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DIRNP-91-155
NRC-91-082

August 16, 1991

Document Control Desk
U. S. NUCLEAR REGULATORY COMMISSION
Mail Station P1-137
Washington, DC 20555

Gentlemen:

DOCKETS 50-266
CYCLE 19 STARTUP REPORT
POINT BEACH NUCLEAR PLANT UNIT 1

Enclosed herewith is a summary report of the startup and power escalation testing for the Point Beach Nuclear Plant Unit 1 following refueling 18. This report is intended to document in a concise format the results of the physics testing program and the unit systems response during the unit startup. The new fuel for this cycle consisted of 16 Optimized Fuel Assemblies (OFAs) with 4.0 weight percent U-235 and 12 OFAs with 3.6 weight percent U-235. This is the first cycle that incorporates Integral Fuel Burnable Absorbers (IFBAs) and axial blankets of natural uranium. This is also the first cycle not using secondary neutron source assemblies. We are providing this report for the information of the NRC as requested by your staff.

Please contact us if you have any questions concerning this submittal

Very truly yours,

CW Fay for

James J. Zach
Director
Nuclear Power

Copies to NRC Regional Administrator, Region III
NRC Resident Inspector

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WISCONSIN ELECTRIC POWER COMPANY

POINT BEACH NUCLEAR PLANT

UNIT 1 CYCLE 19 STARTUP

MAY, 1991

BY

P. N. KURTZ

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PREFACE

This report is intended to document in a concise format the results of the physics testing program and unit systems response during the startup of Unit 1 following Refueling 18.

Westinghouse performed the core design calculations for Unit 1 Cycle 19. The reactivity coefficients were calculated based on estimated Cycle 18 burnup of 10,750 MWD/MTU. Actual burnup was 10,748 MWD/MTU. Cycle 18 was ended on April 6, 1991, with a peak assembly burnup of 45,071 MWD/MTU and average assembly burnup of 31,024 MWD/MTU. Electrical power was first generated during Cycle 19 on May 21, 1991.

This report is intended primarily for the use of Wisconsin Electric Power Company personnel as a readily accessible, complete compilation of reduced data.

UNIT 1 CYCLE 19 STARTUP REPORT
May 1991

1.0 REFUELING

1.1 Fuel Movement

A core shuffle was performed with a maximum of 11 core locations empty at any given time. The shuffle started on April 22, 1991 at 1000. The first objective was to unload twelve fuel assemblies (F/As) containing burnable poison inserts. This gave the SFP crews the maximum amount of time to remove the burnable poison inserts before the F/As were needed to complete the shuffle.

Excore detector count rates at the start of the core shuffle were 110 CPS from N31, 120 CPS from N32 and 20 CPS from N40. Count rates ranged from 68 to 126 CPS from N31, 52 to 124 CPS from N32 and 10 to 24 CPS on N40. Count rates at the end of the shuffle were 64 CPS from N31, 60 CPS from N32 and 17 CPS from N40. The secondary sources were permanently removed from the core accounting for the lower counts at end of the shuffle.

Boron concentration was maintained above 2000 ppm at all times. Westinghouse conservatively calculated a minimum boron concentration of 1716 ppm was required to keep the core shutdown by greater than 5 percent at all times during the shuffle. Basic restrictions were to allow no temporary repositions of fuel and that no more than three control rods would be out of the core at any time. These restrictions were part of the refueling procedure (RP-1C) and were adhered to at all times.

There was one fuel handling incident involving slight damage to a F/A. A small section of the uppermost grid of F/A U07 was torn and folded over. The fold was approximately 1 inch long and turned up about 1/4 of an inch. A manipulator overload trip occurred when removing the adjacent F/A (H85). The torn grid on U07 was discovered by looking at the core with binoculars after H85 was removed. When U07 was inspected at the periscope, it was not certain when the damage occurred because there were no shiny scratches. Westinghouse recommended that U07 could be reused, with reasonable certainty that the damage would remain stable and not cause further damage. U07 was reloaded without incident. F/A H85 had no indications of scratching or other damage on any of its faces.

Minor bowing problems resulted in a field change to the fuel shuffle sequence. F/A U27 at core location L-9 leaned into a hole at location L-10. F/A T09 was temporarily placed in the END basket after unsuccessfully trying to reposition it into location L-10. The manipulator was used to reseat F/A U27. F/A T09 was then moved into L-10 with no load deflections.

The source assemblies were removed from the core without incident.

There were no significant mechanical problems with the fuel transfer system.

The fuel shuffle ended on April 27, 1991 at 0038.

1.2 Core Design

New fuel (X01 - X28) for Cycle 19 consists of 16 OFAs with 4.0 w/o U-235 and 12 OFAs with 3.6 w/o U-235.

This is the first cycle that incorporates Integral Fuel Burnable Absorbers (IFBAs) and axial blankets of natural uranium.

This is the first cycle not using secondary source assemblies.

The as-loaded core matches the initial core loading pattern. The core configuration is shown in Figure 1-1. Of the 121 F/As loaded, 120 are OFAs and 1 is of the older standard design (from the SFP) in location G-7. The as-loaded burnups for each fuel assembly are shown in Figure 1-2.

All control rods used in Cycle 18 were reloaded for Cycle 19.

FIGURE 1-1

FI[illegible] CORE LOADING PATTERN U1C18

					A- 6 R23 1H109	A- 7 R19 1H107	A- 8 R26 1H113					
			B- 4 P11	B- 5 T17	B- 6 V18 R146	B- 7 V20	B- 8 V21 R504	B- 9 T19	B-10 H71			
		C- 3 S28	C- 4 V03	C- 5 V06 R96	C- 6 T05	C- 7 T04 R85	C- 8 T02	C- 9 V08 R137	C-10 V14	C-11 S17		
	D- 2 H67	D- 3 V15	D- 4 S19 R92	D- 5 S25	D- 6 U22 4P147	D- 7 U15	D- 8 V29 4P144	D- 9 S26	D-10 S20 R100	D-11 V02	D-12 P20	
	E- 2 T14	E- 3 V16 R124	E- 4 S30	E- 5 U28 R132	E- 6 U03	E- 7 T18	E- 8 U08	E- 9 U18 R147	E-10 S24	E-11 V04 R94	E-12 T27	
F- 1 R09 1H115	F- 2 V26 R101	F- 3 T03	F- 4 U19 4P146	F- 5 U05	F- 6 T25 R97	F- 7 U07	F- 8 T23 R108	F- 9 U04	F-10 U17 4P150	F-11 T08 S57	F-12 V27 R89	F-13 R14 1H104
G- 1 R27 1H103	G- 2 V17	G- 3 T01 R143	G- 4 U23	G- 5 T28	G- 6 U12	G- 7 H85 R129	G- 8 U01	G- 9 T24	G-10 U16	G-11 T12 R130	G-12 V28	G-13 R28 1H110
H- 1 R08 1K101	H- 2 V19 R117	H- 3 T10	H- 4 U26 4P149	H- 5 U06	H- 6 T16 R87	H- 7 U02	H- 8 T15 R106	H- 9 U09	H-10 U20 4P151	H-11 T11	H-12 V24 R95	H-13 R20 1H102
	I- 2 T22	I- 3 V11 R84	I- 4 S23	I- 5 U13 R136	I- 6 U10	I- 7 T13	I- 8 U11	I- 9 U24 R140	I-10 S21	I-11 V12 R86	I-12 T21	
	J- 2 P17 S56	J- 3 V09	J- 4 S27 R105	J- 5 S31	J- 6 U14 4P148	J- 7 U25	J- 8 U27 4P145	J- 9 S18	J-10 S29 R99	J-11 V10	J-12 H68	
		K- 3 S22	K- 4 V05	K- 5 V07 R104	K- 6 T07	K- 7 T06 R131	K- 8 T09	K- 9 V01 R91	K-10 V13	K-11 S32		
			L- 4 H66	L- 5 T20	L- 6 V25 R102	L- 7 V22	L- 8 V23 R125	[illegible] 9 T26	L-10 P23			
					M- 6 R10 1H105	M- 7 R05 1H111	M- 8 R21 1H112					

FIGURE 1-2

BOL BURNUP DATA

PBNP UNIT 1 START OF CYCLE 19

	1	2	3	4	5	6	7	8	9	10	11	12	13
A						T04 38646 118A	S32 42063 117B	S20 41190 117B					
B				T05 38062 118A	U22 27127 119B	X15 0 121B	V20 14426 120B	X18 0 121B	V29 14196 120C	T02 38351 118A			
C			T18 39011 118B	X20 0 121B	X02 0 121A	V25 12[illegible] 12[illegible]	U02 27217 119A	V23 12872 120B	X04 0 121A	X26 0 121B	T24 38591 118B		
D		T03 38273 118A	X27 0 121B	V01 15255 120A	U03 29232 119A	T17 34126 118B	X05 0 121A	T19 34246 118B	U08 29294 119A	V11 15454 120A	X14 0 121B	T08 38100 118A	
E		U19 26613 119B	X10 0 121A	U05 29096 119A	T15 38088 118B	V03 13188 120A	U25 27990 119B	V14 12593 120A	T16 38457 118B	U04 29559 119A	X11 0 121A	U17 27283 119B	
F	S19 41600 117B	X28 0 121B	V27 13330 120B	T14 34466 118B	V15 13123 120A	U28 27780 119B	V16 153[illegible]9 120A	U18 27875 119B	V02 12842 120A	T27 34447 118B	V26 13078 120B	X16 0 121B	T12 38479 118A
G	S17 41594 117B	V17 14243 120B	U01 27523 119A	X01 0 121A	U16 28387 119B	V07 14862 120A	[illegible]52 29500 209	V08 15262 120A	U23 28181 119B	X12 0 121A	U12 27260 119A	V28 14518 120B	S22 41510 117B
H	T01 38508 118A	X23 0 121B	V24 13150 120B	T22 34768 118B	V09 12634 120A	U13 27254 119B	V12 15464 120A	U24 27657 119B	V10 12809 120A	T21 34739 118B	V19 13106 120B	X24 0 121B	S29 41240 117B
I		U26 27277 119B	X03 0 121A	U06 29136 119A	T23 38210 118B	V05 12258 120A	U15 28408 119B	V13 12510 120A	T25 37929 118B	U09 29155 119A	X08 0 121A	U20 27720 119B	
J		T10 38115 118A	X21 0 121B	V04 15763 120A	U10 29093 119A	T20 34190 118B	X09 0 121A	T26 34209 118B	U11 29406 119A	V06 15387 120A	X22 0 121B	T11 37858 118A	
K			T28 38108 118B	X17 0 121B	X06 0 121A	V18 13106 120B	U07 27264 119A	V21 13140 120B	X07 0 121A	X19 0 121B	T[illegible]3 38411 118B		
L				T07 37952 118A	U14 27354 119B	X13 0 121B	V22 14182 120B	X25 0 121B	U27 27651 119B	T09 37709 118A			
M						S27 40224 117B	S28 41850 117B	T06 37829 118A					

```
........
.      .  ASSEMBLY ID #
.      .  BURNUP (MWD/MT)
.      .  ASSEMBLY FUEL REGION
........
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2.0 CONTROL ROD OPERATIONAL TESTING

2.1 Hardware Changes/Incidents

All control rods were carried over from Cycle 18. The ARO position is 228 steps as specified in the Setpoint Document and Procedure FC-15.

2.2 Rod Drop Times

See Figures 2-1, 2-2 and 2-3 showing all the rod drop times and RCS conditions. All rod drop times were well within the Technical Specification Limit of 2.2 seconds to dashpot.

2.3 Control Rod Mechanism Testing

Normal gripper signal traces were obtained on all rods.

2.4 Rod Position Calibration

During hot rod drop testing, LVDT voltages were recorded at 20 steps and 200 steps to verify that the RPI coils were responding normally. Once full power operating conditions were obtained, the RPIs were aligned using the SPAN adjustment without changing the ZERO settings.

FIGURE 2-1

PBNP U1C19 COLD ROD DROP TIMES

	1	2	3	4	5	6	7	8	9	10	11	12	13
A													
B						SA 1.39 2.04		SA 1.50 2.15					
C					CA 1.46 2.07		CD 1.61 2.20		CA 1.58 2.19				
D				CC 1.47 2.08						CC 1.54 2.17			
E			CA 1.51 2.16		SB 1.51 2.13				SB 1.55 2.17		CA 1.56 2.10		
F		SA 1.46 2.10				CB 1.56 2.18		CB 1.52 2.17				SA 1.48 2.09	
G			CD 1.45 2.06				CC 1.42 2.03				CD 1.46 2.07		
H		SA 1.50 2.13				CB 1.47 2.08		CB 1.55 2.21				SA 1.49 2.13	
I			CA 1.54 2.10		SB 1.56 2.27				SB 1.52 2.15		CA 1.48 2.13		
J				CC 1.52 2.13						CC 1.45 2.08			
K					CA 1.58 2.17		CD 1.56 2.19		CA 1.46 2.06				
L						SA 1.51 2.09		SA 1.44 2.03					
M													

LEGEND

BANK	
X.XX	— Time To Dashpot (sec)
X.XX	— Time To Seat (sec)

Maximum drop time (dash) = C-7 1.61
Minimum drop time (dash) = B-6 1.39
Average time (dash) = 1.50

DATE 05/10/91

TEMP 193 °F

FLOW 100 %

PRES 359 PSIA

FIGURE 2-2

PBNP U1C19 HOT ROD DROP TIMES

	1	2	3	4	5	6	7	8	9	10	11	12	13
A													
B						SA 1.28 1.77		SA 1.34 1.86					
C					CA 1.28 1.78		CD 1.34 1.92		CA 1.36 1.82				
D				CC 1.30 1.78						CC 1.34 1.82			
E			CA 1.34 1.83		SB 1.31 1.82				SB 1.32 1.82		CA 1.32 1.79		
F		SA 1.30 1.81				CB 1.33 1.84		CB 1.33 1.85				SA 1.32 1.81	
G			CD 1.27 1.77				CC 1.34 1.84				CD 1.29 1.79		
H		SA 1.34 1.81				CB 1.34 1.83		CB 1.35 1.86				SA 1.29 1.79	
I			CA 1.32 1.80		SB 1.34 1.92				SB 1.32 1.85		CA 1.30 1.80		
J				CC 1.32 1.82						CC 1.29 1.79			
K					CA 1.35 1.83		CD 1.36 1.86		CA 1.29 1.78				
L						SA 1.32 1.81		SA 1.31 1.77					
M													

LEGEND

BANK	
x.xx	— Time To Dashpot (sec)
x.xx	— Time To Seat (sec)

Maximum drop time (dash) = C-9 1.36
Minimum drop time (dash) = G-3 1.27
Average time (dash) = 1.32

DATE 05/18/91

TEMP 530 °F

FLOW 100 %

PRES 1985 **PSIA**

3.0 THERMOCOUPLE AND RTD CALIBRATION VERIFICATION

During initial RCS heatup for Cycle 19, loop RTD's and incore thermocouples were checked for normal response throughout the heatup range of about 195°F to 530°F (HZP). Table 3-1 shows the results. All 16 RTDs were within the expected 2°F deviation of each other throughout the heatup. Core exit thermocouples responded normally. The same five thermocouples as for Cycle 18 were OOS (A-7, F-13, H-7, I-8 and L-10).

TABLE 3-1

RTD CALIBRATION CHECK

RTD Element	RTD Temperatures from Measured Resistances (°F)							
LOOP A - COLD LEG								
R 401B	194.9	249.3	310.0	351.5	404.3	455.0	502.8	528.8
R 405B	194.8	249.3	310.0	351.4	404.1	454.9	503.0	528.7
W 402B	194.8	249.4	310.2	351.7	404.2	455.2	503.3	528.9
W 406B	194.8	249.3	310.1	351.6	404.0	455.0	503.1	528.6
LOOP A - HOT LEG								
R 401A	194.7	249.3	310.2	351.6	404.7	455.1	503.1	528.8
R 405A	194.7	249.4	310.2	351.7	404.7	455.2	503.2	528.9
W 402A	194.6	249.2	310.2	351.6	404.4	455.1	503.0	528.6
W 406A	194.7	249.4	310.4	351.9	404.6	455.3	503.2	528.8
LOOP B - COLD LEG								
B 403B	194.8	249.3	310.3	351.7	404.7	455.3	503.2	528.7
B 407B	194.8	249.5	310.4	351.9	404.8	455.4	503.3	528.7
Y 404B	194.8	249.5	310.5	352.1	404.7	455.5	503.4	528.7
Y 408B	194.8	249.5	310.6	352.2	404.7	455.5	503.4	528.7
LOOP B - HOT LEG								
B 403A	194.7	249.5	310.6	352.1	404.6	455.4	503.3	528.7
B 407A	194.8	249.5	310.7	352.2	404.7	455.5	503.5	528.8
Y 404A	194.7	249.5	310.8	352.4	404.5	455.6	503.4	528.7
Y 408A	194.7	249.6	310.8	352.4	404.5	455.[illegible]	503.5	528.7
RTD AVERAGE	194.8	249.4	310.4	351.9	404.5	455.3	503.2	528.7
S.G. TEMP	219.7	252.7	309.7	352.5	403.6	454.4	503.1	527.8
CORE EXIT T/C	195.0	252.9	314.9	354.9	406.5	455.4	505.0	529.5

4.0 PRESSURIZER TESTS

4.1 Thermal Transients

Pressurizer pressure increase rate with spray valves indicated shut and all heaters on was 12 psi/min. This is typical and close to the nominal value of 14 psi/min. During the thermal equilibrium test, Heater Group A was required to be on all of the time to maintain pressure with main spray valves shut. Spray valve effectiveness was normal with the A loop valve decreasing pressure at 128 psi/min and the B loop at 131 psi/min.

Spray bypass valve positions were such that spray line temperatures were maintained above 475°F.

4.2 Heater Capacity

Pressurizer heater capacity was determined from direct volt/amp readings on each group of heaters. Table 4-I shows that heater capacity is above Technical Specification requirements of l00 KW minimum for the heater groups operational during emergency conditions (Groups A, C and D). Heater Group A current readings were greater than normal.

TABLE 4-1

HEATER GROUP POWER SUPPLY READINGS

Heater Group	I-Current (amps)	V-Voltage (volts)	KW - Energy Input $KW = \sqrt{3} x V x I / 1000$
A	323	480	268
B	230	485	194
C	228	477	188
D	227	480	189
E	225	475	185
TOTAL			1024

5.0 CONTROL SYSTEMS

There were no difficulties encountered during heatup or startup of the pressurizer level, pressurizer pressure and rod control systems.

6.0 TRANSIENTS

There were no transient tests performed during startup or approach to full power. There were no violations of the fuel conditioning restrictions on power and rod stepping rates.

7.0 INITIAL CRITICALITY AND REACTIVITY COMPUTER CHECKS

7.1 Initial Criticality

The approach to criticality was made in two phases. The first step, which began at 0320 hours on May 19, 1991, was the withdrawal of control rods until Bank D reached 180 steps. The reactor coolant boron concentration was then decreased by dilution until criticality was achieved. The dilution rate averaged about 93 ppm/hr or 33 gpm. Actual critical boron concentration was 5 ppm greater than estimated concentration of 1445 ppm. ICRR plots were maintained during each phase of the approach to criticality. All plots were as expected with a more pronounced "knee" in the dilution phase due to the absence of the secondary sources.

The reactor conditions at the time of criticality were determined to be as follows:

Date:	May 19, 1991
Time:	1000
RCS Temperature:	530 °F
RCS Pressure:	1985 psig
Rod Position:	Bank D at 173 steps
Boron Concentration:	1450 ppm

7.2 Reactivity Computer Setup and Checkout

7.2.1 Setup

Table 7-2 shows the reactivity computer setup results. Test 1 is a static test which tests for the reactivity zero point. Test 2 is a dynamic test which inputs an exponentially increasing flux to test for a positive reactivity output.

7.2.2 Checkout

Following criticality, acceptable zero power physics testing flux levels were determined. The flux level at which nuclear heat appeared was about $3 \cdot 10^{-6}$ amps on the Keithley picoammeter. Normal flux levels for physics testing are about one-third the point of adding heat by procedure.

The reactivity computer's response was also checked using actual core flux. Control Bank D was pulled from a critical position to obtain distinctly different reactivity levels. For each reactivity level, flux doubling time was measured with a stopwatch. Measured reactivity was then compared to design reactivity calculated from the measured doubling time. Table 7-1 shows the results. Differences were within 5 percent which is acceptable.

TABLE 7-1

REACTIVITY COMPUTER CHECKOUT

Measured Doubling Time (sec)	Measured Reactivity (pcm)	Calculated Doubling Time (sec)	Difference $\frac{M-D}{D} \times 100$
72.2	53	71.0	+1%
56.8	60.5	59.8	-5%
39.1	81	40.2	-2%

TABLE 7-2

CSCN 680 1-18-88
MINIAC COMP TER SETUP

UNIT	CYCLE	DATE	BURNUP MWD/MTU	BETA TOTAL	I	L-STAR (MS)
1	19	05-07-91	0	0.006094	0.97	16.9

DELAYED GROUP	1	2	3	4	5	6
BETA FRACTION	0.000199	0.001258	0.001130	0.002415	0.000880	0.000212
LAMBDA	0.0128	0.0315	0.1208	0.3218	1.4042	3.8608

INPUT POT NUMBER	11	12	21	22	31	32
SETTING	1.2354	3.8438	1.3241	3.7692	1.1986	0.7939
AS LEFT #1	1.2356	3.8442	1.3243	3.7695	1.1995	0.7941
AS LEFT #2						

FEEDBACK POT NUMBER	13	14	23	24	33	34
SETTING	1.2800	3.1500	1.2080	3.2180	1.4042	3.8608
AS LEFT #1	1.2801	3.1491	1.2082	3.2179	1.4043	3.8605
AS LEFT #2						

TEST 1 SET POT 36 TO 9.000 (VOLTS). POT 3* SHOULD BE 5.9112 AS LEFT #1 ~~[illegible]~~ 5.9182 [illegible] AS LEFT #2 ________
ADJL POT 35 UNTIL AMPLIFIER 14 (RHO) OUTPUT IS 0.0 VOLTS.

AMPLIFIER NUMBER	11	12	21	22	31	32
AMPLIFIER VOLTS	8.68635	10.98234	9.86490	10.54147	7.68240	1.85076
AS LEFT #1	8.6908	11.0163	9.8894	10.5595	7.6818	1.8467
AS LEFT #2						

TEST 2 SET POT 26 TO ABOUT 0.75 V

POT 25 SETTING	J.20	0.50	0.80	1.10	1.40	.70	2.00	2.30	2.60
PERIOD (SEC)	500.00	200.00	125.00	90.91	71.43	58.82	50.00	43.48	38.46
T-DBLG (SEC)	346.57	138.63	86.64	63.01	49.51	40.77	34.66	30.14	26.66
OBSERVED T-D #1	346.55	138.51	86.49	62.98	49.87	40.43	34.46	30.15	26.60
OBSERVED T-D #2									
EXPECTED RHO (PCM)	13.26	30.42	45.17	58.14	69.72	80.20	89.77	98.59	106.77
OBSERVED RHO #1	13.5	30.4	45.2	58.2	69.3	80.1	89.4	98.6	106.[illegible]
OBSERVED RHO #2									

DATE	INITIALS
5/19/91	RWH

8.0 CONTROL ROD WORTH MEASUREMENT

8.1 Test Description

The rod worth verification utilizing rod exchange ("rod swap") was divided into two parts. In the first part, the reactivity worth of the reference bank was obtained from reactivity computer measurements and boron endpoint data during RCS boron dilution. In the second part, the critical height of the reference bank was measured after exchange with each remaining bank.

In the rod exchange technique, the reference bank is defined as that bank whith the highest worth of all banks, control or shutdown, when inserted into the core alone. For this cycle the reference bank was Control Bank A (CA) as was the case in all prior rod swap tests.

Using the analog reactivity computer, reactivity measurements were made during the insertion of Control Bank A from the fully withdrawn to the fully-inserted position. The average current (flux level) during the measurement was maintained within the physics testing range and temperature was held steady near 530°F. Critical boron concentration measurements (boron endpoints) were made before and after the insertion of Control Bank A (see Section 10.0). Figure 8-1 shows the results of the differential worth measurements.

Starting at a critical position with the reference bank fully inserted and Control Bank C at 219 steps, a new critical configuration at constant RCS boron concentration was established with Control Bank C fully inserted and Control Bank A at 95 steps. Control Bank C was then withdrawn and Control Bank A inserted to one step to establish the initial conditions for the next exchange. This sequence was repeated until a critical position was established for the reference bank with each of the other banks individually inserted. Criticality determinations before and after each exchange were made with the reactivity computer.

The sequence of events during the rod exchange and a summary of the rod exchange data is presented in Table 8-1.

8.2 Data Analysis and Test Results

The integral reactivity worth of the measured bank is inferred from the swapped portion of Control Bank A by the following equation:

$$W_X^I = W_R^M - \Delta\sigma_1 - (\alpha_X)(\Delta\sigma_2) + W_X^E$$

where:

W_X^I = The inferred worth of Bank X, pcm.

W_R^M = The measured worth of the reference bank, Control A, from fully withdrawn to fully inserted with no other bank in the core.

α_X = A design correction factor taking into account the fact that the presence of another control rod bank is affecting the worth of the reference bank.

$\Delta\sigma_2$ = The measured worth of the reference bank from the elevation at which the reactor is just critical with Bank X in the core to the reference bank fully withdrawn condition. This worth was measured with no other bank in the core.

$\Delta\sigma_1$ = The measured worth of the reference bank from the fully inserted condition to the elevation at which the reactor was just critical prior to the worth measurement of Bank X. In this test $\Delta\sigma_1$ is zero because Bank A was fully inserted.

W_X^E = The worth of Bank X from the initial position (before the start of the exchange) to 228 steps. This worth is measured by the normal endpoint worth method.

Final values for the integral worth of control and shutdown banks inferred from the measurement data are tabulated in Table 8-2. Values for α_X, obtained from the design predictions, are also listed in Table 8-2.

8.3 Evaluation of Test Results

A comparison of the measured/inferred bank worths with design predictions is presented in Table 8-2.

In evaluating the test results, the standard review and acceptance criteria below were used.

Review Criteria:

8.3.1 The measured worth of the reference bank agrees with design predictions within ±10 percent.

8.3.2 The inferred individual worth of each remaining bank agrees with design predictions within ±15 percent or ±100 pcm, whichever is greater.

8.3.3 The sum of the measured and inferred worths of all control and shutdown banks is less than 1.1 times the predicted sum.

Acceptance Criteria:

The sum of the measured/inferred worths of all control and shutdown banks is greater than 0.9 times the predicted sum.

All review and acceptance criteria were met. Although Control Bank B was outside the ±15 percent part of criterion 8.3.2, it was within the 100 pcm limit. This is consistent with recent results from prior cycles.

TABLE 8-1

CRITICAL ROD CONFIGURATION DATA

Bank	Time	RCS Tavg (°F)	CA Position Steps	Bank Position Steps
CC CC	0310 0336	530 530	1 95	219 1
SB SB	0401 0413	530 530	1 64	220 1
SA SA	0436 0451	530 530	1 127	217 1
CB CB	0515 0526	530 530	1 69	222 1
CD CD	0547 0600	530 530	1 89	219 1

Boron concentration was 1296 ppm.

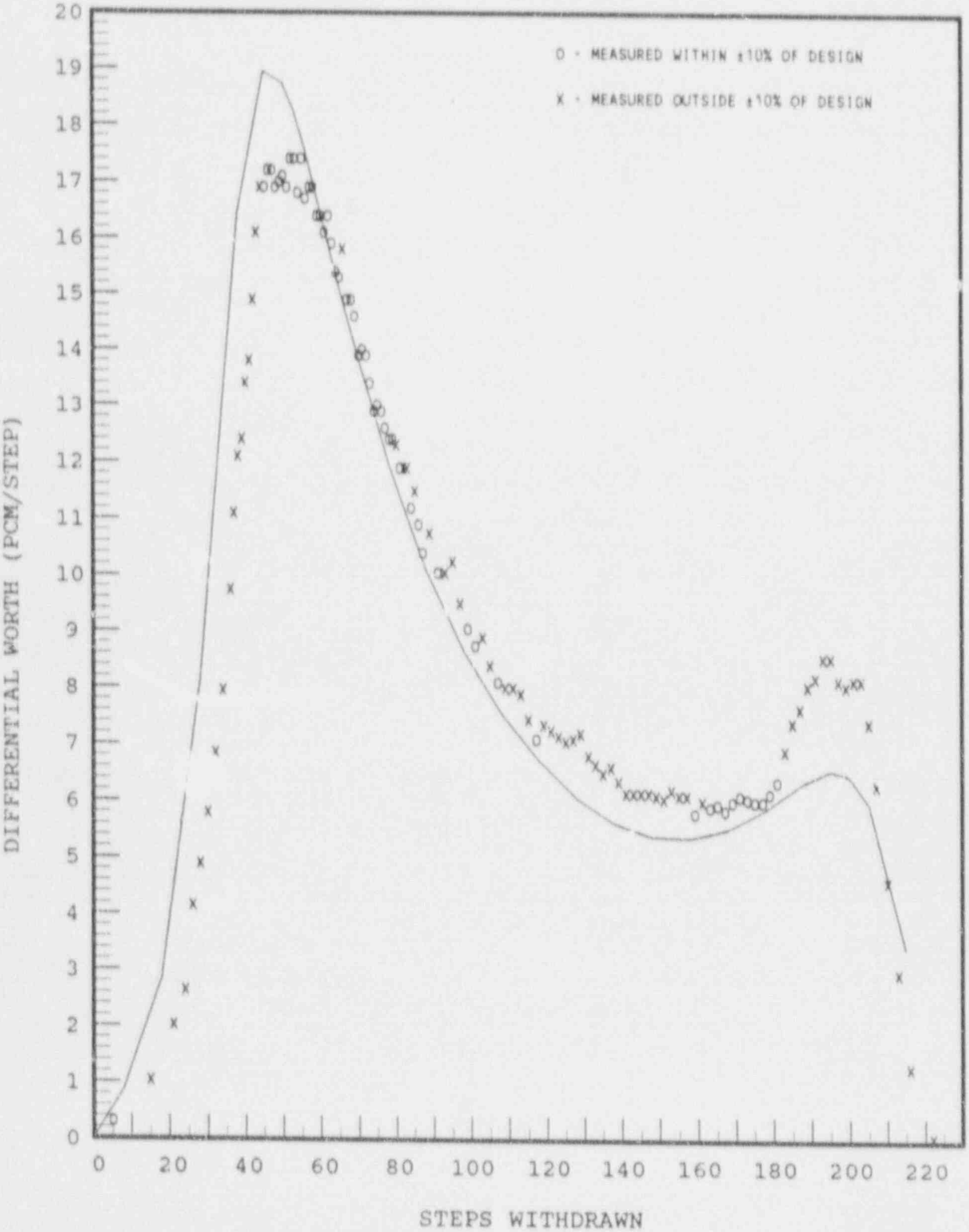
TABLE 8-2

COMPARISON OF INFERRED/MEASURED BANK WORTHS WITH DESIGN PREDICTIONS

Bank X	$\Delta\sigma_2$	α_x	W_X^E	W_X^I	W_X^P	(I-P)/P x 100
	pcm		pcm	pcm	pcm	%
CC	869	0.968	6	944	994	-5.0
SB	1271	1.044	6	457	514	-11.1
SA	603	0.882	5	1252	1238	+1.1
CB	1191	1.137	6	431	527	-96 pcm
CD	853	1.000	5	853	903	-5.5
CA				1779	1785	-0.4
TOTAL				5716	5961	-4.1

FIGURE 8-1

PBNP UNIT 1 CYCLE 19 BOL HZP
REFERENCE BANK DIFFERENTIAL WORTH



9.0 TEMPERATURE COEFFICIENT MEASUREMENTS

A near all rods out isothermal temperature coefficient measurement was taken during zero power physics testing. The measured value is the average of the recorded reactor coolant system heatups and cooldowns. Reactivity from the reactivity computer and reactor coolant system temperature were recorded on an X-Y plotter and two-pen recorder.

Measured ARO isothermal temperature coefficient was 1.0 pcm/°F, within the review criteria of ±3 pcm/°F of the design isothermal temperature coefficient of +0.7 pcm/°F for 530°F and 1477 ppm.

10.0 BORON WORTH AND ENDPOINT MEASUREMENTS

Figure 10-1 shows RCS boron concentration during zero power physics testing. Table 10-1 shows results of the endpoint measurements. The measured boron worth was obtained by dividing bank worth (pcm) into change in boron concentration between endpoints. The review criterion of ± 0.5 pcm/ppm was met.

TABLE 10-1

BORON WORTH AND ENDPOINTS

Bank Configuration	Endpoint		Bank Worth		Boron Worth	
	Design	Measured	Design	Measured	Design	Measured
	ppm	ppm	pcm	pcm	pcm/ppm	pcm/ppm
ARO	1460	1475	----	----		
CA in	1279	1298	1785	1779	-9.9	-10.1

At measurement conditions (530°F)

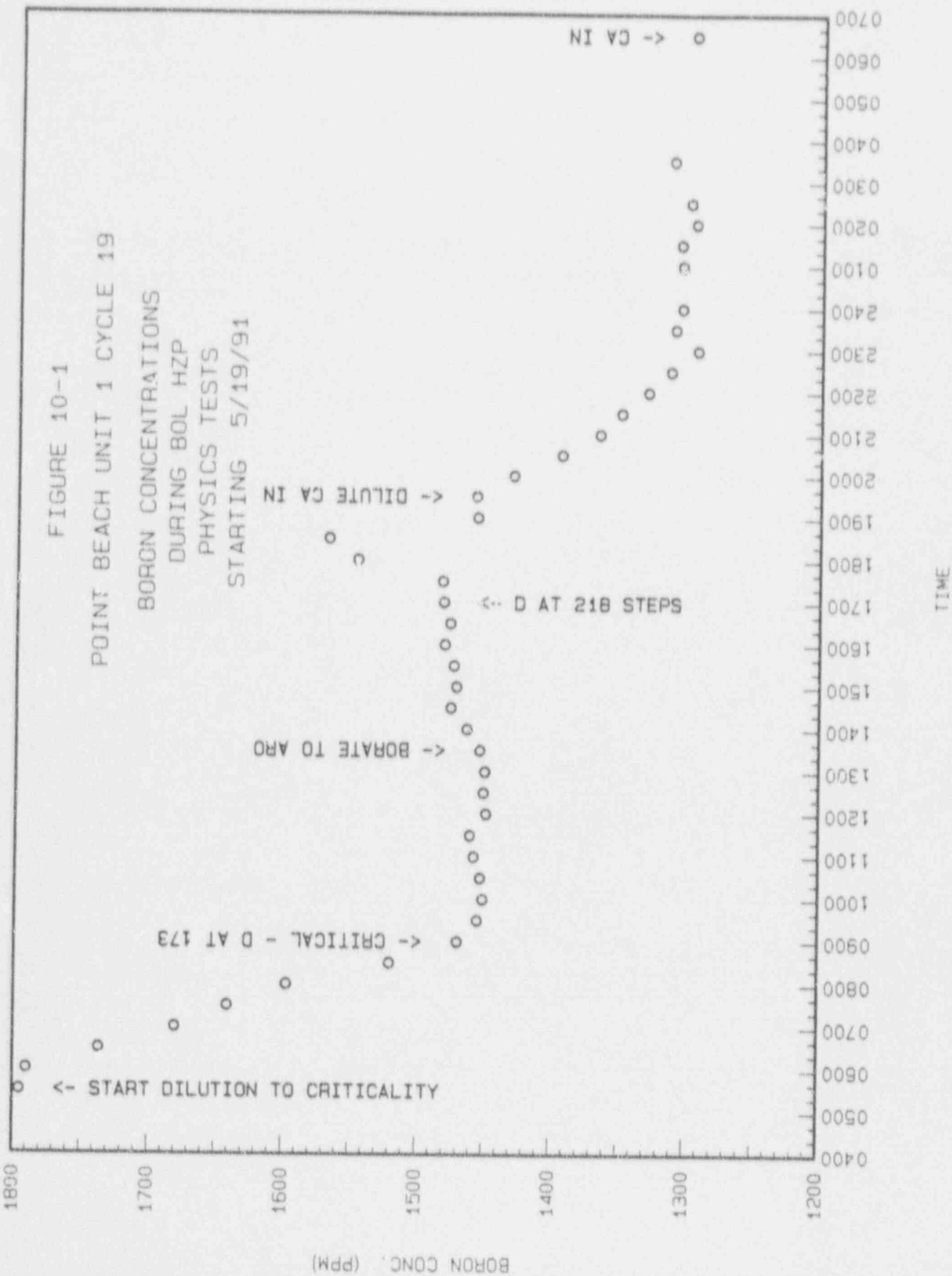


FIGURE 10-1
POINT BEACH UNIT 1 CYCLE 19
BORON CONCENTRATIONS
DURING BOL HZP
PHYSICS TESTS
STARTING 5/19/91
<- START DILUTION TO CRITICALITY
<- CRITICAL - D AT 173
<- BORATE TO ARO
<- D AT 218 STEPS
<- DILUTE CA IN
<- CA IN
BORON CONC. (PPM)
TIME
1800
1700
1600
1500
1400
1300
1200
0400
0500
0600
0700
0800
0900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
0100
0200
0300
0400
0500
0600
0700

11.0 POWER DISTRIBUTION

Table 11-1 illustrates the margin of hot channel factors to their full power limits during initial power increase to full load. Flux maps were taken using ANSI Standard ANS-19.6.1-1985 as guidance. Allowed power levels were calculated using the relationships for FH and FQ versus power level in Technical Specification 15.3.10.B.1.a.

Measured axial power distribution, compared to design, is shown in Figure 11-1 and 11-2.

TABLE 11-1

INITIAL POWER ESCALATION
FLUX MAP RESULTS

MAP NO.	DATE	POWER %	THIM. MISS.	ALLOWED POWER		BANK STEPS	AO %
				FDH	FQ		
1	05-21-91	28	0	83	84	180	+5.3
2	05-23-91	75	0	104	114	221	+7.0
3	05-24-91	95	0	106	116	227	+2.5
4	05-24-91	99.8	0	107	116	227	+2.1
7	06-20-91	100	0	109	118	220	+1.5

FIGURE 11-1

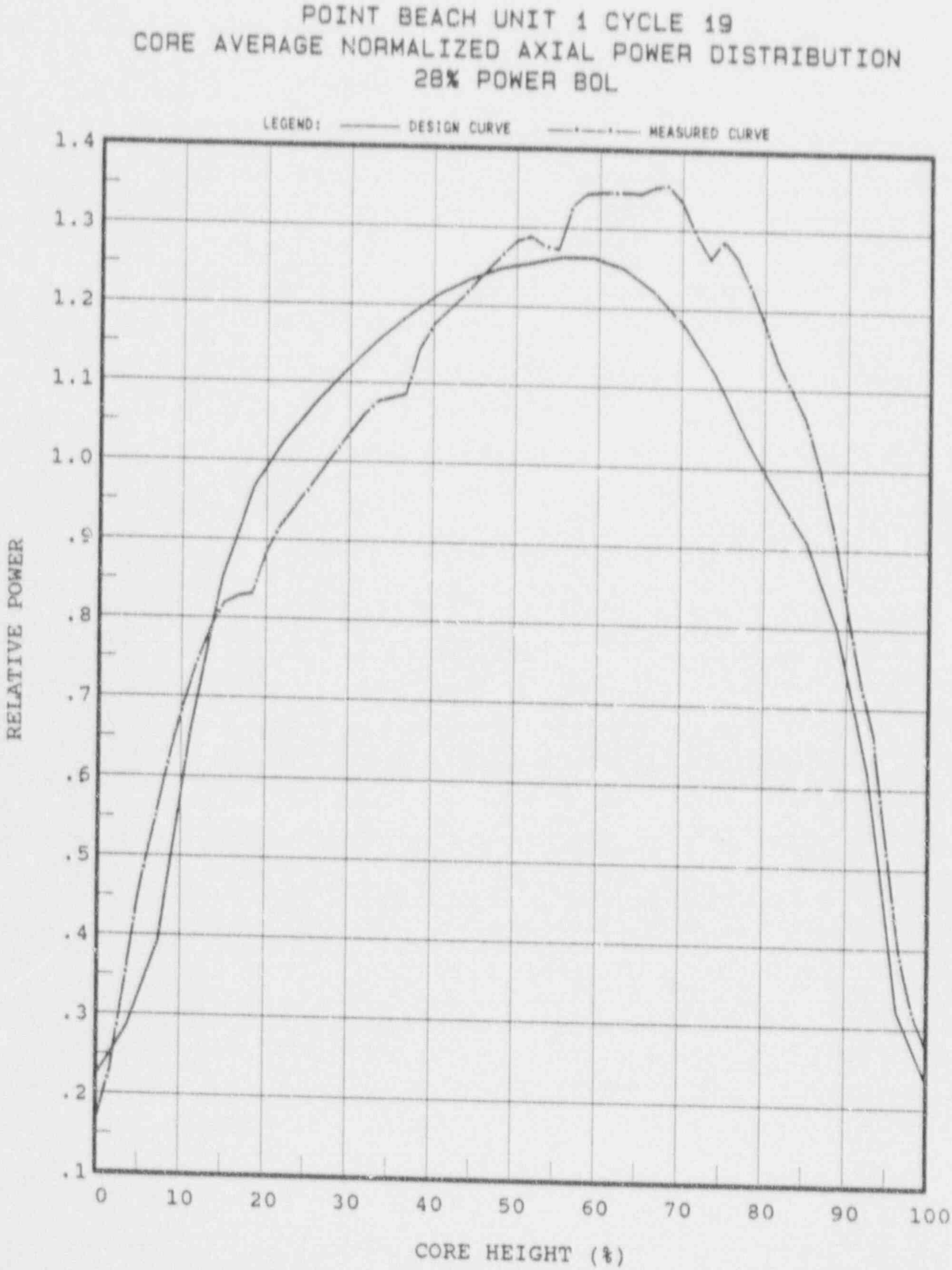
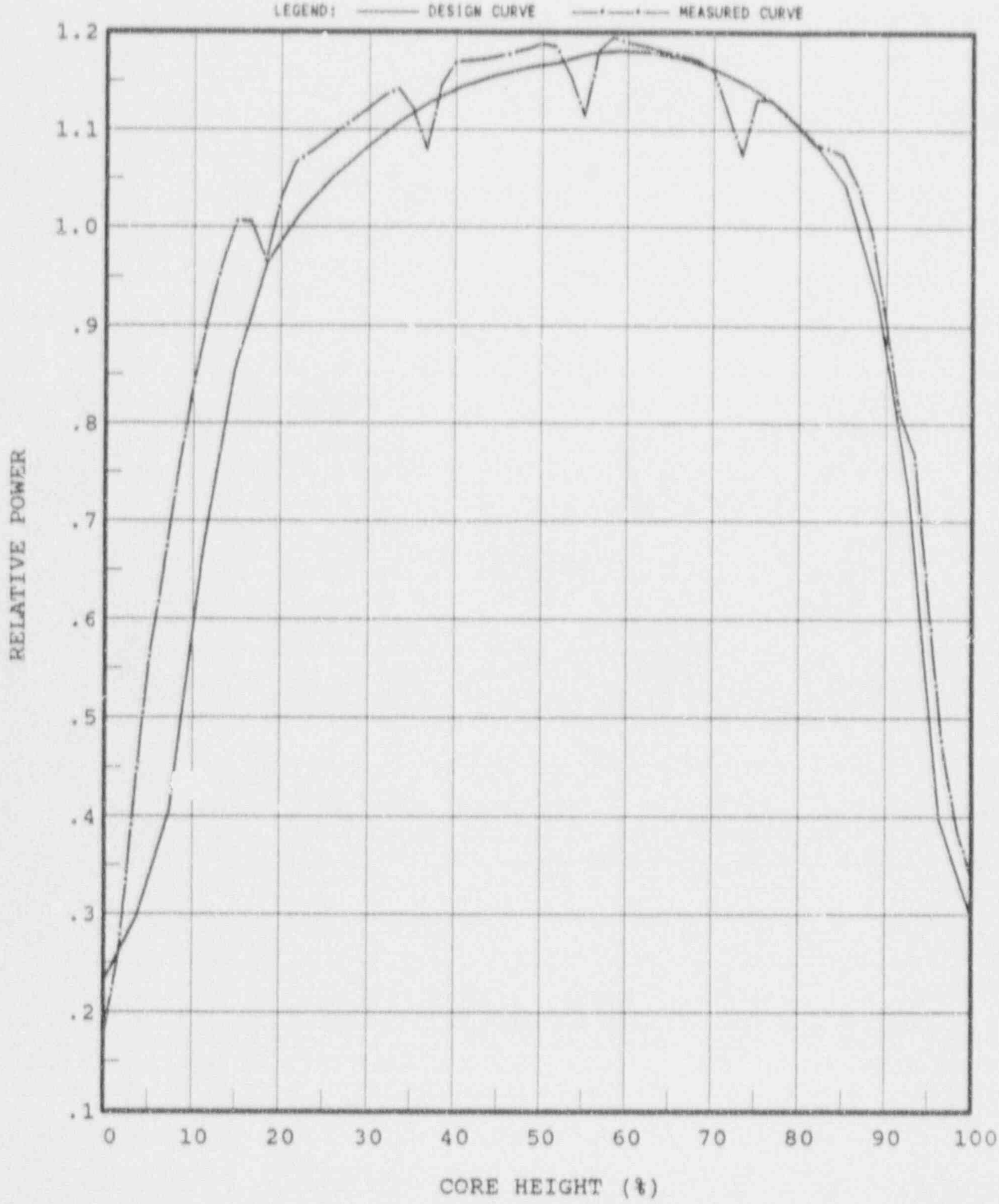

POINT BEACH UNIT 1 CYCLE 19
CORE AVERAGE NORMALIZED AXIAL POWER DISTRIBUTION
28% POWER BOL
LEGEND: DESIGN CURVE
MEASURED CURVE
RELATIVE POWER
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
10
20
30
40
50
60
70
80
90
100
CORE HEIGHT (%)

FIGURE 11-2

POINT BEACH UNIT 1 CYCLE 19
CORE AVERAGE NORMALIZED AXIAL POWER DISTRIBUTION
HFP BOL EQXE



12.0 XENON REACTIVITY

Xenon reactivity behavior data for Unit 1 Cycle 19 was supplied by Westinghouse separate from the WATCH data package. Point Beach code Xenon will be run with a TDF1 of 0.95 and TDF2 of 1.2 to remain consistent with the Xenon Tables. Tables are supplied for BOL, MOL and EOL conditions.

13.0 SHUTDOWN MARGIN CONSIDERATIONS

Rod swap results were within acceptance criteria and were accepted as valid proof of rod worth for shutdown margin determination. See Section 8.0 for rod swap details. Thus WCAP-12903 Table 6.2 was accepted as a valid shutdown margin determination. Table 13-1 calculates the excess worth available to Unit 1 Cycle 19.

TABLE 13-1

EXCESS SHUTDOWN WORTH AVAILABLE
FOR A FULL POWER TRIP

	BOL (pcm)	[illegible] (pcm)
Shutdown Margin From WCAP	3800	3860
Required Shutdown	-1000	-2770
Excess Worth	-2800	-1090

14.0 EXCORE DETECTOR BEHAVIOR

14.1 Intermediate Range Detectors

Intermediate range detector currents versus power level are shown in Figure 14-1. Intermediate range detector trip setpoints were the same as for Cycle 18. The trip setpoints were reached within the expected reactor power level range of 20 percent - 25 percent. This shows that the core design changes for Cycle 19 had minimal impact on the intermediate range detector response.

14.2 Power Range Detectors

Table 14-1 lists the "tilt free" power range detector calibration currents corresponding to 100 percent power at BOL. These currents were calculated using the multi-map method at 100 percent power. The multi-map method was used as a conservative measure to ensure that core design changes that may have affected the power range detectors were accounted for.

Table 14-2 shows the changes in the installed axial offset constants. The changes are probably due more to the aging of the detectors since the last multi-map calibration than to Cycle 19 design changes.

Power range quadrant tilt alarms are designed to alert for rapidly developing tilts. Natural core tilts are eliminated by obtaining calibration currents for the core with a tilt. A tilt is indicated only when actual currents deviate from the calibration currents even though the core already may have a tilt before the start of the deviation. This practice complies with Technical Specifications and the Westinghouse position on core tilt.

TABLE 14-1

POWER RANGE DETECTOR
BOL CALIBRATION CURRENTS

		N41	N42	N43	N44
Cycle 16	T	242	296	299	316
	B	222	295	277	294
Cycle 17	T	239	277	290	293
	B	210	268	261	268
Cycle 18	T	208	244	260	265
	B	186	238	236	243
Cycle 19	T	236	267	285	282
	B	210	264	258	263

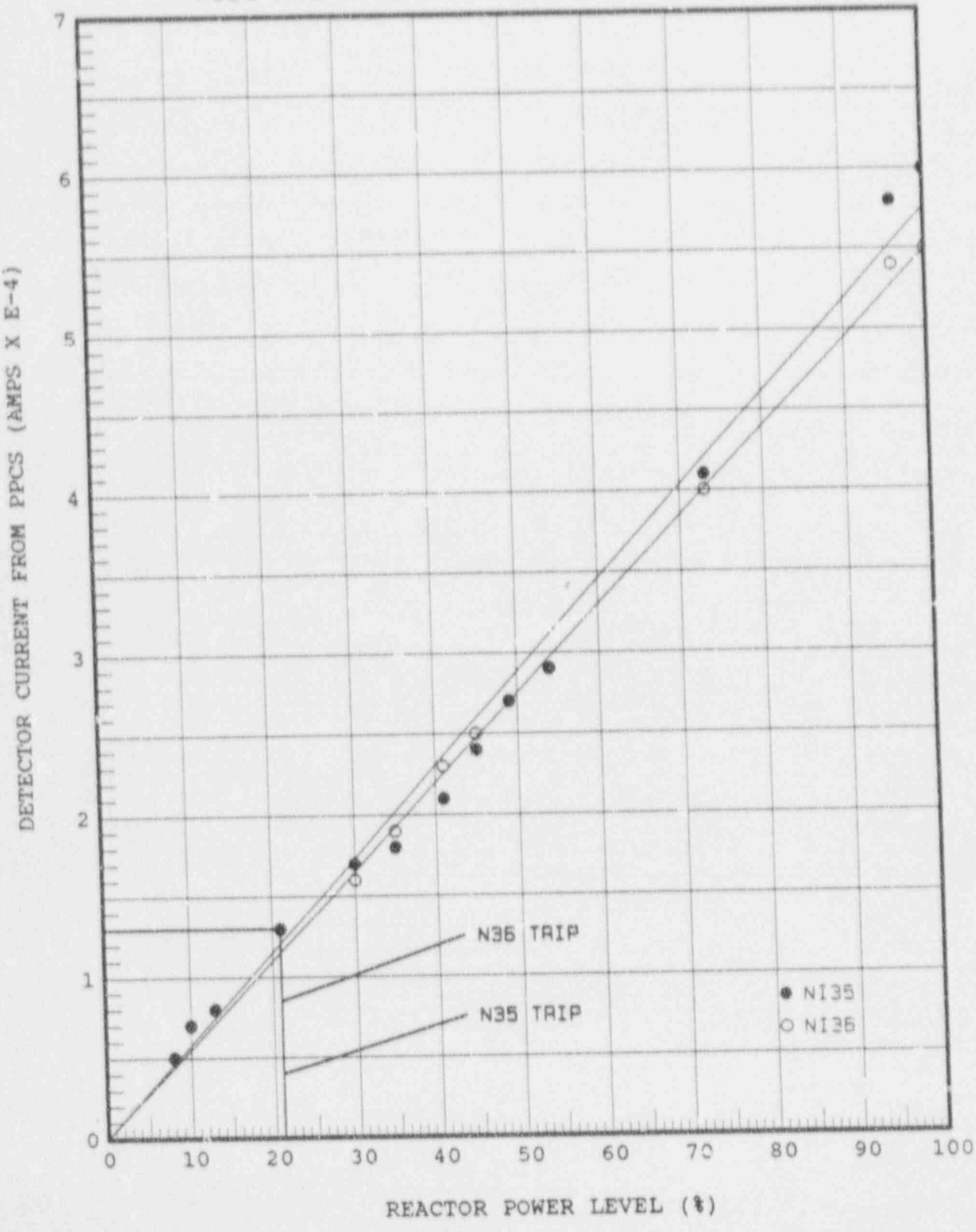
TABLE 14-2
AXIAL OFFSET CONSTANTS

	N-41	N-42	N-43	N-44
Before	1.55	1.63	1.55	1.63
After	1.44	1.55	1.55	1.54

FIGURE 14-1

U1C19

NI35 AND NI36 RESPONSE TO POWER LEVEL



15.0 OVERPOWER AND OVERTEMPERATURE ΔT SETPOINTS

15.1 Overpower and Overtemperature ΔT Setpoints

Shown below are the equations from Technical Specification 15.2.3.1.B.4/5 effective during Cycle 19.

Overpower ΔT

$$\left(\frac{1}{1+\tau_5 S}\right) \le \Delta T_o\left[K_4 - K_5\left(\frac{\tau_3 S}{\tau_3 S+1}\right)\left(\frac{1}{1+\tau_4 S}\right)T - K_6\left[T\left(\frac{1}{1+\tau_4 S}\right) - T'\right]\right]$$

Overtemperature ΔT

$$\left(\frac{1}{1+\tau_5 S}\right) \le \Delta T_o\left[K_1 - K_2\left(T\left(\frac{1}{1+\tau_4 S}\right) - T'\right)\left(\frac{1+\tau_1 S}{1+\tau_2 S}\right) + K_3(P - P') - f(\Delta I)\right]$$

See Tables 15-1 and 15-2 for the constants associated with this cycle of operation.

15.2 Delta Flux Input to Overtemperature ΔT Setpoint

The overtemperature ΔT setpoint is reduced when the excore detectors sense a percent power mismatch between the top and bottom of the core. The dead band is +5 percent and -17 percent before the setpoints are reduced. For each percent (more than 5 percent) the top detector output exceeds the bottom detector, the setpoints are reduced an equivalent of 2 percent of the rated power. For each percent (more than -17 percent) the bottom detector exceeds the top detector, the setpoints are reduced an equivalent of 2 percent of rated power.

TABLE 15-1

OVERPOWER ΔT CONSTANTS

ΔT_o	= Indicated ΔT at rated power, °F
T	= Average temperature, °F
T'	≤ 573.9°F
K_4	≤ 1.089 of rated power
K_5	= 0.0262 for increasing T = 0.0 for decreasing T
K_6	= 0.00123 for $T \geq T^1$ = 0.0 for $T < T^1$
τ_5	= 10 seconds
τ_3	= 2 seconds for Rosemount or equivalent RTD = 0 seconds for Sostman or equivalent RTD
τ_4	= 2 seconds for Rosemount or equivalent RTD = 0 seconds for Sostman or equivalent RTD

TABLE 15-2

OVERTEMPERATURE ΔT CONSTANTS

ΔT_0 = Indicated ΔT at rated power, °F

T = Average temperature, °F

T' ≤ 573.9°F

P = Pressurizer pressure, psig

P' = 2235 psig

K_1 ≤ 1.30

K_2 = 0.0200

K_3 = 0.000791

τ_1 = 25 seconds

τ_2 = 3 seconds

τ_3 = 2 seconds for Rosemount or equivalent RTD
= 0 seconds for Sostman or equivalent RTD

τ_4 = 2 seconds for Rosemount or equivalent RTD
= 0 seconds for Sostman or equivalent RTD

16.0 FUEL PERFORMANCE

Figure 16-1 shows relatively low coolant activity just before refueling with still lower activity after refueling. There is no reason to suspect the presence of any leaking fuel at the start of Cycle 19.

17.0 CONCLUSION

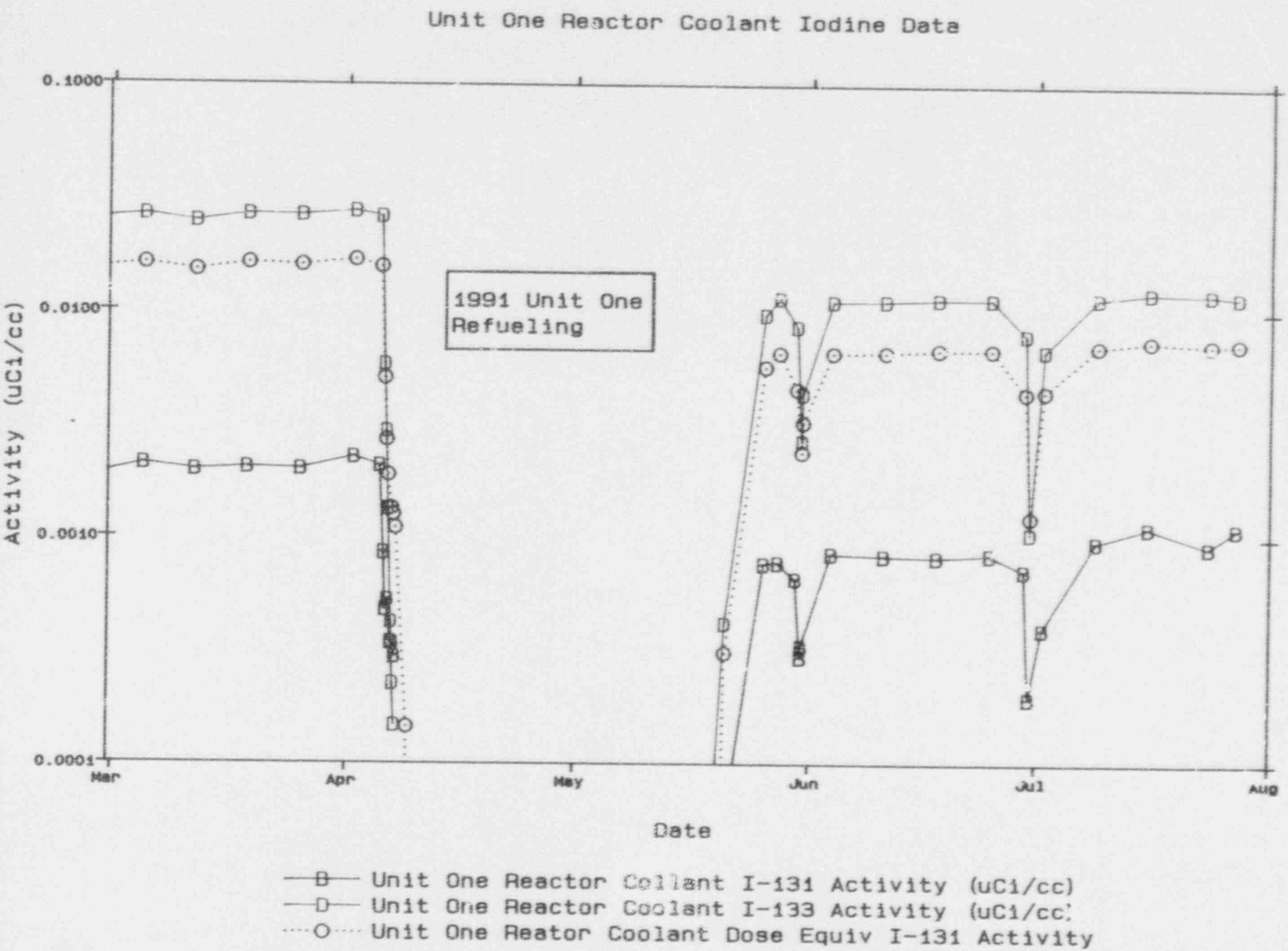
The following results of startup testing should be highlighted.

17.1 The bank swap method for measuring rod worth produced acceptable results. However, measured differential worth for the reference bank at higher core elevations was greater than design which is typical. This results in larger deviations in rod swap worths for banks of smaller worth.

17.2 Core design changes including natural uranium blankets and IFBAs did not significantly change the sensitivities of the excore detectors.

17.3 During initial power escalation, the magnitude of core power distribution hot channel factors were typical, compared to those obtained in prior cycles.

The other Unit 1 Cycle 19 startup and refueling activity results were normal.



Unit One Reactor Coolant Iodine Data
0.1000
0.0100
0.0010
0.0001
Activity (uCi/cc)
1991 Unit One
Refueling
Mar
Apr
May
Jun
Jul
Aug
Date
Unit One Reactor Collant I-131 Activity (uCi/cc)
Unit One Reactor Coolant I-133 Activity (uCi/cc)
Unit One Reator Coolant Dose Equiv I-131 Activity

FIGURE 16-1