KEWAUNEE NUCLEAR POWER PLANT

CYCLE 5
STARTUP REPORT
SEPTEMBER, 1979

ICE CORPORATION

LIGHT COMPANY

TRIC COMPANY

DOCKET 50-350

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CYCLE V

STARTUP REPORT

SEPTEMBER 1979

Wisconsin Public Service
Corporation
Green Bay, Wisconsin
Date 9/15/79

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1.0 INTRODUCTION, SUMMARY, AND CONCLUSIONS

1.1 Introduction

This report presents the results of the physics tests performed for Kewaunee Cycle 5. The core design and reload safety evaluation were performed by Wisconsin Public Service Corporation (1), using methods previously described to the NRC 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, Revision 1, which was submitted to the NRC in May, 1979 (4). Also included are tests which were performed but not required by the Reactor Test Program. Finally, as required by the Technical Specifications, Sec. 6.9, tests listed in Section 13 of the Kewaunee FSAR are addressed in Section 8 of this report.

During cycle 4-5 refueling, 40 of the 121 fuel assemblies in the core were replaced with fresh, Exxon fuel assemblies enriched to 3.2 w/o U235. The Exxon fuel assemblies have been shown to be neutronically and thermal hydraulically compatible with the current resident fuel assemblies (5). Cycle 5 core consists of the following regions of fuel:

Number	Region	Number Of Cycles Burned	Fabricated w/o U-235
1	1	1	2.2
8	4	2	3.3
8	4	3	3.3
24	5	2	3.3
40	6	1	3.1
40	7	0	3.2

The core loading pattern, burnup per assembly, and Cycle 4 core position are shown in Figure 1.1. The Cycle 5 pattern utilizes two secondary sources in place of the two primary/secondary sources used in the past. The replacement of the primary/secondary sources required the Kewaunee core to commence startup without activated sources. A background count rate of 150 CPS was found to be sufficient for the approach to criticality.

On July 29, 1979 at 1003 HRS., initial criticality was achieved on the Cycle 5 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 by boration/dilution and the rod swap method, all results were within the established acceptance criteria (4), and thereby demonstrated adequate shutdown margin.

Section 3 presents the boron endpoints and boron worth measurements. The endpoint measurements were within the acceptance criteria (4).

Section 4 shows the results of the isothermal temperature coefficient measurements. These agreed well with predictions and were within the acceptance criteria (4).

Power distributions were measured via flux maps and the Incore code for beginning of life (BOC) through power escalation and 100% power, equilibrium xenon. The results indicate compliance with Technical Specification limits (9) and are presented in Section 5.

Section 6 shows the available boron letdown data covering the first few days of reactor operation. The data agrees well with predictions, and meets the review and acceptance criteria (4).

Section 7 discusses the various calibrations performed during the startup of Cycle 5.

Section 8 addresses other tests described in the Kewaunee FSAR (8).

1.3 Conclusion

The startup testing of Kewaunee's Cycle 5 core has verified that the reactor core has been properly loaded and the core characteristics satisfy the Technical Specifications (9) and are consistent with the parameters used in the design and safety analysis.

TABLE 1.1

KEWAUNEE NUCLEAR POWER PLANT

BOL CYCLE V PHYSICS TEST

Test	Date Completed	Time Completed	Plant Conditions
Cold Rod Drops	7/17/79	1710	200 F/400#
Hot Rod Drops	7/27/79	1900	547 F/2235#
RPI Calibrations	7/29/79	0245	547 F/2235#
Initial Criticality	7/29/79	1003	HZP
Reactivity Computer Checkout	7/30/79	1210	HZP
MTC Determination	7/30/79	1430	HZP
Boron Endpoint - ARO	7/30/79	1545	HZP
Bank C Worth	7/30/79	1830	HZP
Boron Endpoint - C in	7/30/79	1930	HZP
Rod Swap	7/30/79	2330	HZP
Bank D Worth	7/31/79	0300	HZP
Boron Endpoint - D & C in	7/31/79	0330	HZP
Bank B Worth	7/31/79	0515	HZP
Boron Endpoint - D,C,B in	7/31/79	0605	HZP
Bank A Worth	7/31/79	0840	HZP
Boron Endpoint - D,C,B & A in	7/31/79	1015	HZP
Incore T/C and RTD Cross Check	7/31/79	1530	HZP
Control Bank Overlap (A,B,C,D)	7/31/79	1845	HZP
Boron Endpoint - ARO	7/31/79	2015	HZP
Zero Power Flux Map 292	7/31/79	2050	HZP
Power Ascension Flux Map 293	8/01/79	1548	25%
Power Ascension Flux Map 294	8/02/79	0945	41%
Incore/Excore Calibration Flux Map 295	8/06/79	0955	74%
Incore/Excore Calibration Flux Map 296	8/06/79	1250	74%
Incore/Excore Calibration Flux Map 297	8/06/79	1515	74%
Incore/Excore Calibration Flux Map 298	8/07/79	0830	74%
Incore/Excore Calibration Flux Map 299	8/07/79	1245	74%
Measure Reactor Coolant System Flow	8/09/79	0840	90%
Excore Nuclear Instrumentation Calibration	8/10/79	1600	90%
Incore Flux Map 300	8/18/79	1834	90%
Incore Flux Map 301	8/21/79	1325	99%
Incore Flux Map 302 Equilibrium Xenon	8/23/79	1024	100%

LOOP B ↖ LOOP A ↙

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						M8 4 28.05	7 0.00	M8 4 25.98					
B				L8 8 12.40	7 0.00	7 0.00	J7 8 14.54	7 0.00	7 0.00	L8 8 12.35			
C			J11 0 12.53	7 0.00	E8 4 28.00	J5 8 14.09	F7 5 22.43	J9 8 14.09	E8 4 25.95	7 0.00	K4 8 12.57		
D		F12 8 12.39	7 0.00	C4 8 12.57	7 0.00	H11 5 27.41	7 0.00	H3 5 27.34	7 0.00	011 8 12.55	7 0.00	F2 8 12.38	
E		7 0.00	F5 4 25.93	7 0.00	K11 5 22.70	B5 8 10.85	J12 5 20.55	B9 8 10.70	K3 5 22.72	7 0.00	F9 4 25.89	7 0.00	
F	H13 4 25.95	7 0.00	E10 8 14.01	K8 5 27.34	E2 8 10.85	L10 5 20.47	M7 8 7.37	J2 5 20.48	E12 8 10.85	K8 5 27.22	E4 8 14.01	7 0.00	H1 4 25.98
G	7 0.00	010 8 14.54	08 5 22.41	7 0.00	B10 5 20.42	013 8 7.38	07 1 17.89	01 8 7.35	L4 5 20.39	7 0.00	08 5 22.40	04 8 14.58	7 0.00
H	F13 4 25.92	7 0.00	I10 8 14.09	C8 5 27.23	I2 8 10.84	012 5 20.38	A7 8 7.35	B4 5 20.55	I12 8 10.85	C8 5 27.34	I4 8 14.11	7 0.00	F1 4 25.99
I		7 0.00	H5 4 25.91	7 0.00	C11 5 22.77	L5 8 10.82	D2 5 20.45	L9 8 10.83	C3 5 22.74	7 0.00	H9 4 28.00	7 0.00	
J		H12 8 12.43	7 0.00	J3 8 12.50	7 0.00	F11 5 27.28	7 0.00	F3 5 27.34	7 0.00	K10 8 12.55	7 0.00	H2 8 12.45	
K			C10 8 12.49	7 0.00	I8 4 28.00	05 8 14.09	H7 5 22.48	09 8 13.98	I8 4 28.05	7 0.00	D3 8 12.57		
L				B8 8 12.40	7 0.00	7 D.00	07 8 14.57	7 0.00	7 0.0D	B8 8 12.45			
M						A8 4 28.13	7 0.00	A8 4 25.99					

LOOP B ↗ LOOP A ↘

Legend (box):
- CYCLE 4 LOCATION
- REGION
- BURNUP(=1000MWD/MTU)

KEWAUNEE CYCLE 5
CORE LOADING MAP

2.0 RCCA MEASUREMENTS

2.1 RCCA Drop Time Measurements

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

2.2 RCCA Bank Measurements

During Cycle V startup, RCCA bank worth measurements were obtained using two techniques, boration/dilution measurements using the reactivity computer and rod swap reactivity comparisons. Both techniques were used to demonstrate WPS core model applicability in predicting RCCA bank worths for both methods, and thereby demonstrate their equivalent applications for design verification.

2.2.1 Boration/Dilution Technique

For the boration/dilution method a constant boron dilution rate was established and the banks were inserted in incremental steps in order to provide reactivity compensation for the changing boron concentration. The neutron flux changes resulting from RCCA bank movements were converted to reactivity changes using the reactivity computer. These incremental reactivity changes plotted against the corresponding change in RCCA bank position provide the differential control bank plots shown in Figures 2.2, 2.4, 2.6 and 2.8. The integral control bank worths are obtained by summing the individual reactivity measurements and are shown plotted in Figures 2.1, 2.3, 2.5, and 2.7.

2.2.2 Rod Swap Technique

Implementation of the rod swap technique requires the boration/dilution method to measure the worth of the largest worth reference bank, (for this core bank C). The remaining banks are inferred by trading the reactivity worth of the bank with the reference bank (6). This method allows measurement and design verification comparisons of all the RCCA banks in a much shorter period of time than the boration/dilution method. It should be noted that this measured worth is not the same for the bank if it would have been inserted in the normal boration/dilution sequential situation with other RCCA banks in the core. Therefore the rod swap method cannot be used directly in a verification of the shutdown margin of the core.

However, when combined with comparisons of predictions using a model which has been demonstrated to be applicable under both core configurations (i.e. sequential and individual rod bank insertions), the verification of calculated shutdown margin can be adequately demonstrated (inferred).

2.2.3 Rod Bank Measurement Results

The results of the WPS predicted to measured bank worth comparisons are presented in Table 2.2 for both rod swap and boration/dilution. All review and acceptance criteria are adequately met for both techniques. The measured to predicted comparisons of total bank worth were -4.0 % and -3.7 % for the boration/dilution and rod swap methods, respectively. These results verify that the WPS core model can calculate and predict the measured worths with equivalent accuracy for both the sequential or rod swap situations. Therefore, rod swap comparisons to WPS core model predictions can be used to adequately infer shutdown margin.

2.3 Shutdown Margin Evaluation

Prior to power escalation a shutdown margin evaluation was made to verify the existence of core shutdown capability. The shutdown margin evaluation is performed at beginning and end of cycle under various core configurations. The minimum shutdown margins at beginning and end of cycle are presented in Table 2.3. A 10% margin is allotted in the calculation of rod worth in these shutdown margin analyses. Since the measured rod worths using both techniques resulted in less than a 10% difference from predicted values, the analysis in Table 2.3 is conservative and no additional evaluation is necessary.

TABLE 2.1

KEWAUNEE CYCLE V

RCCA DROP TIME MEASUREMENTS

HOT ZERO POWER

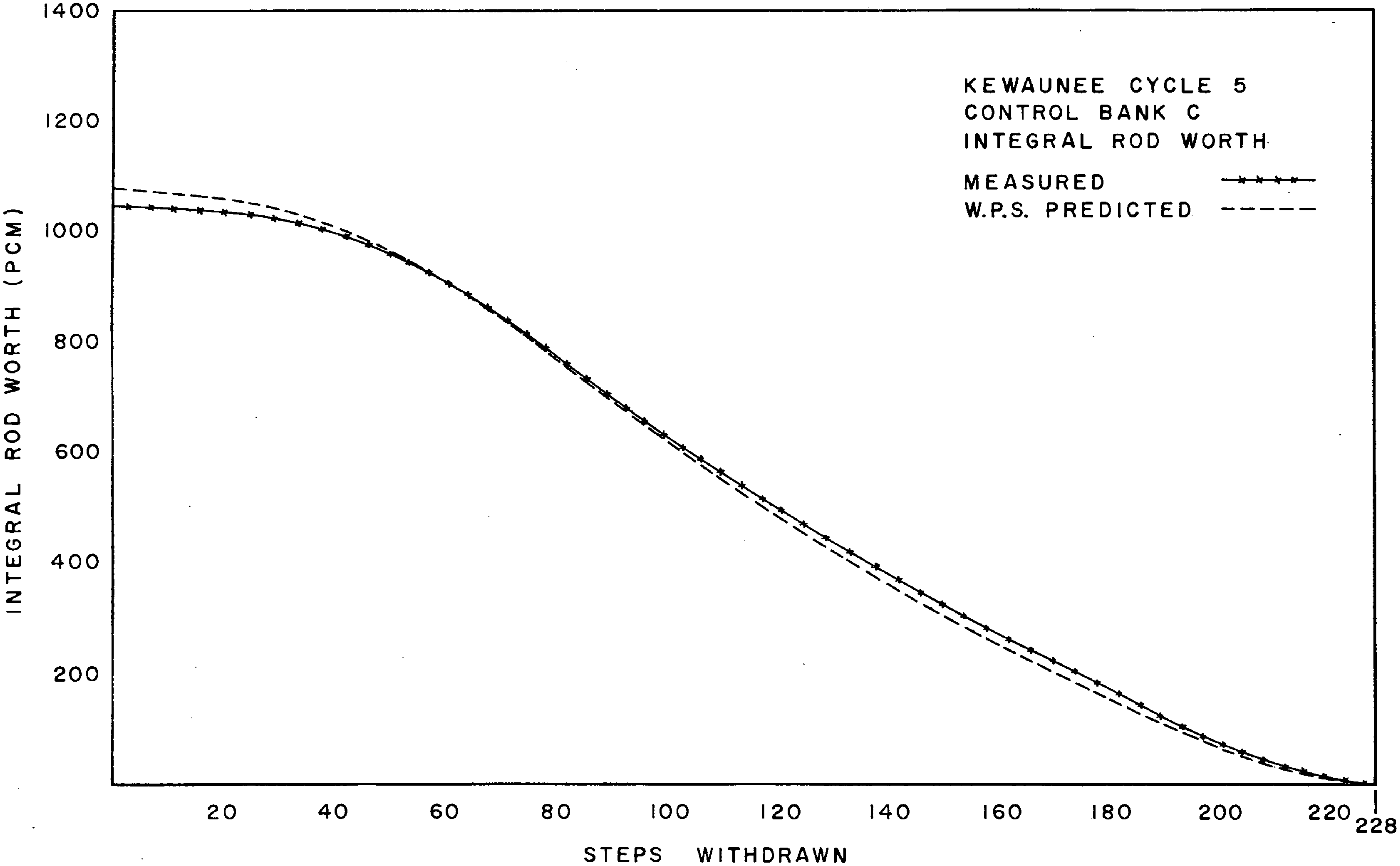
	All Fuel	Westinghouse Fuel	Exxon Fuel
Dashpot Delta T (Sec)	1.297	1.313	1.255
Standard Deviation	.034	.023	.018
Rod Bottom Delta T (Sec)	1.766	1.781	1.726
Standard Deviation	.0375	.030	.023

TABLE 2.2
KEWAUNEE CYCLE V
RCCA BANK WORTH SUMMARY

Dilution Method RCCA Bank	Measured Worth (PCM)	WPS Predicted Worth (PCM)	Difference PCM	Percent Difference
C	1045	1077	32	-3.0
D	870	927	57	-6.1
B	866	941	75	-8.0
A	1571	1588	17	-1.1
Total	4352	4533	181	-4.0

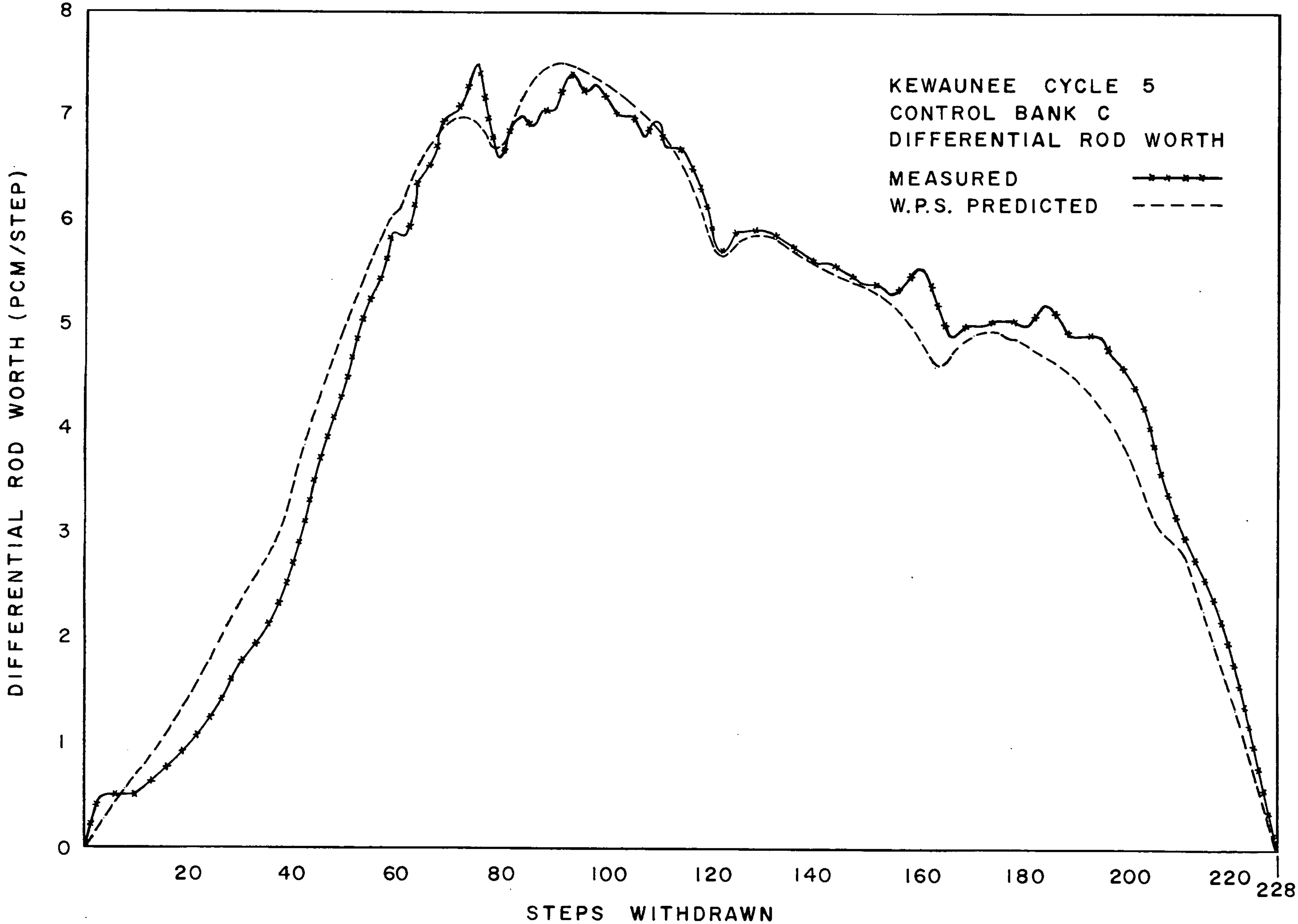
Rod Swap Method RCCA Bank	Measured Worth (PCM)	WPS Predicted Worth (PCM)	Difference PCM	Percent Difference
D	640.5	702	61.5	-8.8
C	1045.0	1077	32.0	-3.0
B	679.7	685	5.3	-0.8
A	908.0	909	1.0	-0.1
SA	565.6	595	29.4	-4.9
SB	556.6	595	38.4	-6.4
Total	4395.4	4563	167.6	-3.7

FIG. 2.1



KEWAUNEE CYCLE 5
CONTROL BANK C
INTEGRAL ROD WORTH
MEASURED
W.P.S. PREDICTED
INTEGRAL ROD WORTH (PCM)
1400
1200
1000
800
600
400
200
20
40
60
80
100
120
140
160
180
200
220
228
STEPS WITHDRAWN

FIG. 2.2



KEWAUNEE CYCLE 5
CONTROL BANK C
DIFFERENTIAL ROD WORTH
MEASURED
W.P.S. PREDICTED
DIFFERENTIAL ROD WORTH (PCM/STEP)
STEPS WITHDRAWN
0
1
2
3
4
5
6
7
8
20
40
60
80
100
120
140
160
180
200
220
228

FIG. 2.3

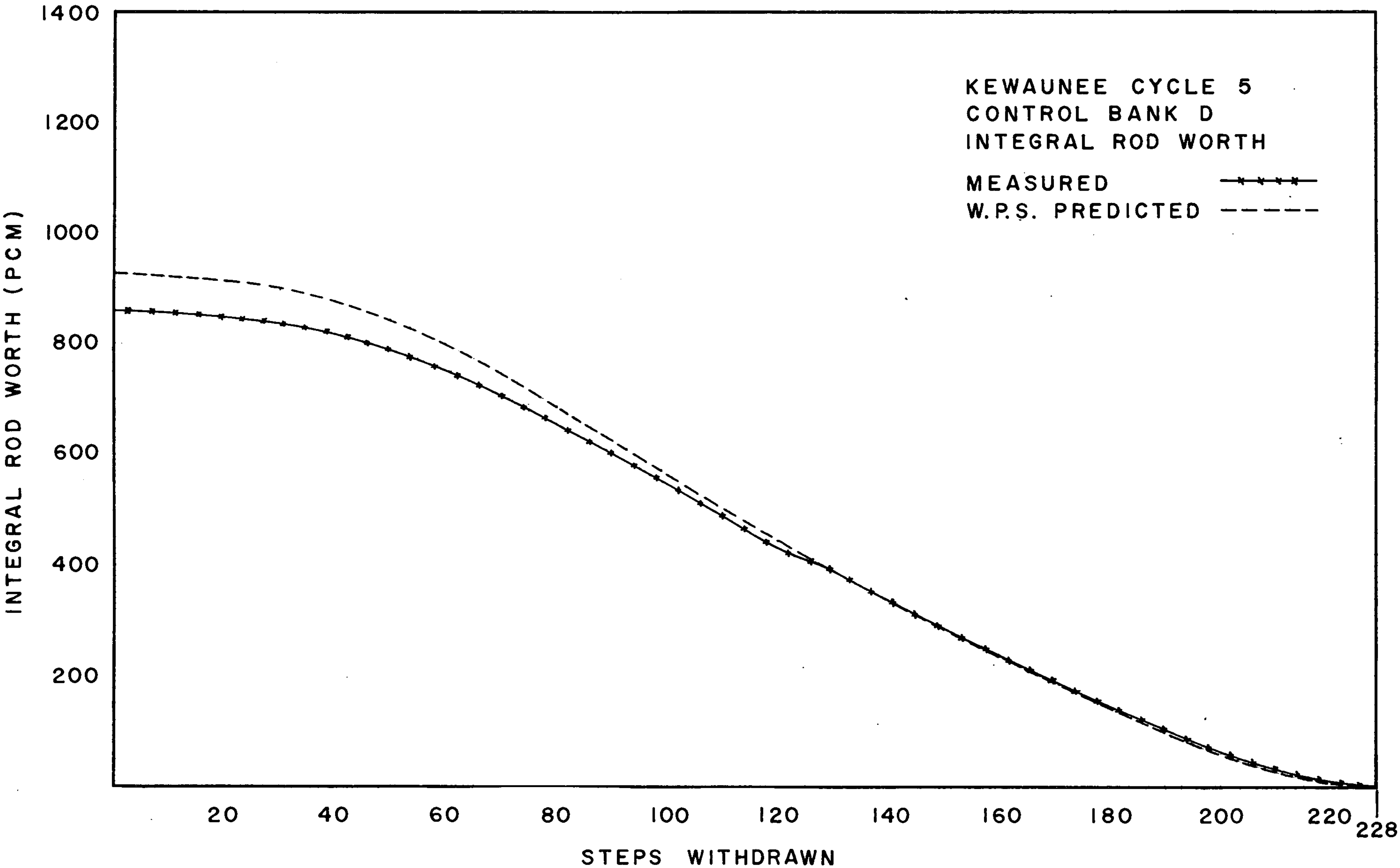

KEWAUNEE CYCLE 5
CONTROL BANK D
INTEGRAL ROD WORTH
MEASURED
W.P.S. PREDICTED
INTEGRAL ROD WORTH (PCM)
1400
1200
1000
800
600
400
200
20
40
60
80
100
120
140
160
180
200
220
228
STEPS WITHDRAWN

FIG. 2.4

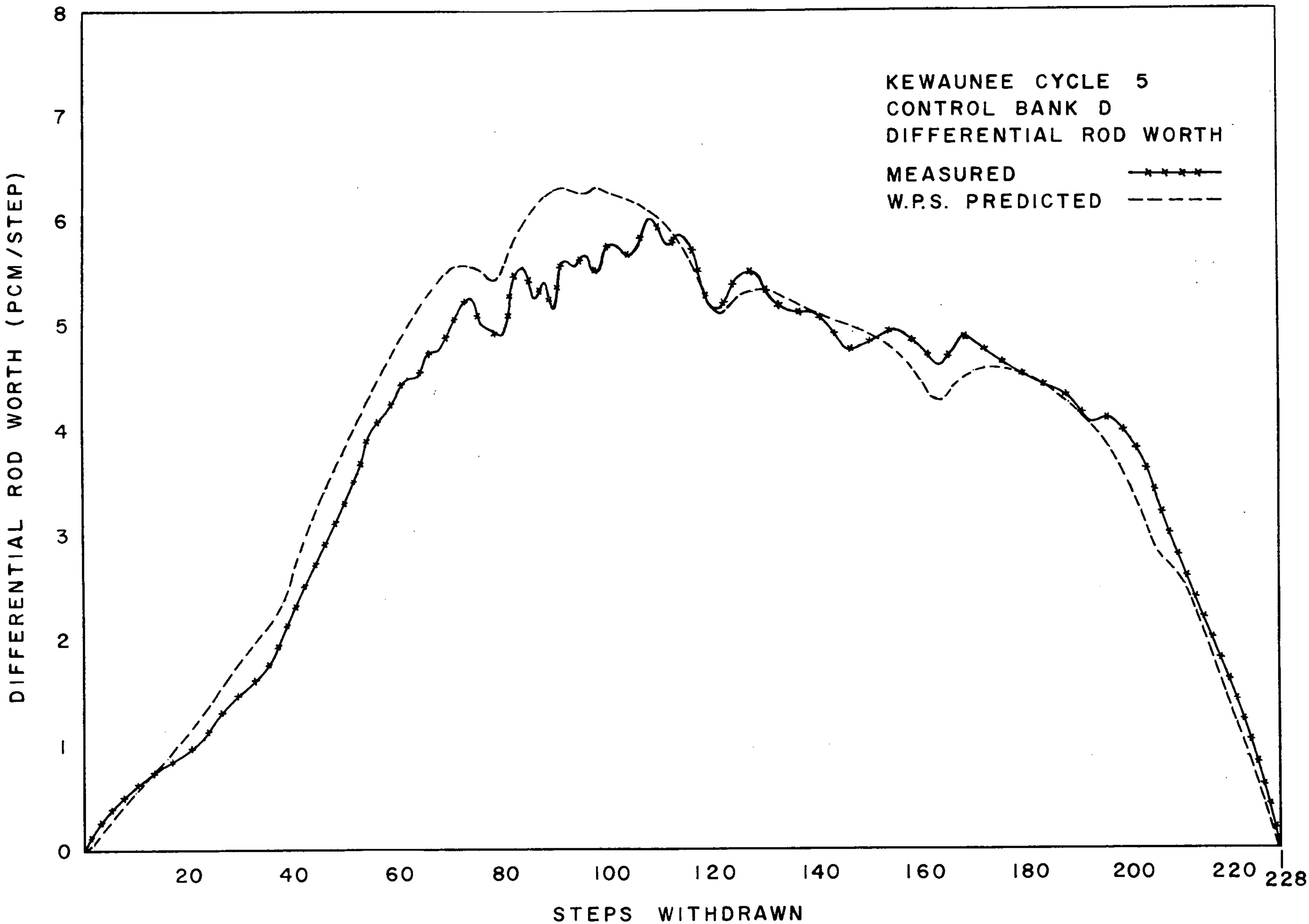
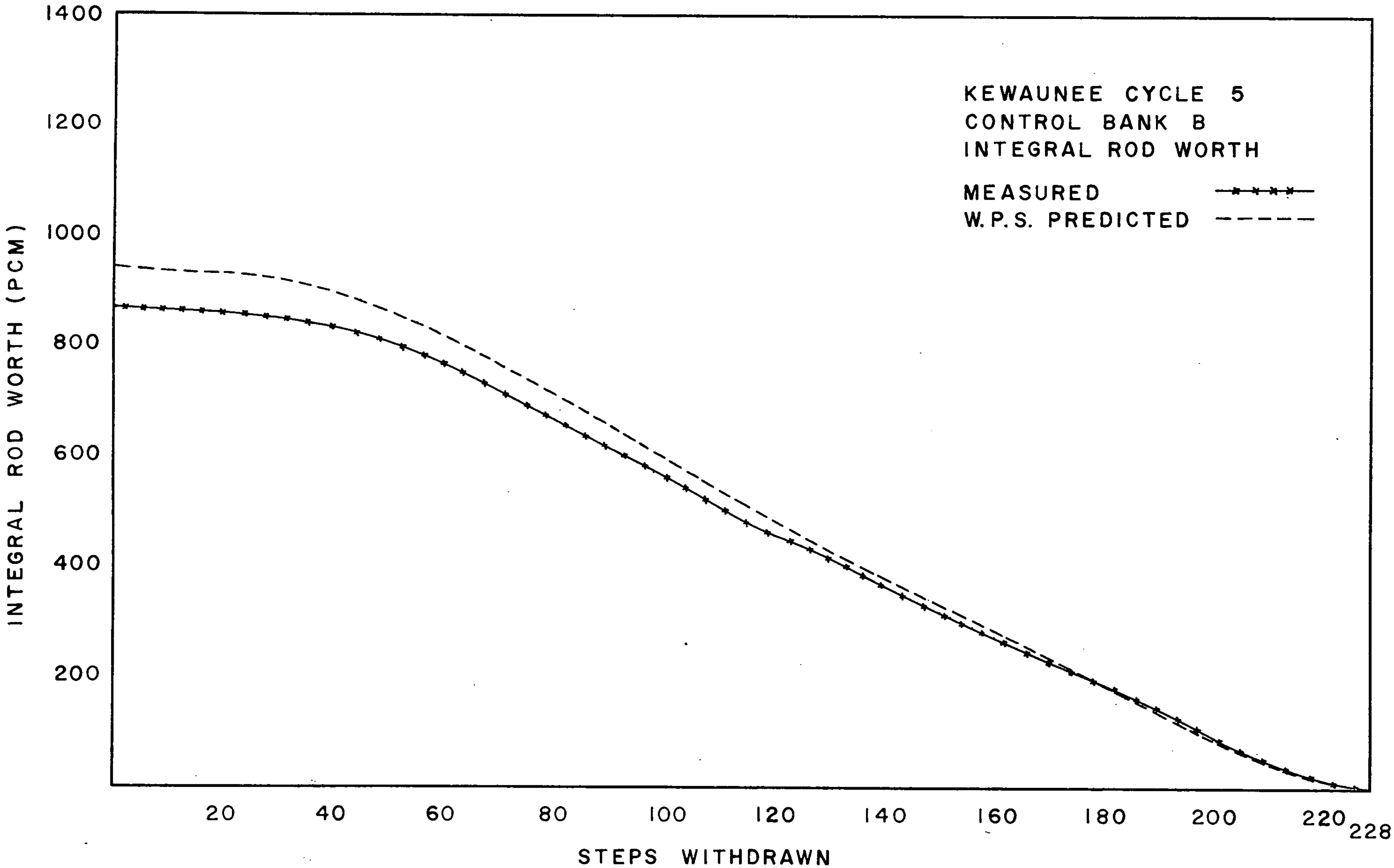
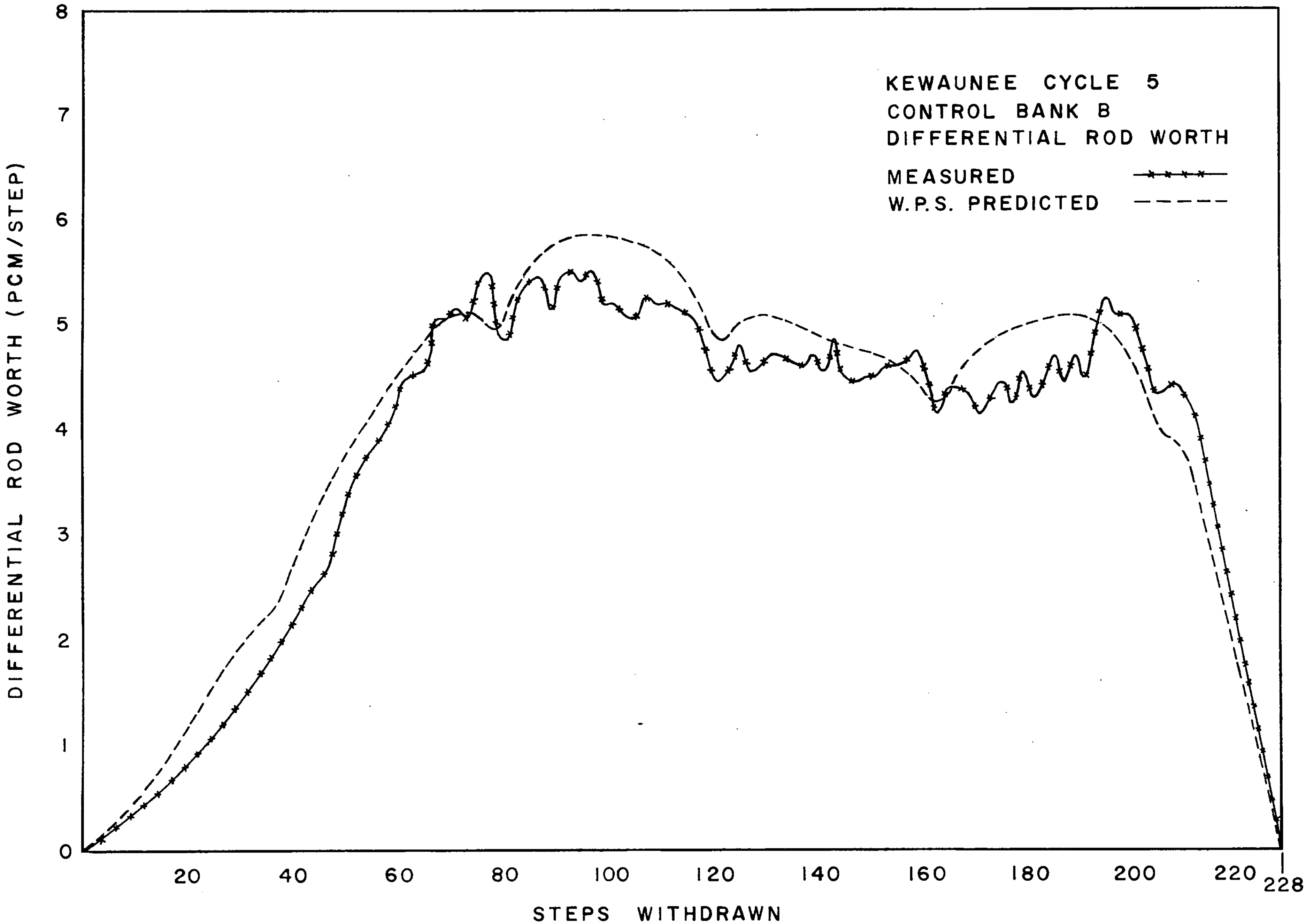

KEWAUNEE CYCLE 5
CONTROL BANK D
DIFFERENTIAL ROD WORTH
MEASURED
W.P.S. PREDICTED
DIFFERENTIAL ROD WORTH (PCM/STEP)
STEPS WITHDRAWN
0
1
2
3
4
5
6
7
8
20
40
60
80
100
120
140
160
180
200
220
228

FIG. 2.5



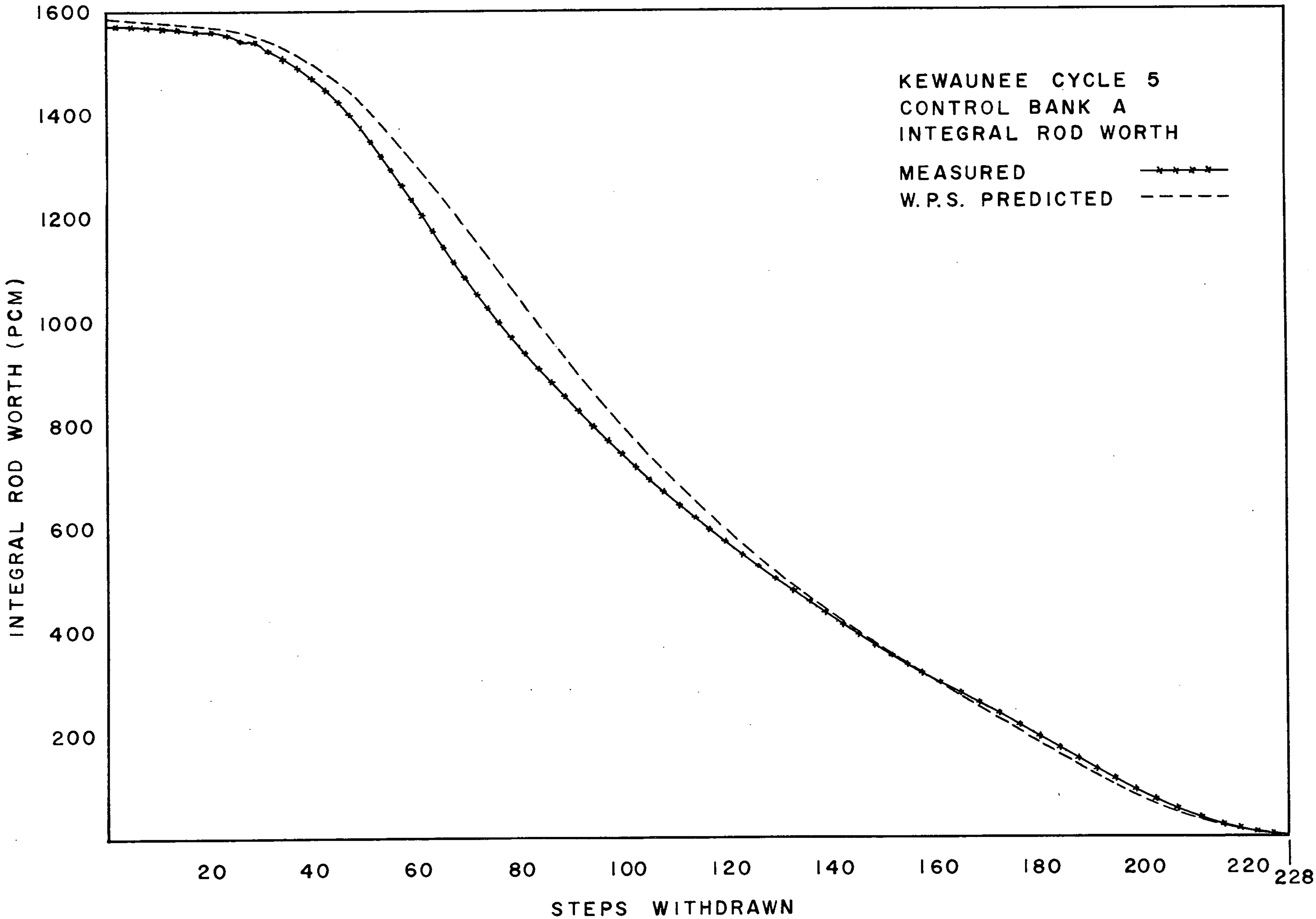
KEWAUNEE CYCLE 5
CONTROL BANK B
INTEGRAL ROD WORTH
MEASURED
W.P.S. PREDICTED
INTEGRAL ROD WORTH (PCM)
1400
1200
1000
800
600
400
200
20
40
60
80
100
120
140
160
180
200
220
228
STEPS WITHDRAWN

FIG. 2.6



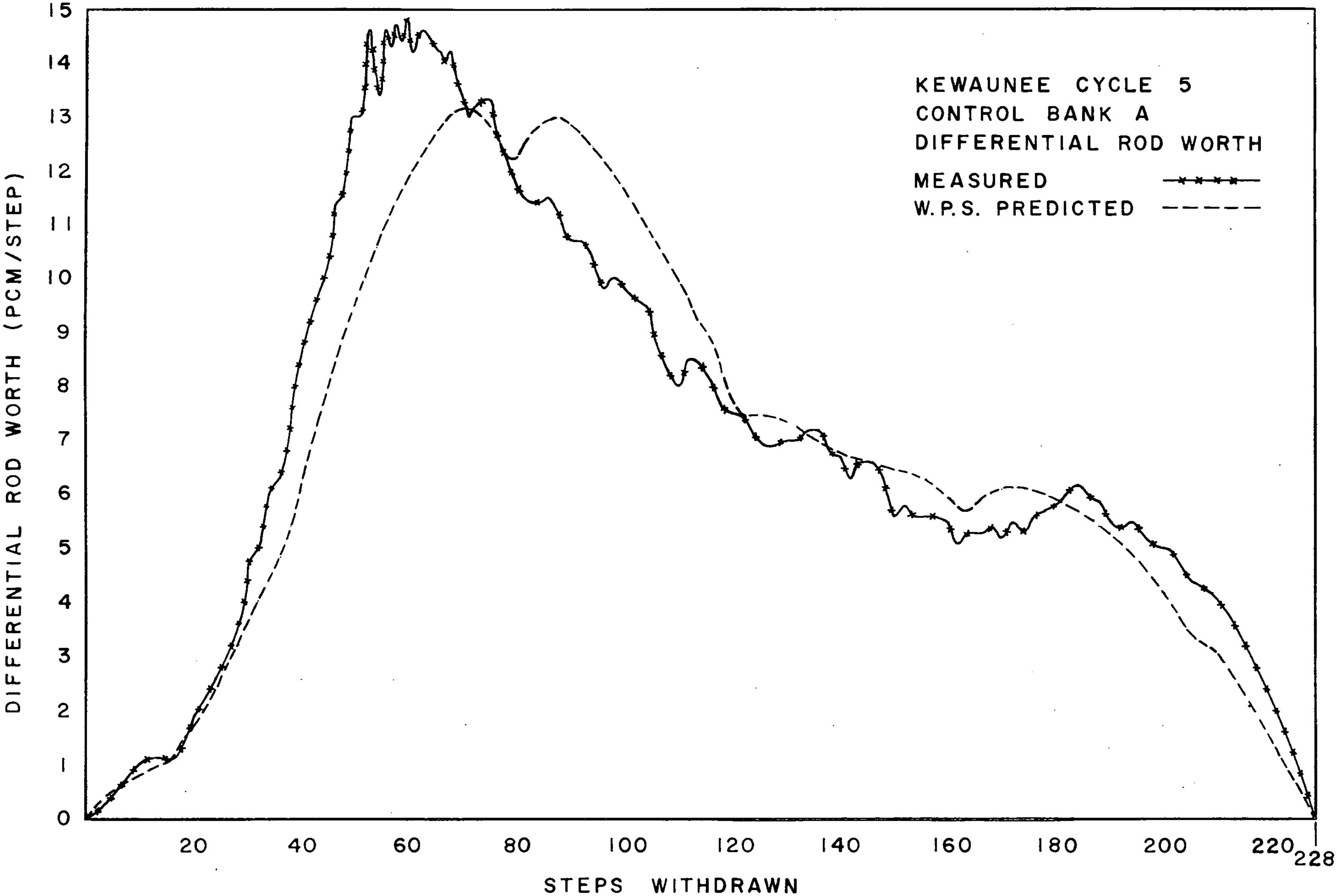
KEWAUNEE CYCLE 5
CONTROL BANK B
DIFFERENTIAL ROD WORTH
MEASURED
W.P.S. PREDICTED
DIFFERENTIAL ROD WORTH (PCM/STEP)
STEPS WITHDRAWN
0
1
2
3
4
5
6
7
8
20
40
60
80
100
120
140
160
180
200
220
228

FIG. 2.7



KEWAUNEE CYCLE 5
CONTROL BANK A
INTEGRAL ROD WORTH
MEASURED
W.P.S. PREDICTED
INTEGRAL ROD WORTH (PCM)
1600
1400
1200
1000
800
600
400
200
20
40
60
80
100
120
140
160
180
200
220
228
STEPS WITHDRAWN

FIG. 2.8



KEWAUNEE CYCLE 5
CONTROL BANK A
DIFFERENTIAL ROD WORTH
MEASURED
W.P.S. PREDICTED
DIFFERENTIAL ROD WORTH (PCM/STEP)
STEPS WITHDRAWN
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
20
40
60
80
100
120
140
160
180
200
220
228

TABLE 2.3

KEWAUNEE CYCLE V

MINIMUM SHUTDOWN MARGIN ANALYSIS

	BOC	EOC
RCCA Bank Worths (PCM)		
N	6005	6528
N-1	5278	5629
Less 10 Percent	527.8	562.9
Sub Total	4750	5066
Total Requirements		
(Including Uncertainties)	2010	2533
Shutdown Margin	2740	2533
Required Shutdown Margin	1000	2000

3.0 BORON ENDPOINTS AND BORON WORTH MEASUREMENTS

3.1 Boron Endpoints

During rod movements to measure rod worth and differential boron worth, the dilution was stopped near the fully inserted position of control banks C, D, B, and A, respectively, to obtain boron endpoint measurements. The boron concentration was allowed to stabilize and the just critical boron concentration was determined 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 37 PPM bias for the measured all rods out endpoint value. This reactivity bias is also evident in the predicted to measured comparisons under the various RCCA bank configurations. The acceptance criterion on the all rods out boron endpoint is + or - 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 banks C, D, B, and A by the difference in boron endpoint measurements of the corresponding bank out and bank in configuration. Table 3.2 presents boron worth comparisons and indicates good agreement between measured and predicted values. No acceptance criteria are applied to these comparisons.

TABLE 3.1

KEWAUNEE CYCLE V

RCCA BANK ENDPOINT MEASUREMENTS

RCCA Bank Configuration	Measured Endpoint (PPM)	WPS Predicted Endpoint (PPM)	Difference (PPM)
All Rods Out	1439	1402	37
Bank C In	1307	1271	36
Bank D,C In	1198	1157	41
Bank D,C,B In	1101	1045	56
Bank D,C,B,A In	900	839	61

TABLE 3.2

KEWAUNEE CYCLE V

DIFFERENTIAL BORON WORTH

RCCA Bank Configuration	CB Change Measured (PPM)	CB Change Predicted (PPM)	Measured Boron Worth (PCM/PPM)	Predicted Boron Worth (PCM/PPM)	Percent Difference
Bank In					
C	132	131	-7.92	-8.22	-3.6
C,D	109	114	-7.98	-8.13	-1.8
C,D,B	97	112	-8.93	-8.40	6.3
C,D,B,A	201	206	-7.82	-7.71	-1.4

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 at 183 steps, all other RCCA banks full out, with a boron concentration of 1430 PPM. This condition approximates the HZP, all rods out core condition which yields the least conservative (most positive) 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 of + or - 3 PCM/Degree F is adequately met.

TABLE 4.1

ISOTHERMAL TEMPERATURE COEFFICIENT

Cooldown

Tave Start	543 Degrees F
Tave End	534 Degrees F
Bank D	183 Steps
Boron Concentration	1430 PPM

Measured ITC (PCM/DEG F)	WPS Predicted ITC (PCM/DEG F)	Error (PCM/DEG F)
-2.4	-2.8	0.4

Heat Up

Tave Start	538 Degrees F
Tave End	543 Degrees F
Bank D	183 Steps
Boron Concentration	1424 PPM

Measured ITC (PCM/DEG F)	WPS Predicted ITC (PCM/DEG F)	Error (PCM/DEG F)
-2.4	-2.8	0.4

5.0 POWER DISTRIBUTION

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

Review criteria are established on the measurement by verifying that the percent difference of the normalized reaction rate integrals of symmetric thimbles do not exceed 5% at low power physics tests and 3% at equilibrium conditions (4).

Review criteria are established on the prediction by verifying that the standard deviation of percent difference between measured and predicted reaction rate integrals does not exceed 5%.

Review criteria are also established for INCORE calculated quadrant power such that the quadrant tilt is less than 5% at low power physics tests and 2% at equilibrium conditions (4).

Table 5.1 identifies the flux maps recorded and the reactor conditions for the beginning of Cycle 5.

Table 5.2 identifies flux map peak FDHN and FQN and addresses acceptance criteria by verifying that technical specifications limits were not exceeded.

Table 5.3 identifies for the flux maps:

a) the maximum measured difference in reaction rate integrals between symmetric thimble locations,

b) the standard deviation between measured and predicted percent difference of reaction rate integrals,

c) the percent maximum calculated quadrant tilt,

and verifies that the review criteria are not exceeded.

The results of the Hot Zero Power Flux Map initially did not meet the review criteria. The failure was determined to be measurement inconsistencies frequently observed at these low power levels. A flux map (293) was recorded at 25% power to address the review criteria. The results of Flux Map 293 met the review criteria. The Kewaunee Plant Operations Review Committee (PORC) reviewed the results of Flux Maps 292 and 293 (item no. 79-21, PORC meeting 79-67) and recommended concurrence with the Flux Map 293 evaluation. The plant was released from the low power physics test phase to the power escalation phase. An analytic review of Flux Map 292 identified the measurement inconsistencies. A re-evaluation of the map, with the measurement inconsistencies removed, exhibited agreement with the review criteria.

All flux maps taken during the power escalation phase met the acceptance and review criteria.

TABLE 5.1

FLUX MAP CHRONOLOGY AND REACTOR CHARACTERISTICS

Map	Date-Time	Percent Power	Xenon	Boron PPM	D Rods Steps	Exposure MWD/MTU
292	7/31/79-2050	0	None	1424	216	0
293	8/01/79-1548	25	0.05	1340	150	0
294	8/02/79- 954	41	0.48	1175	201	11
295	8/06/79- 953	74	EQ.	1017	228	77
296	8/06/79-1250	74	EQ.	1017	202	80
297	8/06/79-1513	74	EQ.	1017	186	84
298	8/07/79- 827	74	EQ.	1013	228	102
299	8/07/79-1234	74	EQ.	1013	160	106
300	8/18/79-1834	90	EQ.	952	228	224
301	8/21/79-1325	99	0.92	947	210	287
302	8/23/79-1024	100	EQ.	923	228	353

TABLE 5.2

VERIFICATION OF ACCEPTANCE CRITERIA

Flux Map	Core Location	FQN	Limit	Percent Margin
292	H-09KJ,13	2.47	4.12	40.0
*292	H-09KJ,13	2.50	4.12	39.3
293	I-10GH,31	2.09	4.32	51.6
294	I-10GH,23	1.90	4.23	55.1
295	I-10GH,23	1.84	2.86	35.7
296	H-12DE,32	1.84	2.92	37.0
297	H-12DE,34	1.92	2.92	34.2
298	I-10GH,23	1.85	2.86	35.3
299	I-10GH,44	2.12	2.92	27.4
300	I-10GH,22	1.82	2.35	22.6
301	B-08EK,34	1.80	2.18	17.4
302	B-08EK,34	1.80	2.16	16.7

Flux Map	Core Location	FDHN	Limit	Percent Margin
292	D-11CJ	1.56	1.86	16.1
*292	H-09KJ	1.55	1.86	16.7
293	H-09KJ	1.54	1.78	13.5
294	I-10GH	1.48	1.73	14.5
295	I-10GH	1.47	1.63	9.8
296	I-10GH	1.48	1.63	9.2
297	I-10GH	1.48	1.63	9.2
298	I-10GH	1.47	1.63	9.8
299	I-10GH	1.49	1.63	8.6
300	I-10GH	1.47	1.58	7.0
301	I-10GH	1.47	1.55	5.2
302	I-10GH	1.47	1.55	5.2

FQN and FDHN include appropriate uncertainties and penalties.

Limit on FQN is a function of Core Power and Axial Location.

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

Percent Margin is [(Limit-Measured)/Limit)] *100

*292 is 292 with data inconsistencies eliminated

TABLE 5.3

VERIFICATION OF REVIEW CRITERIA

Flux Map	(a) Maximum Percent Difference	(b) Standard Deviation	(c) Maximum Quadrant Tilt
292	14.7	8.4	3.8
*292	4.8	4.3	2.5
293	3.4	2.4	1.7
294	2.2	1.6	1.2
295	2.3	1.6	1.1
296	2.4	1.7	1.3
297	2.5	2.3	1.5
298	2.1	1.5	1.2
299	2.6	2.8	1.3
300	2.3	1.5	1.2
301	2.7	1.5	1.0
302	2.6	1.5	1.2

(a) Maximum Percent Difference between symmetric thimbles for measured reaction rate integrals. Review criteria are 5% at low power, 3% at equilibrium power.

(b) Standard Deviation of the percent difference between measured and predicted reaction rate integrals. Review criteria are 5%.

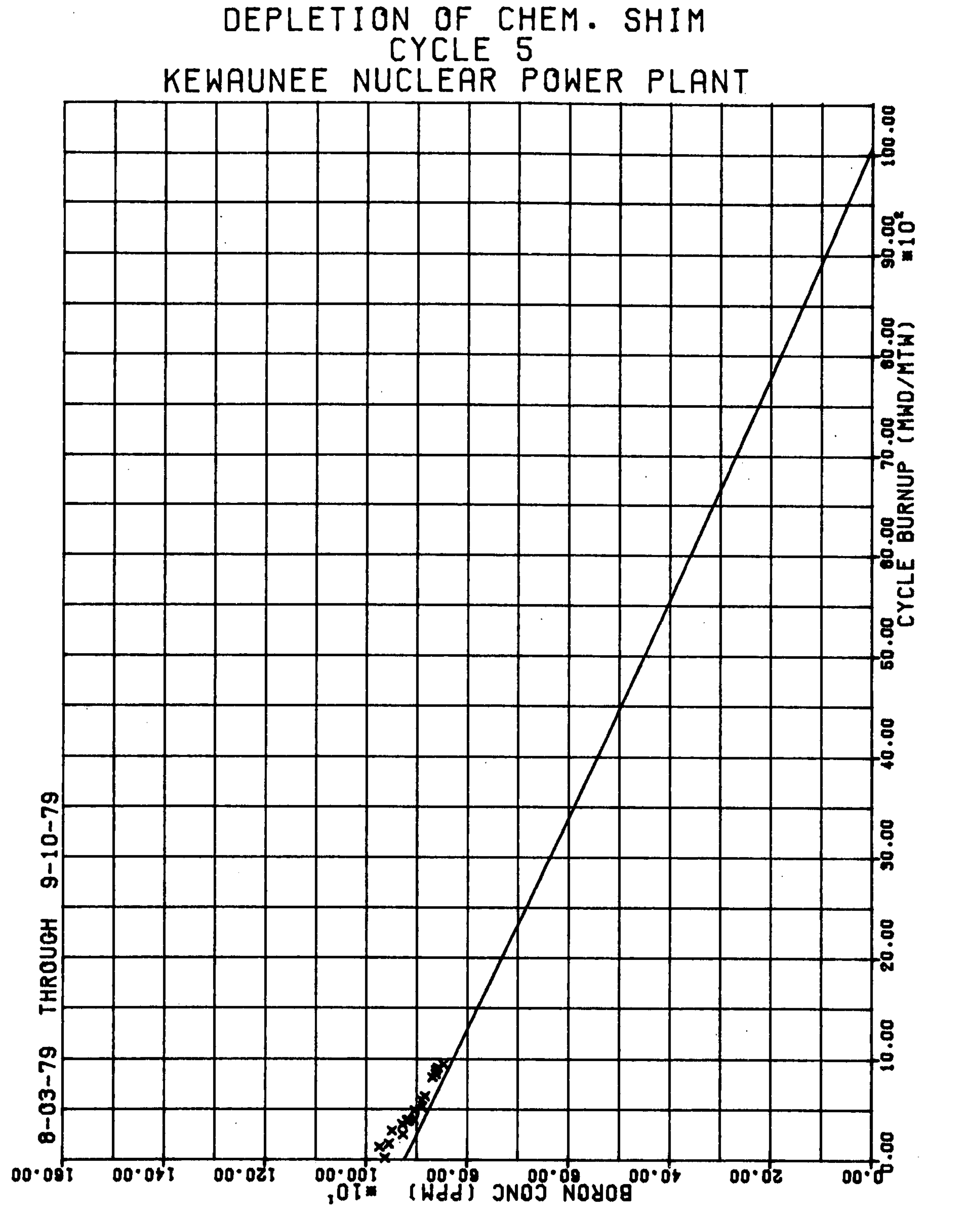
(c) Percent Maximum Quadrant Tilt from normalized calculated quadrant powers. Review criteria are 5% at low power, 2% at equilibrium power.

*292 is 292 with data inconsistencies eliminated.

6.0 BORON LETDOWN

The measured boron concentration data for the first few days of power operation is corrected to nominal core conditions and presented versus cycle burnup in Figure 6.1. The predicted boron letdown curve is included for comparison.

Figure 6.1


DEPLETION OF CHEM. SHIM
CYCLE 5
KEWAUNEE NUCLEAR POWER PLANT
8-03-79 THROUGH 9-10-79
CYCLE BURNUP (MWD/MTW) *10²
BORON CONC (PPM) *10¹

7.0 REACTOR STARTUP CALIBRATIONS

7.1 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 at 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 bistable trip setpoint is checked

The calibration was performed satisfactorily during the Cycle 5 startup; no problems or abnormalities were encountered and site procedure acceptance criteria were met.

7.2 Thermocouple and RTD Cross Calibration

KNPP utilizes incore thermocouples (T/C'S) for core exit temperature measurements and resistance temperature devices (RTD'S) for loop temperature measurements. This instrumentation is cross checked with other instrumentation after each reload to insure proper operation. The cross check is two-fold: the T/C'S and RTD'S should trend together and the temperature of saturated steam as indicated by the Heise pressure gauge is consistent with the measured temperatures.

Two new RTD'S were installed this cycle and were calibrated using the Heise steam generator pressure measurement. The cross calibration check performed during the cycle five startup was completed normally and satisfied all acceptance criteria as defined in the Kewaunee site test procedure.

7.3 Nuclear Instrumentation Calibration

The nuclear instrumentation (NI) calibration was performed in accordance with the Kewaunee Reactor Test Program during the Cycle 5 startup (4). Several flux maps were performed over a range of axial offsets at approximately 74 % power. The incore axial offset to excore axial offset ratio was generated for each detector from the data collected during the mappings. These ratios agreed well with previous results. The NI'S were then calibrated with a conservative incore axial offset-to-excore axial offset ratio of 1.7.

8.0 TECHNICAL SPECIFICATIONS REQUIREMENTS

The Kewaunee Nuclear Power Plant Technical Specification, Section 6.9.A.1 requires this report to address the startup and power escalation tests described in Section 13 of the Kewaunee Nuclear Power Plant FSAR (8). The applicable tests can be divided into the following two groups:

1) System Response Tests
2) Plant Transient Response Tests.
3) Other Tests

8.1 System Response Tests

These tests are:

- Automatic control system checkout
- Load swing test
- Load rejection test
- Step load reduction test
- Turbine generator startup test
- Turbine generator trip
- Static RCCA Test
- Dynamic RCCA Drop Test
- PZR Spray Effectiveness Test
- 100 Hour Acceptance Run

Their purpose is to verify the proper operation of the combined primary and secondary systems. They were performed with satisfactory results during the initial startup and testing of the Kewaunee Plant. Since these tests are not dependent on specific fuel design parameters, they were not affected by the change in fuel suppliers and were not repeated during this outage.

8.2 Plant Transient Response Tests

Change in specific fuel design parameters could have an effect on certain Plant Transient responses described in the Kewaunee FSAR (8). Exxon Nuclear Corporation performed a plant transient analysis for the Kewaunee Plant (7) to show compatibility of Exxon fuel design to the Kewaunee Plant Systems. The following transients were analyzed:

- Fast rod withdrawal
- Slow rod withdrawal
- Coastdown of both primary coolant pumps
- Seizure of core primary coolant pump
- Loss of external electric load
- Large steam line break
- Small steam line break

The transient analyses predicted that there is adequate margin to the regulatory limits with Exxon fuel used in the Kewaunee core under the plant transient assumed operating conditions. No further testing was performed.

8.3 Other Tests

8.3.1 Power Coefficient Measurement

WPS predicts the power coefficient to compute the shutdown margin and to predict boron endpoint data. Therefore, verification of the power coefficient prediction is implicit in the boron measurements done at power and direct measurement of the power coefficient is unnecessary. The full power boron endpoint and letdown data show good agreement with predictions, thus implicitly verifying the power coefficient prediction.

8.3.2 Minimum Shutdown Margin Measurement

The shutdown margin is determined as described in Section 2.3. Since the rod worth measurements meet the acceptance criteria and the analysis used to determine the shutdown margin is conservative, direct measurement of the shutdown margin is not required and was not performed.

8.3.3 Part Length Rod Group Operation

Kewaunee Nuclear Power Plant does not utilize part length rods; therefore this test is not applicable.

9.0 REFERENCES

(1) "Reload Safety Evaluation Kewaunee Cycle V", Wisconsin Public Service Corporation, April, 1979

(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

(4) "Reactor Test Program, Kewaunee Nuclear Power Plant",Wisconsin Public Service Corporation, May, 1979

(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) "Plant Transient Analysis for the Kewaunee Nuclear Power Plant", Exxon Nuclear Corporation, January 1979

(8) "Kewaunee Final Safety Analysis Report",Wisconsin Public Service Corporation, Docket 50-305

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