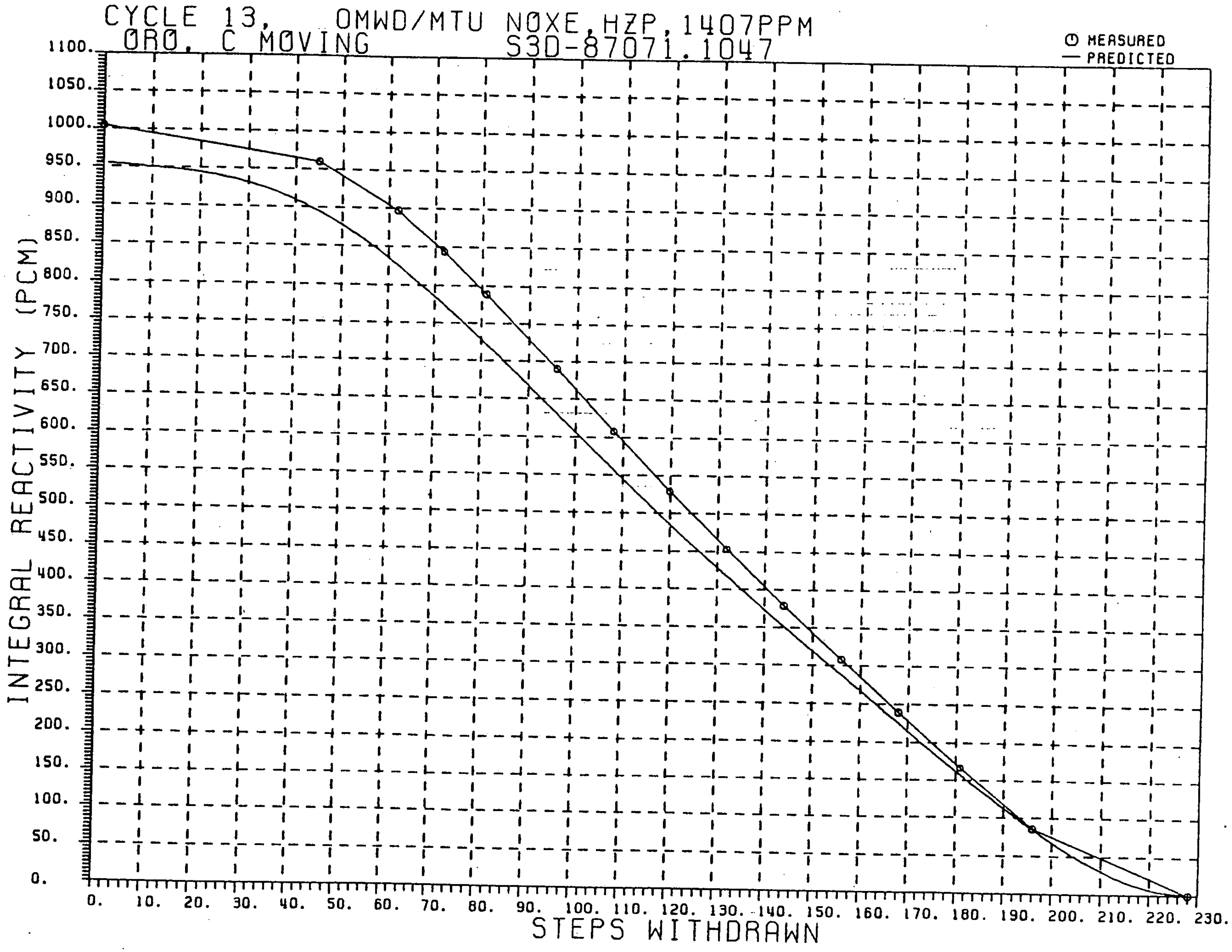


FIGURE 2.1

RCCA Bank C Integral Worth

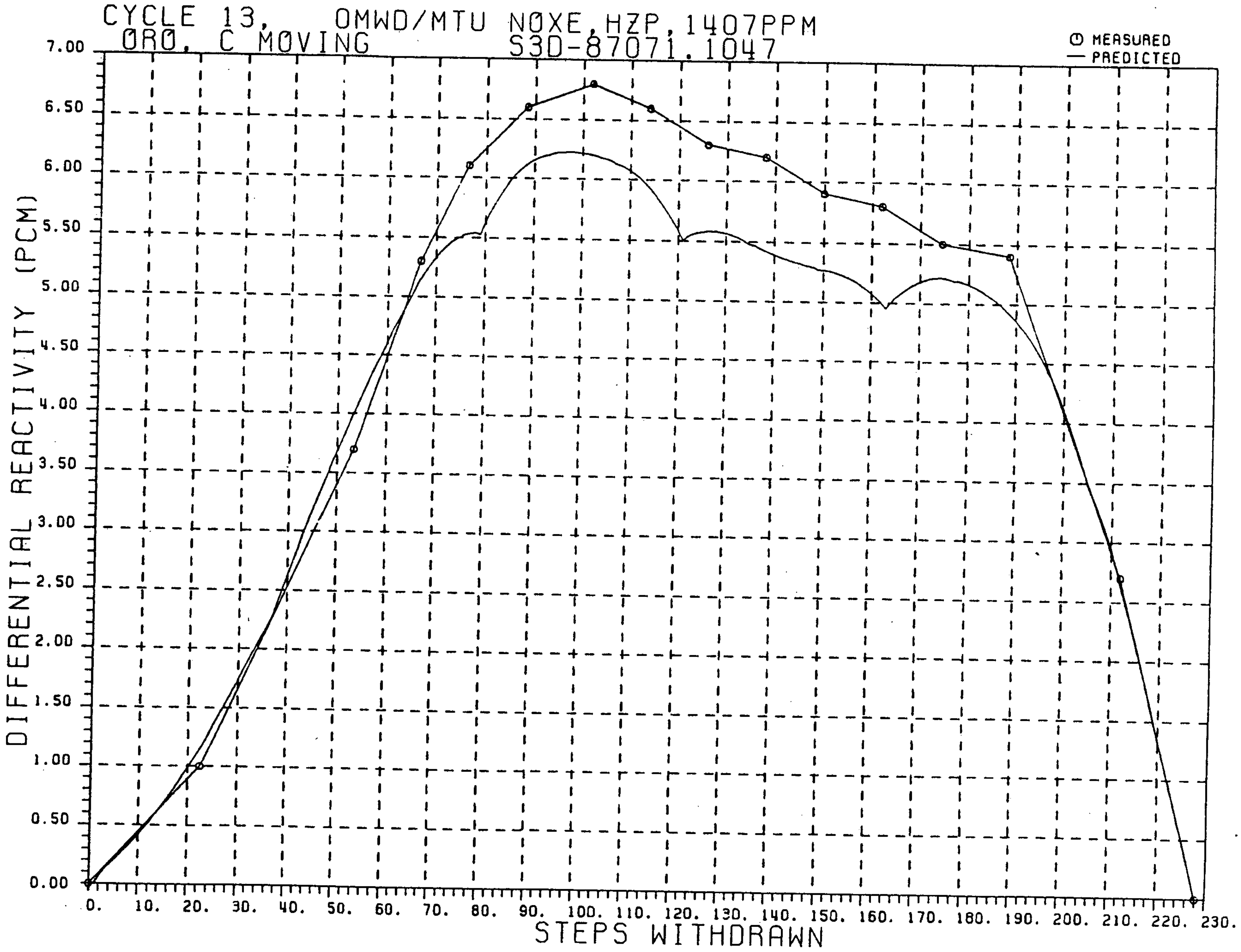


FIGURE 2.2

RCCA Bank C Differential Worth

TABLE 2.3

Kewaunee Cycle 13

Minimum Shutdown Margin Analysis

RCCA Bank Worths (PCM)	BOC	EOC	EOC*
N	6593	6688	6688
N-1	5631	5857	5677
Less 10 Percent	563	586	568
Sub Total	5068	5271	5109
Total Requirements (Including Uncertainties)	2141	2772	2772
Shutdown Margin	2927	2499	2337
Required Shutdown Margin	1000	2000	2000

*Reanalyzed due to rod swap B bank discrepancy

3.0 BORON ENDPOINTS AND BORON WORTH MEASUREMENTS

3.1 Boron Endpoints

During rod movements to measure control rod worth and differential boron worth, the dilution was stopped near the fully inserted position of control Bank C to obtain a boron endpoint measurement. The boron concentration was allowed to stabilize and the critical boron concentration was measured for the configuration desired.

Table 3.1 lists the measured and WPS predicted boron endpoints for the RCCA bank configurations shown. The results indicate a difference of -5 ppm for both the ARO and "Bank C In" core configurations. The acceptance criterion on the all rods out boron endpoint is ±100 PPM, thus, the boron endpoint comparisons are considered acceptable.

3.2 Differential Boron Worth

The differential boron worth was calculated by dividing the worth of control Bank C by the difference in boron endpoint measurement of the corresponding bank out and bank in configuration. Table 3.2 presents a comparison between measured and predicted boron concentration change and differential boron worth. No acceptance criteria are applied to these comparisons.

3.3 Boron Letdown

The measured boron concentration data for the first month of power operation is corrected to nominal core conditions and presented versus cycle burnup in Figure 3.1. The predicted boron letdown curve is included for comparison.

TABLE 3.1

Kewaunee Cycle 13

RCCA Bank Endpoint Measurements

RCCA Bank Configuration	Measured Endpoint (PPM)	WPS Predicted Endpoint (PPM)	Difference (PPM)
All Rods Out	1463	1468	-5
Bank C In	1350	1355	-5

TABLE 3.2

Kewaunee Cycle 13

Differential Boron Worth

RCCA Bank Configuration	CB Change Measured (PPM)	CB Change Predicted (PPM)	Percent Difference
ARO to C Bank In	113	113	0.0

RCCA Bank Configuration	Measured Boron Worth (PCM/PPM)	Predicted Boron Worth (PCM/PPM)	Percent Difference
ARO/C Bank In	-8.9	-8.5	4.7

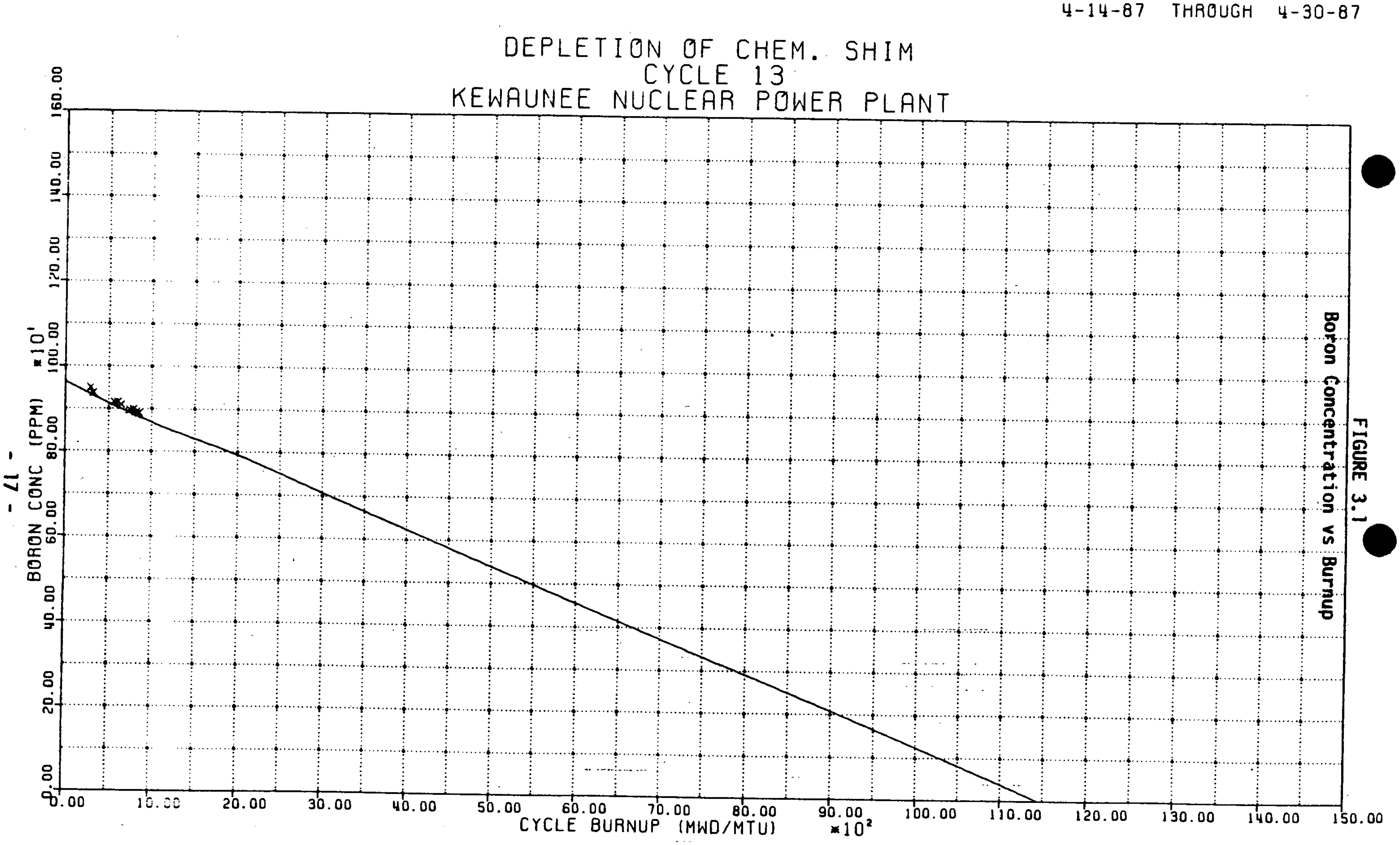


FIGURE 3.1

Boron Concentration vs Burnup

4.0 ISOTHERMAL TEMPERATURE COEFFICIENT

The measurement of the isothermal temperature coefficient was accomplished by monitoring reactivity while cooling down and heating up the reactor by manual control of the steam dump valves. The temperature and reactivity changes were plotted on an X-Y recorder and the temperature coefficient was obtained from the slope of this curve.

Core conditions at the time of the measurement were Bank D slightly inserted, all other RCCA banks full out, with a boron concentration of 1458 ppm. These conditions approximate the HZP, all rods out core condition which yields the most conservative (least negative) isothermal temperature coefficient measurement.

Table 4.1 presents the heatup and cooldown core conditions and compares the measured and predicted values for the isothermal temperature coefficient. The review criterion (4) of ±3 PCM/Degrees F was met.

TABLE 4.1

Kewaunee Cycle 13

Isothermal Temperature Coefficient

Cooldown

Tave Start - 547.5 Degrees F

Tave End - 539.9 Degrees F

Bank D - 213 Steps

Boron Concentration 1458 PPM

Measured ITC (PCM/Deg F)	WPS Predicted ITC (PCM/Deg F)	Difference (PCM/Deg F)
-3.2	-5.6	+2.4

Heat Up

Tave Start - 539.5 Degrees F

Tave End - 545.4 Degrees F

Bank D - 206 Steps

Boron Concentration 1458 PPM

Measured ITC (PCM/Deg F)	WPS Predicted ITC (PCM/Deg F)	Difference (PCM/Deg F)
-3.0	-4.7	+1.7

5.0 POWER DISTRIBUTION

5.1 Summary of Power Distribution Criteria

Power distribution predictions are verified through data recorded using the incore detector system and processed through the INCORE computer code. The computer code calculates FQN and FDHN which are limited by technical specifications. These parameters are defined as the acceptance criteria on a flux map (4).

The review criterion for measurement is that the percent differences of the normalized reaction rate integrals of symmetric thimbles do not exceed 10 percent at low power physics test conditions and 6 percent at equilibrium conditions (4).

The review criterion for the prediction is that the standard deviation of the percent differences between measured and predicted reaction rate integrals does not exceed 5 percent.

The review criteria for the INCORE calculated quadrant powers are that the quadrant tilt is less than 4 percent at low power physics test conditions and less than 2 percent at equilibrium conditions (4).

5.2 Power Distribution Measurements

Table 5.1 identifies the reactor conditions for each flux map recorded at the beginning of Cycle 13.

Comparisons of measured to predicted power distributions for the flux maps are exhibited in Figures 5.1 through 5.8. As evidenced by these figures the predicted assembly powers in the central region of the core are less than the measured assembly powers by about 6 percent in the low power flux maps, 1301 and 1302, and by about 4 percent in flux maps 1303 through 1306.

The observed underprediction of power in the core center region is consistent with the underprediction of the worth of bank B discussed in Section 2.2. Bank B is located in the core central region (see Fig. 1.1) and its worth is directly related to the power distribution.

After a short period of operation at power the power distribution differences are reduced to less than 2 percent as shown in Fig. 5.8 for Flux Map 1308.

Table 5.2 identifies flux map peak FDHN and minimum margin FQN. This table addresses acceptance criteria by verifying that technical specification limits are not exceeded. The Cycle 13 flux maps met all acceptance criteria.

Table 5.3 addresses the established review criteria for the flux maps. All review criteria were met for all the Cycle 13 flux maps.

TABLE 5.1

Flux Map Chronology and Reactor Characteristics

Map	Date	Percent Power	Xenon	Boron PPM	D Rods Steps	Exposure MWD/MTU
1301	4/04/87	28	TR.	1410	164	2
1302	4/05/87	43	TR.	1283	176	10
1303	4/07/87	69	EQ.	1133	228	50
1304	4/09/87	90	EQ.	1073	228	105
1305	4/10/87	98	TR.	975	226	149
1306	4/13/87	98	EQ.	960	228	246
1307	4/22/87	97	EQ.	932	228	564
1308	4/27/87	100	EQ.	891	228	743

TABLE 5.2

Verification of Acceptance Criteria

Flux Map	Core Location	FQN	Limit
1301	H-05 EK,25	2.45	4.38
1302	I-08 KJ,24	2.32	4.37
1303	H-09 JK,21	2.15	3.13
1304	H-09 JK,30	2.12	2.40
1305	F-09 JD,30	2.11	2.24
1306	F-09 JD,31	2.07	2.23
1307	F-09 JD,33	2.04	2.24
1308	F-09 JD,31	2.04	2.20

Flux Map	Core Location	FDHN	Limit
1301	H-09 JK	1.62	1.77
1302	H-09 JK	1.59	1.73
1303	H-09 JK	1.56	1.65
1304	H-09 JK	1.55	1.58
1305	F-09 JD	1.55	1.56
1306	H-09 JK	1.55	1.56
1307	H-09 JK	1.54	1.56
1308	H-09 JK	1.53	1.55

FQN and FDHN include appropriate uncertainties and penalties.

Limit on FQN is a function of core power, axial location, and rod exposure.

Limit on FDHN is a function of Core Power and Assembly Burnup.

TABLE 5.3

Verification of Review Criteria

Flux Map	(a) Maximum Percent Difference	(b) Standard Deviation	(c) Maximum Quadrant Tilt
1301	2.2	3.9	0.4
1302	2.3	3.1	0.5
1303	2.1	3.0	0.4
1304	2.4	2.7	0.4
1305	2.9	2.8	0.4
1306	3.0	2.7	0.4
1307	2.4	2.3	0.4
1308	3.2	2.3	0.3

(a) Maximum Percent Difference between symmetric thimbles for measured reaction rate integrals. Review criterion is 10 percent at low power. Review criterion is 6 percent at equilibrium power.

(b) Standard Deviation of the percent difference between measured and predicted reaction rate integrals. Review criterion is 5 percent.

(c) Percent Maximum Quadrant Tilt from normalized calculated quadrant powers. Review criteria are 4 percent at low power and 2 percent at equilibrium power.

FIGURE 5.1

Power Distribution for Flux Map 1301

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.363 0.365 -0.60	0.604 0.608 -0.59	0.363 0.365 -0.60					
B				0.564 0.573 -1.60	1.025 1.020 0.54	1.125 1.132 -0.59	0.825 0.830 -0.60	1.094 1.132 -3.34	0.984 1.020 -3.49	0.556 0.573 -2.95			
C			0.486 0.494 -1.60	1.141 1.147 -0.55	1.254 1.247 0.54	0.950 0.947 0.29	1.011 1.014 -0.27	0.926 0.947 -2.24	1.202 1.247 -3.58	1.113 1.147 -2.93	0.495 0.494 0.32		
D		0.562 0.573 -1.90	1.125 1.147 -1.87	1.038 1.043 -0.50	1.246 1.230 1.33	1.012 1.003 0.94	1.061 1.055 0.54	0.981 1.003 -2.20	1.209 1.230 -1.72	1.030 1.043 -1.28	1.159 1.147 1.07	0.575 0.573 0.33	
E		0.998 1.020 -2.16	1.220 1.247 -2.17	1.260 1.230 2.49	1.194 1.166 2.41	1.387 1.362 1.84	1.195 1.156 3.37	1.418 1.362 4.15	1.222 1.166 4.84	1.253 1.230 1.85	1.244 1.247 -0.26	0.995 1.020 -2.46	
F	0.345 0.365 -5.26	1.073 1.132 -5.25	0.918 0.947 -3.00	1.033 1.003 2.94	1.410 1.362 3.50	1.308 1.256 4.12	1.384 1.314 5.37	1.337 1.256 6.42	1.428 1.362 4.84	1.012 1.003 0.85	0.932 0.947 -1.57	1.094 1.132 -3.35	0.353 0.365 -3.18
G	0.577 0.608 -5.07	0.795 0.830 -4.21	0.984 1.013 -2.84	1.070 1.055 1.39	1.201 1.156 3.87	1.381 1.314 5.11	1.140 1.062 7.37	1.406 1.314 7.01	1.221 1.156 5.60	1.063 1.055 0.74	0.996 1.013 -1.72	0.801 0.830 -3.41	0.588 0.608 -3.24
H	0.347 0.365 -4.77	1.087 1.132 -3.94	0.920 0.947 -2.79	1.014 1.003 1.09	1.411 1.362 3.61	1.310 1.256 4.28	1.391 1.314 5.88	1.327 1.256 5.68	1.428 1.362 4.86	0.998 1.003 -0.45	0.926 0.947 -2.22	1.086 1.132 -4.02	0.350 0.365 -3.89
I		0.998 1.020 -2.10	1.219 1.247 -2.25	1.227 1.230 -0.21	1.208 1.186 3.63	1.410 1.362 3.54	1.206 1.156 4.31	1.421 1.362 4.36	1.196 1.166 2.56	1.215 1.230 -1.24	1.229 1.247 -1.42	0.976 1.020 -4.32	
J		0.558 0.573 -2.76	1.123 1.147 -2.08	1.041 1.043 -0.20	1.245 1.230 1.23	1.012 1.003 0.86	1.055 1.055 0.05	1.004 1.003 0.11	1.231 1.230 0.11	1.017 1.043 -2.49	1.117 1.147 -2.63	0.549 0.573 -4.33	
K			0.481 0.494 -2.53	1.118 1.147 -2.49	1.217 1.247 -2.42	0.905 0.947 -4.45	0.995 1.014 -1.87	0.924 0.947 -2.46	1.230 1.247 -1.37	1.118 1.147 -2.52	0.489 0.494 -0.95		
L				0.559 0.573 -2.53	0.995 1.020 -2.48	1.092 1.132 -3.53	0.800 0.830 -3.53	1.090 1.132 -3.75	0.977 1.020 -4.17	0.549 0.573 -4.17			
M						0.355 0.365 -2.83	0.592 0.608 -2.63	0.352 0.365 -3.37					

LOOP B

LOOP F

LOOP B

LOOP A

MEASURED FDHN

PREDICTED FDHN

PERCENT DIFFERENCE

FLUX MAP 1301

δ= 3.11

FIGURE 5.2

Power Distribution for Flux Map 1302

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.377 0.373 1.02	0.629 0.622 1.03	0.377 0.373 1.02					
B				0.565 0.575 -1.88	1.020 1.021 -0.10	1.118 1.140 -1.95	0.842 0.846 -0.46	1.118 1.140 -1.97	1.000 1.021 -2.08	0.560 0.575 -2.61			
C			0.486 0.495 -1.88	1.127 1.138 -1.01	1.239 1.240 -0.10	0.966 0.958 0.81	1.040 1.041 -0.12	0.941 0.958 -1.85	1.195 1.240 -3.63	1.108 1.138 -2.60	0.495 0.495 -0.10		
D		0.570 0.575 -1.03	1.126 1.138 -1.07	1.028 1.038 -0.96	1.223 1.219 0.35	1.013 1.005 0.84	1.062 1.059 0.30	0.988 1.005 -1.73	1.198 1.219 -1.76	1.027 1.038 -1.04	1.148 1.138 0.88	0.575 0.575 -0.10	
E		1.019 1.021 -0.22	1.237 1.240 -0.22	1.234 1.219 1.26	1.171 1.158 1.13	1.366 1.349 1.26	1.184 1.150 2.95	1.405 1.349 4.12	1.205 1.158 4.08	1.242 1.219 1.91	1.245 1.240 0.44	1.010 1.021 -1.08	
F	0.358 0.373 -4.12	1.093 1.140 -4.14	0.934 0.958 -2.54	1.021 1.005 1.62	1.377 1.349 2.07	1.274 1.243 2.51	1.345 1.296 3.81	1.322 1.243 6.37	1.406 1.349 4.20	1.003 1.005 -0.18	0.953 0.958 -0.55	1.124 1.140 -1.39	0.370 0.373 -0.94
G	0.593 0.622 -4.66	0.813 0.846 -3.90	1.009 1.040 -2.99	1.065 1.059 0.55	1.178 1.150 2.43	1.340 1.296 3.39	1.115 1.055 5.71	1.381 1.296 6.57	1.208 1.150 5.06	1.057 1.059 -0.14	1.034 1.040 -0.57	0.834 0.846 -1.41	0.617 0.622 -0.93
H	0.357 0.373 -4.37	1.098 1.140 -3.65	0.930 0.958 -2.92	1.005 1.005 0.03	1.375 1.349 1.92	1.283 1.243 3.19	1.362 1.296 5.08	1.314 1.243 5.68	1.408 1.349 4.41	0.992 1.005 -1.33	0.943 0.956 -1.54	1.111 1.140 -2.50	0.370 0.373 -0.80
I		1.003 1.021 -1.71	1.216 1.240 -1.93	1.208 1.219 -0.87	1.171 1.158 1.12	1.386 1.349 2.75	1.199 1.150 4.25	1.406 1.349 4.24	1.182 1.158 2.10	1.201 1.219 -1.44	1.220 1.240 -1.60	0.977 1.021 -4.34	
J		0.563 0.575 -2.22	1.119 1.138 -1.65	1.031 1.038 -0.72	1.220 1.219 0.10	1.012 1.005 0.65	1.068 1.059 0.80	1.014 1.005 0.86	1.216 1.219 -0.21	1.006 1.038 -3.07	1.102 1.138 -3.17	0.550 0.575 -4.34	
K			0.488 0.495 -1.57	1.120 1.138 -1.54	1.224 1.240 -1.25	0.924 0.958 -3.54	1.029 1.041 -1.18	0.946 0.958 -1.28	1.230 1.240 -0.81	1.115 1.138 -1.99	0.485 0.495 -2.02		
L				0.568 0.575 -1.27	1.008 1.021 -1.26	1.107 1.140 -2.92	0.821 0.846 -2.92	1.111 1.140 -2.59	1.001 1.021 -1.95	0.564 0.575 -1.95			
M						0.365 0.373 -2.33	0.608 0.622 -2.31	0.365 0.373 -2.14					

LOOP B

LOOP

LOOP B

LOOP

MEASURED FDHN

PREDICTED FDHN

PERCENT DIFFERENCE

FLUX MAP 1302

δ= 2.52

FIGURE 5.3

Power Distribution for Flux Map 1303

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.382 0.387 -1.37	0.637 0.646 -1.36	0.382 0.387 -1.37					
B				0.570 0.573 -0.51	1.009 1.014 -0.49	1.134 1.150 -1.37	0.870 0.882 -1.36	1.114 1.150 -3.11	0.981 1.014 -3.21	0.560 0.573 -2.29			
C			0.490 0.492 -0.51	1.107 1.113 -0.49	1.218 1.224 -0.50	0.994 0.987 0.68	1.137 1.134 0.24	0.972 0.987 -1.54	1.184 1.224 -3.28	1.088 1.113 -2.27	0.494 0.492 0.39		
D		0.575 0.573 0.40	1.118 1.113 0.41	1.017 1.022 -0.50	1.204 1.197 0.59	1.022 1.011 1.09	1.086 1.077 0.85	0.996 1.011 -1.43	1.177 1.197 -1.66	1.012 1.022 -0.98	1.123 1.113 0.92	0.575 0.573 0.38	
E		1.018 1.014 0.41	1.229 1.224 0.41	1.214 1.197 1.41	1.160 1.142 1.57	1.349 1.327 1.65	1.174 1.141 2.91	1.373 1.327 3.51	1.179 1.142 3.23	1.215 1.197 1.48	1.230 1.224 0.50	1.009 1.014 -0.51	
F	0.373 0.387 -3.67	1.108 1.150 -3.66	0.965 0.987 -2.25	1.030 1.011 1.91	1.359 1.327 2.42	1.259 1.222 3.00	1.314 1.268 3.61	1.272 1.222 4.09	1.369 1.327 3.19	1.013 1.011 0.19	0.977 0.987 -1.02	1.135 1.150 -1.30	0.387 0.387 -0.08
G	0.616 0.646 -4.63	0.846 0.882 -4.13	1.098 1.134 -3.19	1.082 1.077 0.46	1.170 1.141 2.54	1.313 1.268 3.56	1.092 1.041 4.92	1.327 1.268 4.65	1.186 1.141 3.98	1.081 1.077 0.40	1.123 1.134 -0.93	0.870 0.882 -1.35	0.645 0.646 -0.03
H	0.370 0.387 -4.39	1.105 1.150 -3.90	0.956 0.987 -3.15	1.011 1.011 -0.01	1.355 1.327 2.10	1.260 1.222 3.15	1.325 1.268 4.46	1.274 1.222 4.27	1.376 1.327 3.68	1.004 1.011 -0.69	0.967 0.987 -2.08	1.119 1.150 -2.68	0.388 0.387 0.36
I		0.994 1.014 -1.97	1.198 1.224 -2.16	1.188 1.197 -0.73	1.164 1.142 1.97	1.364 1.327 2.81	1.182 1.141 3.58	1.374 1.327 3.58	1.165 1.142 2.00	1.182 1.197 -1.20	1.207 1.224 -1.40	0.968 1.014 -4.51	
J		0.562 0.573 -1.87	1.096 1.113 -1.53	1.018 1.022 -0.38	1.202 1.197 0.45	1.016 1.011 0.52	1.080 1.077 0.26	1.014 1.011 0.32	1.196 1.197 -0.05	0.994 1.022 -2.75	1.081 1.113 -2.88	0.547 0.573 -4.52	
K			0.488 0.492 -0.91	1.103 1.113 -0.88	1.219 1.224 -0.42	0.948 0.987 -4.01	1.115 1.134 -1.64	0.978 0.987 -1.10	1.222 1.224 -0.19	1.103 1.113 -0.87	0.486 0.492 -1.28		
L				0.571 0.573 -0.37	1.010 1.014 -0.38	1.116 1.150 -2.91	0.857 0.882 -2.90	1.126 1.150 -2.06	1.009 1.014 -0.46	0.570 0.573 -0.47			
M						0.380 0.387 -1.81	0.634 0.646 -1.80	0.382 0.387 -1.16					

LOOP B

LOOP F

LOOP B

LOOP F

MEASURED FDHN

PREDICTED FDHN

PERCENT DIFFERENCE

FLUX MAP 1303

δ = 2.27

FIGURE 5.4

Power Distribution for Flux Map 1304

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.392 0.392 -0.03	0.652 0.652 -0.03	0.392 0.392 -0.03					
B				0.564 0.576 -2.08′	1.004 1.009 -0.52	1.127 1.144 -1.53	0.879 0.886 -0.78	1.121 1.144 -2.01	0.988 1.009 -2.09	0.566 0.576 -1.75			
C			0.485 0.496 -2.08	1.090 1.105 -1.32	1.210 1.216 -0.53	0.992 0.991 0.10	1.130 1.134 -0.41	0.973 0.991 -1.82	1.178 1.216 -3.15	1.086 1.105 -1.76	0.501 0.496 1.03		
D		0.571 0.576 -0.82	1.095 1.105 -0.89	1.008 1.021 -1.27	1.200 1.193 0.58	1.023 1.016 0.70	1.084 1.080 0.37	0.998 1.016 -1.74	1.175 1.193 -1.54	1.015 1.021 -0.60	1.120 1.105 1.30	0.582 0.576 1.04	
E		1.013 1.009 0.39	1.221 1.216 0.38	1.211 1.193 1.50	1.162 1.143 1.63	1.344 1.325 1.42	1.174 1.146 2.43	1.362 1.325 2.81	1.179 1.143 3.13	1.212 1.193 1.58	1.224 1.216 0.65	1.006 1.009 -0.31	
F	0.377 0.392 -3.82	1.100 1.144 -3.84	0.966 0.991 -2.46	1.035 1.016 1.89	1.355 1.325 2.26	1.260 1.225 2.86	1.312 1.270 3.31	1.272 1.225 3.84	1.366 1.325 3.06	1.020 1.016 0.36	0.984 0.991 -0.71	1.133 1.144 -0.96	0.393 0.392 0.15
G	0.623 0.652 -4.52	0.850 0.886 -4.09	1.095 1.134 -3.41	1.065 1.080 0.41	1.173 1.146 2.31	1.312 1.270 3.33	1.099 1.051 4.53	1.326 1.270 4.39	1.189 1.146 3.75	1.085 1.080 0.48	1.126 1.134 -0.70	0.877 0.886 -0.99	0.653 0.652 0.18
H	0.376 0.392 -4.23	1.100 1.144 -3.85	0.957 0.991 -3.35	1.014 1.016 -0.21	1.348 1.325 1.70	1.257 1.225 2.64	1.321 1.270 3.98	1.273 1.225 3.93	1.371 1.325 3.47	1.012 1.016 -0.36	0.975 0.991 -1.54	1.121 1.144 -2.02	0.395 0.392 0.59
I		0.993 1.009 -1.58	1.194 1.216 -1.85	1.186 1.193 -0.63	1.162 1.143 1.67	1.356 1.325 2.36	1.181 1.146 3.05	1.365 1.325 3.04	1.163 1.143 1.72	1.183 1.193 -0.85	1.204 1.216 -0.99	0.975 1.009 -3.35	
J		0.569 0.576 -1.22	1.093 1.105 -1.13	1.019 1.021 -0.22	1.197 1.193 0.36	1.019 1.016 0.34	1.079 1.080 -0.07	1.016 1.016 -0.03	1.189 1.193 -0.38	0.999 1.021 -2.16	1.080 1.105 -2.26	0.556 0.576 -3.35	
K			0.494 0.496 -0.30	1.102 1.105 -0.31	1.218 1.216 0.14	0.954 0.991 -3.66	1.114 1.134 -1.80	0.979 0.991 -1.23	1.211 1.216 -0.40	1.096 1.105 -0.82	0.490 0.496 -1.17		
L				0.577 0.576 0.24	1.011 1.009 0.21	1.113 1.144 -2.76	0.862 0.886 -2.75	1.122 1.144 -1.97	1.005 1.009 -0.45	0.573 0.576 -0.45			
M						0.385 0.392 -1.86	0.640 0.652 -1.86	0.388 0.392 -1.17					

LOOP 8

LOOP A

LOOP B

LOOP A

☐ ← MEASURED FOHN
← PREDICTED FOHN
← PERCENT DIFFERENCE

FLUX MAP 1304

δ = 2.08

FIGURE 5.6

Power Distribution for Flux Map 1305

LOOP B ↖

LOOP A ↙

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.395 0.396 -0.18	0.656 0.658 -0.20	0.395 0.396 -0.18					
B				0.569 0.577 -1.39	1.004 1.009 -0.48	1.121 1.144 -1.99	0.880 0.890 -1.10	1.121 1.144 -2.02	0.988 1.009 -2.08	0.568 0.577 -1.61			
C			0.490 0.497 -1.37	1.092 1.102 -0.93	1.207 1.213 -0.47	0.995 0.993 0.21	1.128 1.134 -0.55	0.976 0.993 -1.74	1.176 1.213 -3.03	1.084 1.102 -1.61	0.501 0.497 0.72		
D		0.573 0.577 -0.64	1.095 1.102 -0.66	1.011 1.020 -0.91	1.195 1.189 0.50	1.025 1.018 0.70	1.082 1.079 0.22	1.001 1.018 -1.65	1.172 1.189 -1.41	1.016 1.020 -0.43	1.116 1.102 1.25	0.581 0.577 0.71	
E		1.009 1.008 0.08	1.214 1.213 0.08	1.206 1.189 1.39	1.159 1.142 1.48	1.341 1.323 1.35	1.177 1.146 2.67	1.367 1.323 3.31	1.184 1.142 3.64	1.210 1.189 1.80	1.219 1.213 0.47	0.999 1.008 -0.92	
F	0.380 0.396 -4.14	1.097 1.144 -4.15	0.966 0.993 -2.74	1.035 1.018 1.65	1.351 1.323 2.14	1.258 1.224 2.75	1.314 1.268 3.58	1.276 1.224 4.25	1.368 1.323 3.37	1.023 1.018 0.46	0.985 0.993 -0.81	1.130 1.144 -1.26	0.395 0.396 -0.35
G	0.624 0.658 -5.05	0.850 0.890 -4.42	1.094 1.134 -3.57	1.082 1.079 0.27	1.172 1.146 2.22	1.309 1.267 3.31	1.103 1.053 4.78	1.325 1.267 4.56	1.190 1.146 3.86	1.085 1.079 0.50	1.125 1.134 -0.84	0.878 0.890 -1.28	0.655 0.658 -0.32
H	0.377 0.396 -4.75	1.096 1.144 -4.18	0.958 0.993 -3.50	1.016 1.018 -0.22	1.347 1.323 1.77	1.258 1.224 2.75	1.318 1.268 3.96	1.271 1.224 3.82	1.368 1.323 3.36	1.014 1.018 -0.36	0.978 0.993 -1.51	1.120 1.144 -2.09	0.397 0.396 0.23
I		0.990 1.008 -1.79	1.191 1.213 -1.81	1.182 1.189 -0.56	1.163 1.142 1.84	1.355 1.323 2.44	1.181 1.146 3.01	1.363 1.323 3.01	1.162 1.142 1.71	1.179 1.189 -0.83	1.201 1.213 -0.98	0.974 1.008 -3.35	
J		0.570 0.577 -1.18	1.094 1.102 -0.74	1.021 1.020 0.12	1.199 1.189 0.83	1.021 1.018 0.31	1.078 1.079 -0.10	1.017 1.018 -0.06	1.186 1.189 -0.28	0.998 1.020 -2.13	1.078 1.102 -2.22	0.558 0.577 -3.36	
K			0.497 0.497 0.04	1.103 1.102 0.07	1.221 1.213 0.65	0.955 0.993 -3.88	1.113 1.134 -1.85	0.982 0.993 -1.17	1.210 1.213 -0.23	1.095 1.102 -0.84	0.492 0.497 -1.09		
L				0.581 0.577 0.73	1.016 1.009 0.69	1.107 1.144 -3.25	0.861 0.890 -3.25	1.119 1.144 -2.18	1.007 1.009 -0.16	0.576 0.577 -0.17			
M						0.386 0.396 -2.63	0.640 0.658 -2.63	0.390 0.396 -1.41					

LOOP B ↗

↘ LOOP A

← MEASURED FDHN
← PREDICTED FDHN
← PERCENT DIFFERENCE

FLUX MAP 1305

δ= 2.18

FIGURE 5.6

Power Distribution for Flux Map 1306

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.394 0.396 -0.43	0.654 0.657 -0.44	0.394 0.396 -0.43					
B				0.570 0.576 -1.11	1.002 1.006 -0.44	1.120 1.142 -1.90	0.878 0.889 -1.18	1.118 1.142 -2.11	0.984 1.006 -2.18	0.570 0.576 -1.02			
C			0.491 0.496 -1.11	1.090 1.098 -0.78	1.206 1.211 -0.44	0.994 0.993 0.09	1.128 1.135 -0.64	0.975 0.993 -1.82	1.174 1.211 -3.05	1.087 1.098 -1.03	0.506 0.496 1.97		
D		0.573 0.576 -0.45	1.093 1.098 -0.49	1.011 1.019 -0.78	1.191 1.189 0.20	1.024 1.020 0.38	1.081 1.082 -0.06	1.002 1.020 -1.74	1.170 1.189 -1.60	1.017 1.019 -0.24	1.116 1.098 1.63	0.587 0.576 1.98	
E		1.007 1.005 0.16	1.213 1.211 0.17	1.202 1.189 1.10	1.156 1.144 1.06	1.339 1.326 0.95	1.174 1.149 2.18	1.365 1.326 2.92	1.180 1.144 3.12	1.204 1.189 1.26	1.216 1.211 0.44	1.001 1.005 -0.42	
F	0.379 0.396 -4.22	1.094 1.142 -4.23	0.965 0.993 -2.81	1.034 1.020 1.32	1.347 1.325 1.68	1.255 1.228 2.18	1.312 1.273 3.04	1.274 1.228 3.75	1.363 1.325 2.86	1.021 1.020 0.13	0.985 0.993 -0.79	1.130 1.142 -1.05	0.396 0.396 -0.10
G	0.624 0.657 -4.95	0.850 0.889 -4.38	1.094 1.135 -3.66	1.082 1.081 0.06	1.170 1.149 1.86	1.309 1.273 2.80	1.105 1.058 4.41	1.326 1.273 4.17	1.190 1.149 3.55	1.085 1.081 0.34	1.127 1.135 -0.67	0.879 0.889 -1.09	0.656 0.657 -0.06
H	0.378 0.396 -4.62	1.095 1.142 -4.12	0.958 0.993 -3.59	1.018 1.020 -0.20	1.347 1.325 1.65	1.259 1.228 2.48	1.319 1.273 3.61	1.270 1.228 3.44	1.367 1.325 3.13	1.016 1.020 -0.42	0.979 0.993 -1.43	1.119 1.142 -2.01	0.397 0.396 0.23
I		0.990 1.005 -1.50	1.192 1.211 -1.59	1.185 1.189 -0.37	1.166 1.144 1.93	1.356 1.326 2.25	1.183 1.149 2.94	1.365 1.326 2.96	1.165 1.144 1.79	1.180 1.189 -0.77	1.200 1.211 -0.90	0.974 1.005 -3.14	
J		0.572 0.576 -0.73	1.095 1.096 -0.27	1.024 1.019 0.46	1.202 1.189 1.12	1.025 1.020 0.45	1.084 1.082 0.17	1.022 1.020 0.23	1.189 1.189 -0.01	0.998 1.019 -2.03	1.075 1.098 -2.12	0.558 0.576 -3.12	
K			0.499 0.496 0.50	1.104 1.098 0.53	1.225 1.211 1.11	0.963 0.993 -3.10	1.122 1.135 -1.19	0.986 0.993 -0.79	1.210 1.211 -0.12	1.090 1.098 -0.72	0.491 0.496 -1.09		
L				0.583 0.576 1.20	1.018 1.006 1.15	1.108 1.142 -2.94	0.863 0.889 -2.95	1.119 1.142 -2.04	1.003 1.006 -0.33	0.574 0.576 -0.31			
M						0.385 0.396 -2.78	0.639 0.657 -2.79	0.390 0.396 -1.59					

LOOP B

LOOP A

LOOP B

LOOP A

MEASURED FDHN

PREDICTED FDHN

PERCENT DIFFERENCE

FLUX MAP 1306

δ = 2.05

FIGURE 5.7

Power Distribution for Flux Map 1307

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.393 0.395 -0.58	0.651 0.655 -0.60	0.393 0.395 -0.58					
B				0.571 0.573 -0.40	0.997 0.998 -0.07	1.123 1.133 -0.87	0.880 0.887 -0.73	1.114 1.133 -1.65	0.980 0.998 -1.71	0.574 0.573 0.16			
C			0.492 0.494 -0.38	1.087 1.089 -0.23	1.206 1.207 -0.07	0.992 0.993 -0.09	1.130 1.136 -0.49	0.978 0.993 -1.52	1.179 1.207 -2.31	1.091 1.089 0.17	0.513 0.494 3.89		
D		0.575 0.573 0.26	1.092 1.089 0.25	1.016 1.018 -0.23	1.197 1.192 0.40	1.028 1.025 0.25	1.089 1.089 -0.02	1.010 1.025 -1.49	1.180 1.192 -1.01	1.024 1.018 0.63	1.119 1.089 2.72	0.595 0.573 3.87	
E		1.007 0.998 0.91	1.218 1.207 0.91	1.203 1.192 0.96	1.160 1.149 0.96	1.340 1.331 0.70	1.170 1.157 1.14	1.349 1.331 1.31	1.173 1.149 2.06	1.210 1.192 1.50	1.218 1.207 0.89	1.000 0.998 0.25	
F	0.382 0.395 -3.31	1.095 1.133 -3.34	0.971 0.993 -2.23	1.035 1.025 0.97	1.346 1.331 1.10	1.255 1.237 1.41	1.307 1.286 1.66	1.264 1.237 2.14	1.356 1.331 1.91	1.023 1.025 -0.18	0.987 0.993 -0.67	1.124 1.133 -0.80	0.397 0.395 0.53
G	0.629 0.655 -3.97	0.853 0.887 -3.82	1.097 1.136 -3.47	1.086 1.089 -0.29	1.170 1.157 1.09	1.307 1.286 1.63	1.098 1.071 2.48	1.319 1.286 2.57	1.182 1.157 2.20	1.086 1.089 -0.30	1.126 1.136 -0.91	0.879 0.887 -0.87	0.659 0.655 0.53
H	0.381 0.395 -3.64	1.092 1.133 -3.59	0.959 0.993 -3.43	1.020 1.025 -0.48	1.344 1.331 0.95	1.253 1.237 1.32	1.312 1.286 2.00	1.264 1.237 2.14	1.359 1.331 2.09	1.015 1.025 -0.98	0.974 0.993 -1.94	1.110 1.133 -2.07	0.398 0.395 0.78
I		0.989 0.998 -0.82	1.195 1.207 -1.03	1.190 1.192 -0.14	1.167 1.149 1.54	1.349 1.331 1.31	1.172 1.157 1.32	1.349 1.331 1.34	1.162 1.149 1.12	1.185 1.192 -0.80	1.198 1.207 -0.76	0.964 0.998 -3.36	
J		0.578 0.573 0.77	1.097 1.089 0.76	1.028 1.018 1.01	1.206 1.192 1.15	1.023 1.025 -0.21	1.079 1.089 -0.92	1.016 1.025 -0.90	1.191 1.192 -0.10	1.005 1.018 -1.33	1.073 1.089 -1.49	0.554 0.573 -3.37	
K			0.502 0.494 1.54	1.106 1.089 1.54	1.230 1.207 1.92	0.961 0.993 -3.24	1.113 1.136 -2.03	0.983 0.993 -1.05	1.210 1.207 0.20	1.095 1.089 0.57	0.496 0.494 0.40		
L				0.585 0.573 2.02	1.017 0.998 1.97	1.106 1.133 -2.38	0.865 0.887 -2.38	1.118 1.133 -1.30	1.005 0.998 0.75	0.578 0.573 0.75			
M						0.389 0.395 -1.52	0.645 0.655 -1.54	0.394 0.395 -0.40					

LOOP B

LOOP F

LOOP B

LOOP A

MEASURED FOHN

PREDICTED FOHN

PERCENT DIFFERENCE

FLUX MAP 1307

δ = 1.68

FIGURE 5.8

Power Distribution for Flux Map 1308

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						0.396 0.397 -0.23	0.655 0.656 -0.23	0.396 0.397 -0.23					
B				0.577 0.573 0.68	0.992 0.995 -0.28	1.113 1.131 -1.61	0.879 0.887 -0.91	1.111 1.131 -1.81	0.976 0.995 -1.88	0.575 0.573 0.21			
C			0.498 0.495 0.69	1.088 1.086 0.21	1.202 1.205 -0.27	0.993 0.994 -0.09	1.127 1.136 -0.75	0.976 0.994 -1.75	1.172 1.205 -2.71	1.088 1.086 0.21	0.515 0.495 4.06		
D		0.580 0.573 1.13	1.098 1.086 1.11	1.021 1.019 0.19	1.193 1.194 -0.04	1.027 1.027 0.02	1.089 1.093 -0.39	1.010 1.027 -1.69	1.179 1.194 -1.26	1.026 1.019 0.69	1.117 1.086 2.65	0.597 0.573 4.06	
E		1.011 0.995 1.57	1.224 1.205 1.57	1.202 1.194 0.70	1.156 1.150 0.55	1.336 1.330 0.43	1.168 1.158 0.87	1.347 1.330 1.26	1.172 1.150 1.96	1.213 1.194 1.59	1.215 1.205 0.87	0.996 0.995 0.12	
F	0.384 0.397 -3.15	1.095 1.131 -3.17	0.972 0.994 -2.18	1.034 1.027 0.71	1.338 1.330 0.62	1.247 1.237 0.84	1.301 1.287 1.09	1.257 1.237 1.62	1.351 1.330 1.56	1.024 1.027 -0.26	0.988 0.994 -0.54	1.124 1.131 -0.64	0.399 0.397 0.58
G	0.629 0.656 -4.16	0.852 0.887 -3.91	1.095 1.136 -3.59	1.087 1.092 -0.41	1.166 1.158 0.67	1.301 1.287 1.10	1.094 1.073 1.97	1.313 1.287 2.04	1.178 1.158 1.76	1.087 1.092 -0.45	1.127 1.136 -0.80	0.881 0.887 -0.68	0.660 0.656 0.61
H	0.382 0.397 -3.83	1.090 1.131 -3.66	0.959 0.994 -3.54	1.021 1.027 -0.54	1.338 1.330 0.62	1.250 1.237 1.08	1.308 1.287 1.63	1.259 1.237 1.75	1.352 1.330 1.63	1.017 1.027 -0.98	0.977 0.994 -1.69	1.112 1.131 -1.72	0.401 0.397 1.03
I		0.988 0.995 -0.75	1.194 1.205 -0.90	1.193 1.194 -0.09	1.167 1.150 1.43	1.348 1.330 1.33	1.174 1.158 1.39	1.349 1.330 1.41	1.163 1.150 1.13	1.188 1.194 -0.49	1.197 1.205 -0.63	0.965 0.995 -2.98	
J		0.578 0.573 0.89	1.100 1.086 1.32	1.033 1.019 1.38	1.214 1.194 1.63	1.026 1.027 -0.11	1.087 1.093 -0.59	1.021 1.027 -0.58	1.196 1.194 0.20	1.007 1.019 -1.14	1.072 1.086 -1.28	0.556 0.573 -2.98	
K			0.505 0.495 2.16	1.110 1.086 2.19	1.239 1.205 2.81	0.965 0.994 -2.96	1.118 1.136 -1.61	0.987 0.994 -0.72	1.210 1.205 0.42	1.093 1.086 0.63	0.497 0.495 0.42		
L				0.590 0.573 2.90	1.024 0.995 2.86	1.102 1.131 -2.52	0.865 0.887 -2.51	1.116 1.131 -1.35	1.003 0.995 0.84	0.578 0.573 0.84			
M						0.388 0.397 -2.09	0.643 0.656 -2.09	0.394 0.397 -0.66					

LOOP B

LOOP A

LOOP B

LOOP A

MEASURED FQHN

PREDICTED FQHN

PERCENT DIFFERENCE

FLUX MAP 1308

δ= 1.70

6.0 REACTOR STARTUP CALIBRATIONS

6.1 Rod Position Calibration

The rod position indicators are calibrated each refueling in accordance with an approved surveillance procedure. The calibration includes the following:

a) The position signal output is checked at 20 and 200 steps for all rods.

b) The rod bottom lamps are checked to assure that they light at the proper rod height.

c) The control room rod position indicators are calibrated to read correctly at 20 and 200 steps.

d) The pulse-to-analog convertor alignment is checked.

e) The rod bottom bypass bi-stable trip setpoint is checked.

The calibration was performed satisfactorily during the Cycle 13 startup; no problems or abnormalities were encountered and site procedure acceptance criteria were met. At full power an adjustment was made to selected RPI channels to compensate for the temperature increase associated with power ascension.

6.2 Nuclear Instrumentation Calibration

The nuclear instrumentation (NI) calibration was performed in accordance with the Kewaunee Reactor Test Program during the Cycle 13 startup (4). A flux map was performed at approximately 70 percent power. The incore axial offset was determined from the data collected during the map. The NI's were then calibrated with a conservative incore axial offset-to-excore axial offset ratio of 1.7.

7.0 REFERENCES

(1) "Reload Safety Evaluation for Kewaunee Cycle 13," Wisconsin Public Service Corporation, December, 1986.

(2) "Qualification of Reactor Physics Methods for Application to Kewaunee," Wisconsin Public Service Corporation, October, 1978.

(3) "Reload Safety Evaluation Methods for Application to Kewaunee," Wisconsin Public Service Corporation, February, 1979. (Revision 1, February, 1987)

(4) "Reactor Test Program, Kewaunee Nuclear Power Plant," Wisconsin Public Service Corporation, May, 1979. (Revision 3, March, 1987)

(5) "Generic Mechanical and Thermal Hydraulic Design for Exxon Nuclear 14 x 14 Reload Assemblies with Zircaloy Guide Tubes for Westinghouse 2-Loop Pressurized Water Reactors," Exxon Nuclear Corporation, November, 1978.

(6) "Rod Exchange Technique for Rod Worth Measurement" and "Rod Worth Verification Tests Utilizing RCC Bank Interchange," Westinghouse Corporation, May 12, 1978.

(7) "Kewaunee Nuclear Power Plant Technical Specifications," Wisconsin Public Service Corporation, Docket 50-305.

(8) "Cycle 12 Startup Report", "Wisconsin Public Service Corporation, June, 1986.