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AUGUST 2 1 1989

L-89-309

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Re: Turkey Point Unit 4
Docket No. 50-251
<u>Startup Report</u>

The attached Startup Report is being submitted in accordance with Technical Specification 6.9.1.a. The Unit 4 Cycle XII Startup Report documents the first use of fuel assemblies with Integral Fuel Burnable Absorbers (IFBA), extended burnup modifications, reconstitutable top nozzles, standardized fuel pellets, reduced fuel rod backfill pressures, 4g fuel rod plenum springs, and 304L stainless grid sleeve material.

Very truly yours,

R. J. Acosta for

C. O. Woody
Acting Senior Vice President - Nuclear

COW/GRM/cm

Attachment

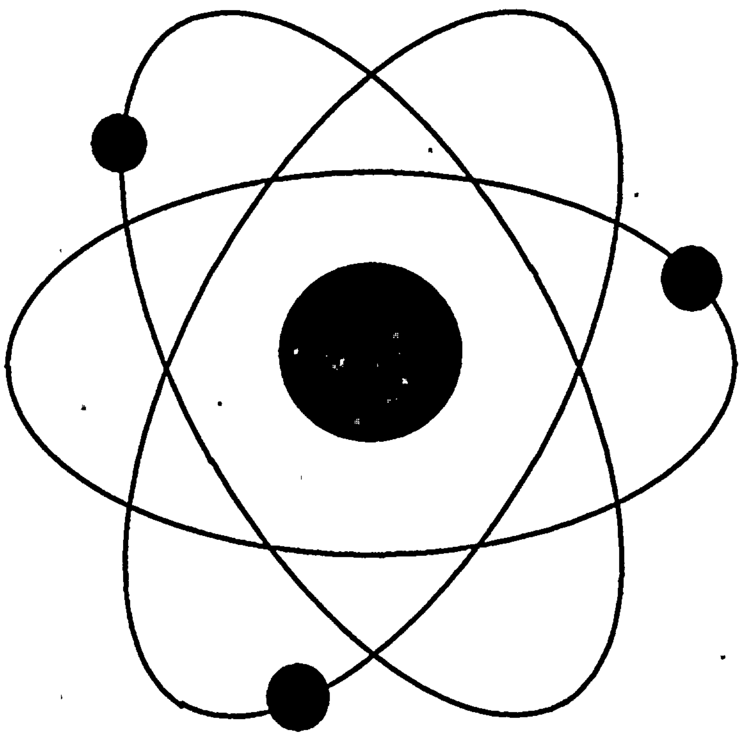
cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

FLORIDA POWER AND LIGHT COMPANY

TURKEY POINT PLANT

UNIT 4 CYCLE XII

STARTUP REPORT



INTRODUCTION

This report contains the official summary of the Startup Physics Tests performed on Turkey Point Unit 4 at the beginning of Cycle XII. The testing program was conducted in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, and Operating Procedure 0204.5, Nuclear Design Check Tests During Startup Sequence After Refueling, and meets the minimum requirements of ANSI/ANS 19.6.1, Revision 0 (12-13-85), Startup Physics Tests for Pressurized Water Reactors. Testing commenced on May 19, 1989, at 0148 and was completed on May 21, 1989 at 0637.

The Westinghouse Nuclear Design Report for Unit 4, Cycle XII, (WCAP-12010) is the design data from which deviations were measured for the purpose of verifying that acceptance criteria were met. The acceptance criteria stated are the more conservative of ANSI/ANS 19.6.1., Revision 0 or Operating Procedure 0204.5.

All of the tests included in this report meet their acceptance criteria.

The contents of this report provide the documentation required by Technical Specification 6.9.1.a.

TABLE OF CONTENTS

★R1:1-yrz

1.0 UNIT 4 CYCLE XII CORE

This section presents the as-loaded core configuration (Figure 1); the Control and Shutdown Rod pattern (Figure 2); and the Rod Drop Times for all rods as measured in Procedure 4-PMI-028.3 RPI Hot Calibration, CRDM Stepping Test, and Rod Drop Test (Figure 3).

All rods met the drop time limit of 2.4 seconds as per Technical Specification 3.2.3.

[redacted]EACTOR FUEL LOCATIO[redacted]
[redacted]KEY POINT PLANT UNIT N[redacted]
CYCLE NO. XII

DATE 2-10-89

FIGURE 1

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
R							NN06 HF23	NN28 HF16	NN12 HF06						
P					Z19	PP30 R80	RR34	Z10	RR36	PP54 R68	Z23				
N				Z57	RR42	RR03	PP08 R59	RR10	PP10 R67	RR12	RR44	Z51			
M			Z46	RR45	PP52	PP05 R58	RR21 8PF1 4WZ	NN33 R86	RR22 8PF0 6WZ	PP22 R89	PP35	RR50	Z59		
L		Z36	RR51	PP56	NN49 R92	RR02 8PF1 5WZ	PP19 R51	PP37	PP03 R57	RR27 8PF0 7WZ	NN50 R69	PP53	RR41	Z20	
K		PP33 R79	RR05	PP15 R78	RR16 8PF0 2WZ	NN19	PP50	PP34 R82	PP28	NN29	RR17 8PF1 3WZ	PP14 R62	RR13	PP40 R70	
J	NN05 HF07	RR37	PP11 R66	RR14 8PF1 0WZ	PP06 R88	PP43	RR29 4PF0 2WZ	Z62	RR30 4PF0 4WZ	PP42	PP21 R95	RR09 8PF1 1WZ	PP12 R64	RR38	NN10 HF13
H	NN39 HF15	Z08	RR11 SS5	NN15 R12	PP25	PP32 R53	NN46	K10 R93	NN47	PP46 R90	PP31	NN16 R63	RR01 SS4	Z06	NN40 HF05
G	NN11 HF20	RR39	PP07 R83	RR20 8PF0 8WZ	PP20 R75	PP41	RR31 4PF0 1WZ	NN48	RR32 4PF0 3WZ	PP44	PP04 R74	RR08 8PF0 5WZ	PP09 R55	RR33	NN09 HF02
F		PP45 R52	RR07	PP18 R85	RR25 8PF0 4WZ	NN37	PP48	PP38 R81	PP29	NN25	RR24 8PF0 1WZ	PP01 R72	RR19	PP51 R65	
E		Z28	RR52	PP36	NN51 R54	RR28 8PF1 6WZ	PP13 R77	PP49	PP17 R76	RR18 8PF0 9WZ	NN52 R61	PP39	RR43	Z22	
D			Z61	RR48	PP47	PP02 R60	RR15 8PF0 3WZ	NN35 R56	RR23 8PF1 2WZ	PP23 R84	PP27	RR49	Z45		
C				Z48	RR46	RR06	PP24 R71	RR26	PP16 R87	RR04	RR47	Z56			
B					Z21	PP26 R91	RR40	Z02	RR35	PP55 R73	Z24				
A							NN08 HF11	NN36 HF10	NN07 HF01						

LEGEND

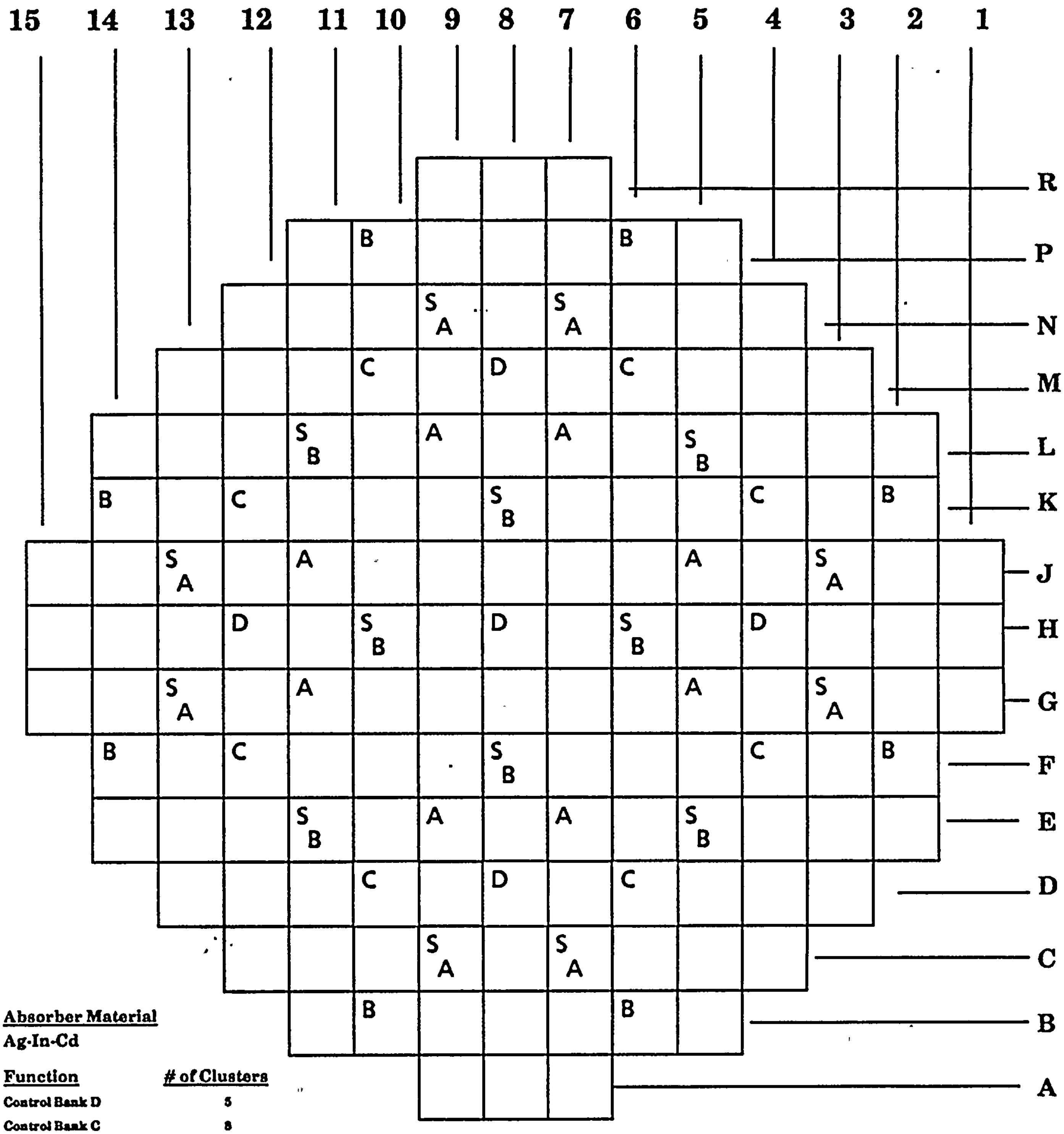
Assembly No. ---

Insert No. ---

Verified By A. R. Dyches

FORM 5445-★R3:1-tb-06/89

CONTROL ROD BANK LOCATION
T[redacted]EY POINT PLANT UNIT No[redacted]
CYCLE No. XII
FIGURE 2



Absorber Material
Ag-In-Cd

Function	# of Clusters
Control Bank D	5
Control Bank C	8
Control Bank B	8
Control Bank A	8
Control Bank SB	8
Control Bank SA	8

★R1:1-yrz

ROD DROP TIMES
TURKEY POINT PLANT UNIT No. 4
CYCLE No. XII
FIGURE 3

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
R															
P						1.33 1.93				1.33 1.95					
N							1.32 1.93		1.33 1.98						
M						1.34 1.95		1.35 1.92		1.27 1.92					
L					1.27 1.77		1.36 2.0		1.35 1.95		1.27 1.78				
K		1.37 2.05		1.32 1.95				1.35 1.97				1.33 1.93		1.32 1.94	
J			1.32 1.95		1.35 1.93						1.33 1.93		1.33 1.95		
H				1.35 1.92		1.35 1.97		1.33 1.85		1.35 1.92		1.35 1.90			
G			1.33 1.93		1.35 2.0						1.32 1.92		1.33 1.95		
F		1.32 1.93		1.32 1.92				1.35 1.92				1.32 1.92		1.33 1.92	
E					1.30 1.80		1.35 1.97		1.35 1.98		1.25 1.77				
D						1.33 1.93		1.37 1.88		1.33 1.98					
C							1.30 1.90		1.30 1.92						
B						1.32 1.93				1.40 2.04					
A															

LEGEND

TIME TO DASHPOT
TIME TO BOTTOM

★R1:1-yrz

2.0 INITIAL CRITICALITY

The approach to criticality began May 19, 1989, @ 0158 hours in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling. Criticality was achieved May 19, 1989, @ 1550 hours by withdrawing control rods to 180 steps on Bank D and diluting the RCS with 19,400 gallons of water.

Upon attaining criticality the flux level was increased to 1×10^{-8} amps on the intermediate range to obtain critical data.

Tavg	=	547°F
Control Bank D	=	210 Steps
Boron	=	1530 ppm
Flux	=	1×10^{-8} amps

TABLE 2.1

FLUX

Picoammeter	N-35	N-36
1.05×10^{-8} amps	1.5×10^{-8} amps	1.6×10^{-8} amps

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

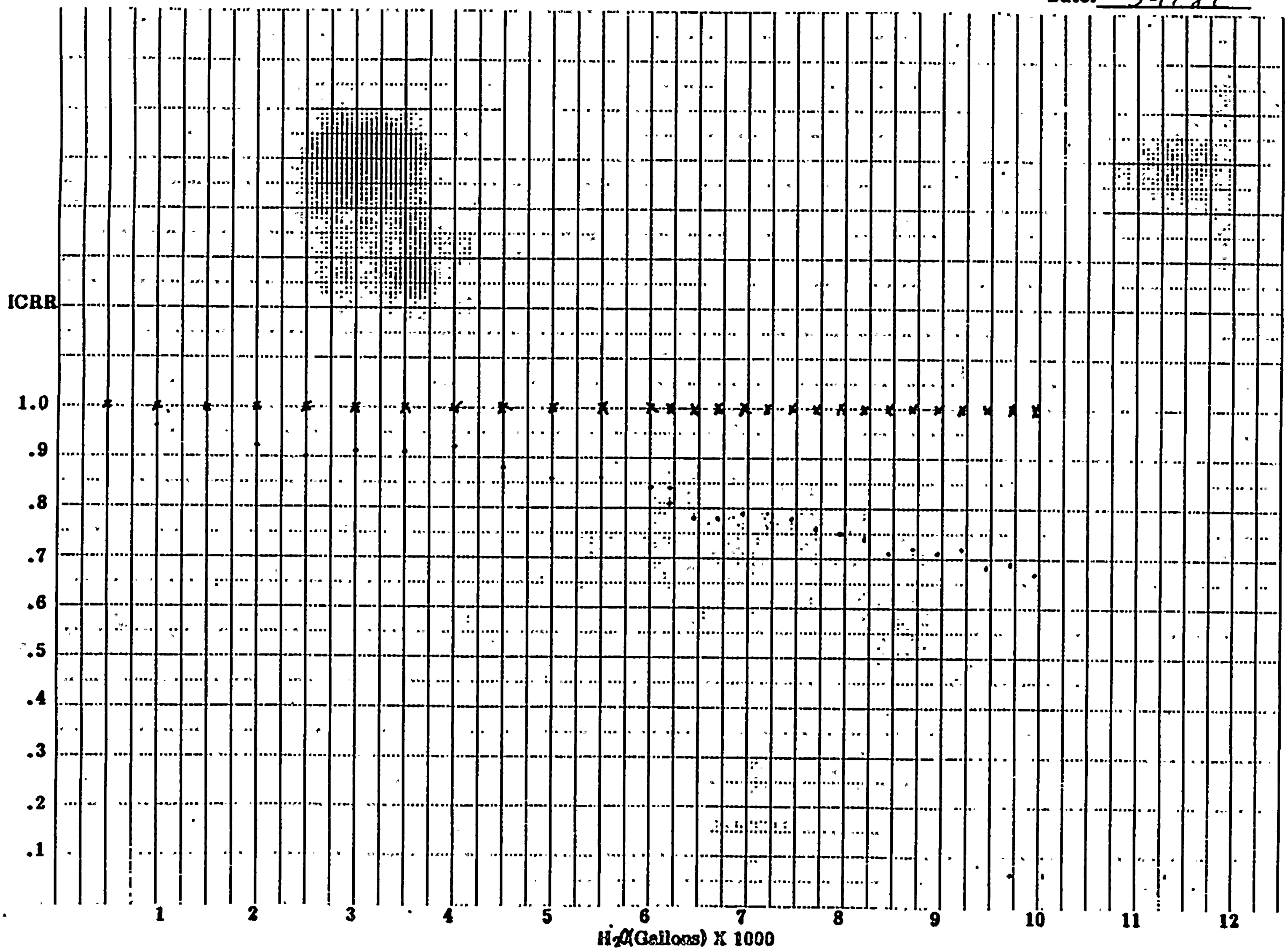
★R1:1-yrz

R3:2
N31 = •
N35 = x

FIGURE 4 46151

ICRR VS. DILUTION H_2O
OP 0204.3

Unit 4 Cycle XII
Date: 5-19-87



★ 8:1

K•E 10 TO THE CENTIMETER 18 X 25 CM KEUFFEL & ESSER CO. MADE IN U.S.A. 46 15.

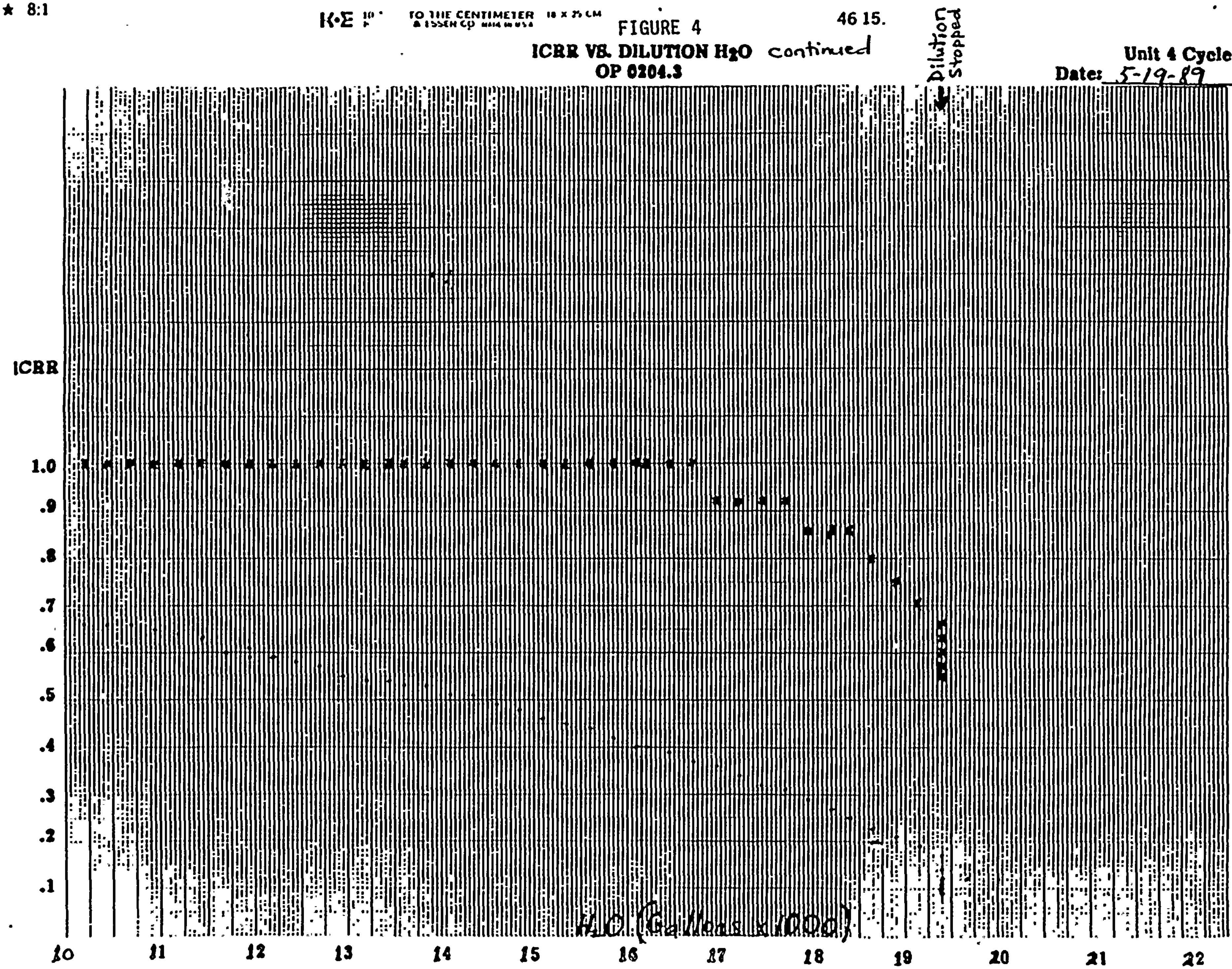
FIGURE 4

ICRR VS. DILUTION H_2O continued

OP 0204.3

Unit 4 Cycle XII

Date: 5-19-89



3.0 Summary of Tests

This section provides a summary of the results of the low power physics tests along with the Westinghouse design data. This report compares design and measured data using difference[1] and percent difference[2]. For each test, the acceptance criteria is listed at the bottom of the table.

[1]The difference = predicted - measured.

[2]For calculating the percent difference, the equation is:

$$\left[\frac{\text{Predicted Value}}{\text{Measured Value}} - 1\right] \times 100\%$$

★R1:1-yrz

3.1 Nuclear Heating

The point of adding Nuclear Heat was determined in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, Step 8.15 and Appendix A. This is performed by establishing a small positive startup rate and measuring the point (flux level) at which T_{avg} departs from its established, steady value.

Nuclear Heating was measured to first occur at:

TABLE 3.1.1

FLUX LEVEL (AMPS)

Picoammeter	N-35	N-36
3.17×10^{-7}	4.5×10^{-7}	4.56×10^{-7}

All physics tests were conducted at or below 1.0×10^{-7} amps on the picoammeter connected to N-44 to assure Nuclear Heating did not occur.

★R1:1-yrz

3.2 Reactivity Vs. Period

Reactivity Computer checkout was done in accordance with Operating Procedure 0204.3, Initial Criticality After Refueling, Step 8.17 and Appendix B. This checkout is performed by inserting small positive and negative reactivities using rod motion, measuring the period generated and the indicated worth, and then comparing design worths to measured worths for the given period.

TABLE 3.2.1

Period (sec)	Reactivity (pcm)	Reactivity (design)	Diff (%)
+123.8	+45.5	+45.8	.66
-191.5	-44.5	-47	5.62
+155.2	+37.5	+38	1.33
-266.6	-30.0	-31.2	4.0
+52.2	+86.0	+87.8	2.09

Acceptance Criteria is +/- 10.0%.

★R1:1-yrz

3.3 **Boron Endpoints (PPM)**

The Boron Endpoints noted below are determined as per Operating Procedure 0204.5, Appendix A. A just-critical condition is established as near as practicable to the required rod configuration (i.e., ARO and control Bank C in). The RCS boron concentration was determined and then adjusted analytically for the ppm worth of the reactivity (measured in pcm) by which the actual critical state deviated from the design condition. Appendix A was performed for the ARO boron endpoint and latter for the CBC in boron endpoint.

TABLE 3.3.1

BORON ENDPOINTS (PPM)

	Measured	Westinghouse	Difference
ARO	1538	1572	34 PPM
CBC	1399	1424	25 PPM

Acceptance Criteria is +/- 50 ppm

3.4 ROD WORTH

Rod worths were measured as per Operating Procedure 0204.5, Appendices D and F. The Reference Bank (highest predicted worth) was diluted into the core. The boron concentration prior to and subsequent to this insertion was determined and the difference in the two boron concentrations is defined as the boron (Rod) worth of the Bank (Table 3.4). The differential and integral worth of control bank C was measured and plotted (Figure 5).

TABLE 3.4

ROD WORTH (PPM)

	Measured	Westinghouse
CBC	139	148

3.5 ROD WORTH (PCM)

The remaining rod bank worths were measured using the rod swap technique, "swapping" negative reactivity insertions on the bank being measured with positive reactivity insertions from the Reference Bank.

TABLE 3.5.1

ROD WORTH (PCM)

	Measured	Westinghouse	Diff (PCM)	% Diff
CBD	691	712	21	+3.04
CBC[1]	1314	1272	-42	-3.20
CBB	375	364	-11	-2.93
CBA	1177	1182	5	+0.42
SBB	1180	1224	44	+3.73
SBA	1000	959	-41	-4.1
Total	5737	5713	-24	-.42

The acceptance criteria for rod worth measurements are:

(1) Reference bank within +/- 10% of design, and

(2) Individual banks within +/- 15% or +/- 100 pcm of design whichever is greater, and

(3) Sum of all measured banks within +/- 10% of design.

★R1:1-yrz

3.6 TEMPERATURE COEFFICIENT

The isothermal and moderator temperature coefficients were determined using Appendix B in Operating Procedure 0204.5, Nuclear Design Check Tests During Startup After Refueling.

The values determined for this testing sequence (in pcm/°F) are:

TABLE 3.6.1

ISOTHERMAL TEMPERATURE COEFICIENT (PCM/°F)

Rods	Measured[1]	Design Westinghouse	Diff
D 214/213	-.88	-1.7	-.82

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

TABLE 3.6.2

MODERATOR TEMPERATURE COEFFICIENT (PCM/°F)

Rods	Measured[1]	Design[2] Westinghouse	Diff
D 214/213	+.92	+.1	-.82

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

[1]This is the average of one heat up and one cool down measurement.
[2]This value has been adjusted for boron and temperature sensitivity.

★R1:1-yrz

3.7. HZP DIFFERENTIAL BORON WORTH

The Hot Zero Power (HZP) Differential Boron worth was measured using Control Bank C, which had a bank worth of 1314 pcm. The value obtained for this test was:

TABLE 3.7.1

HZP DIFFERENTIAL BORON WORTH (PCM/PPM)

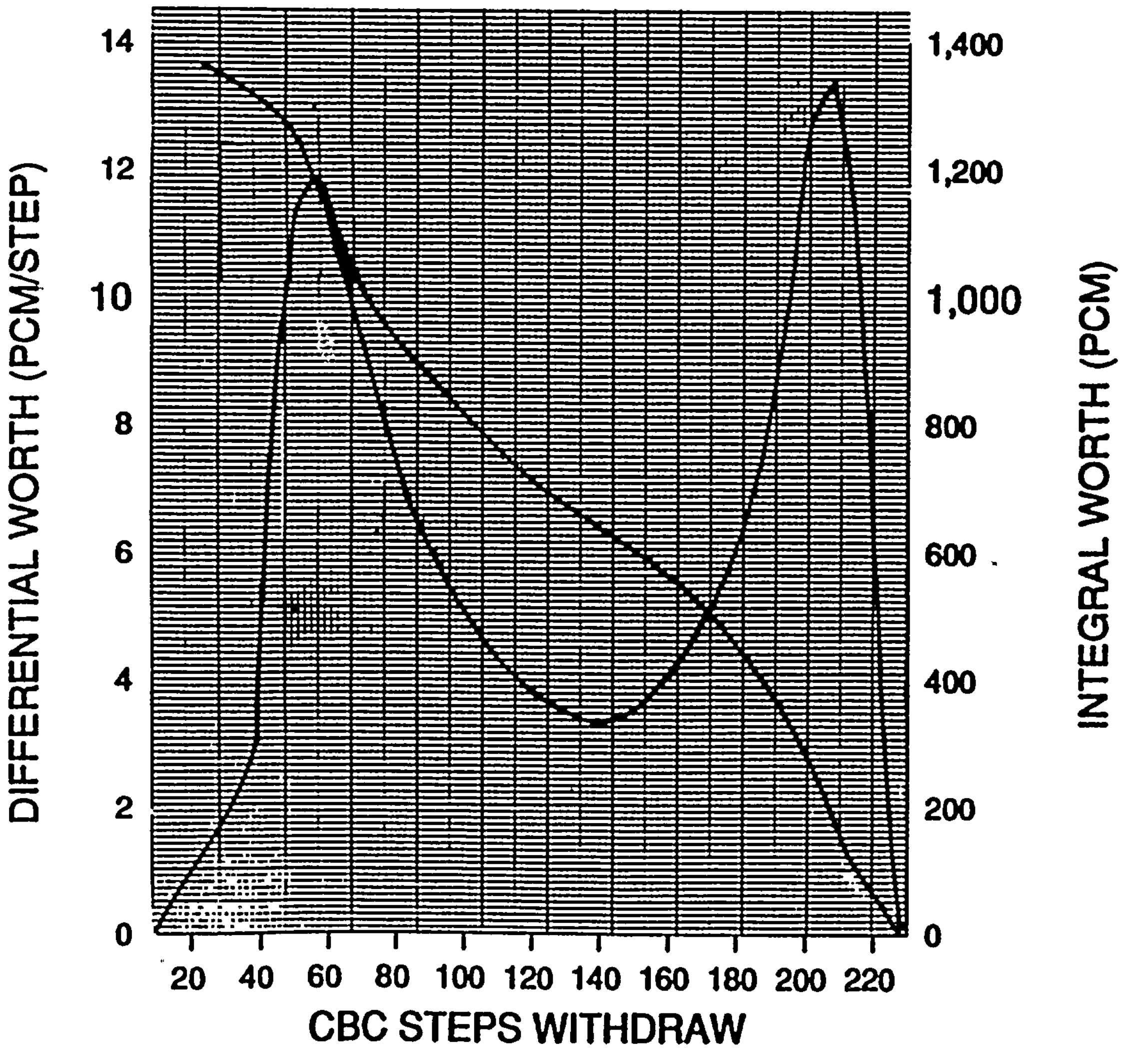
Measured	Westinghouse	% Diff
9.45	8.58	-9.2

Acceptance criteria is ≤ +/- 15%.

★R1:1-yrz

HOT ZERO POWER
DIFFERENTIAL AND INTEGRAL CONTROL BANK C WORTH
VS
BANK POSITION

FIGURE 5



UNIT 4
CYCLE XII
EXPOSURE 0.0 **MWD/MTU**
BANK CBC

BANK POSITIONS

	OUT	IN	MOVING
SBA	☒	☐	☐
SBB	☒	☐	☐
CBA	☒	☐	☐
CBB	☒	☐	☐
CBC	☐	☐	☒
CBD	☒	☐	☐

TEST METHOD

DILUTION	☒
BORATION	☐

4.0 SHUTDOWN MARGIN

The Shutdown Margin was calculated prior to power escalation to verify adequate shutdown capability. For this calculation the total of the design rod worths (minus the most reactive stuck rod) were reduced by 10%. The results show adequate shutdown margin at BOC and EOC. The following is a summary of the results:

	Cycle XII	
	BOC	EOC
Control Rod Worth (%Δρ)		
All Rods Inserted Less Worst Stuck Rod	6.41	6.53
(1) Less 10%	5.77	5.88
Control Rod Requirements (%Δρ)		
Reactivity Defects (Doppler, T_{avg}, Void, Redistribution)	1.90	3.27
Rod Insertion Allowance	1.52	.50
(2) Total Requirements	3.42	3.77
Shutdown Margin (1) - (2) %Δρ	2.35	2.11
Required Shutdown Margin (%Δρ)	1.00	1.77

Source: WCAP 12010

N (arrow)

Row	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
R							0.239	0.285	0.239						
							0.226	0.271	0.226						
							5.5	5.5	5.3						
P					0.328	0.645	1.161	0.913	1.146	0.661	0.346				
					0.332	0.653	1.121	0.875	1.121	0.653	0.332				
					-1.2	-1.2	3.6	4.4	2.3	1.3	4.1				
N				0.417	1.081	1.269	1.166	1.401	1.124	1.301	1.139	0.433			
				0.422	1.095	1.284	1.136	1.321	1.136	1.284	1.095	0.422			
				-1.2	-1.2	-1.2	2.6	6.1	-1.1	1.3	4.1	2.7			
M			0.417	1.141	1.270	1.181	1.256	0.985	1.259	1.193	1.304	1.178	0.421		
			0.421	1.152	1.285	1.201	1.254	0.966	1.254	1.201	1.285	1.152	0.421		
			-0.8	-1.0	-1.2	-1.7	0.2	2.0	0.5	-0.6	1.4	2.2	0.1		
L		0.329	1.084	1.300	1.218	1.269	1.145	1.259	1.165	1.273	1.213	1.346	1.121	0.332	
		0.332	1.092	1.284	1.224	1.303	1.174	1.251	1.174	1.303	1.224	1.284	1.092	0.332	
		-0.8	-0.8	1.2	-0.5	-2.6	-2.5	0.7	-0.8	-2.3	-0.9	4.8	2.6	0.0	
K		0.679	1.296	1.237	1.313	1.081	1.216	1.245	1.200	1.069	1.300	1.235	1.347	0.670	
		0.650	1.280	1.197	1.298	1.097	1.233	1.263	1.233	1.097	1.298	1.197	1.280	0.650	
		4.4	1.3	3.3	1.2	-1.5	-1.3	-1.4	-2.7	-2.6	0.2	3.1	5.2	3.0	
J	0.258	1.241	1.177	1.291	1.175	1.217	1.175	0.972	1.133	1.207	1.165	1.226	1.110	1.156	0.233
	0.225	1.116	1.131	1.249	1.169	1.228	1.186	1.020	1.186	1.228	1.169	1.249	1.131	1.116	0.225
	14.4	11.2	4.1	3.3	0.5	-0.9	-0.9	-4.7	-4.5	-1.7	-0.3	-1.8	-1.9	3.6	3.6
H	0.307	0.942	1.379	0.989	1.240	1.248	1.005	0.922	0.978	1.272	1.246	0.947	1.290	0.902	0.278
	0.269	0.872	1.314	0.962	1.250	1.261	1.020	0.977	1.020	1.261	1.250	0.962	1.314	0.872	0.269
	14.4	8.1	4.9	2.8	-0.8	-1.0	-1.5	-5.6	-4.1	0.8	-0.3	-1.6	-1.8	3.5	3.6
G	0.244	1.171	1.187	1.290	1.186	1.223	1.167	0.987	1.088	1.163	1.132	1.216	1.107	1.124	0.230
	0.225	1.116	1.131	1.249	1.169	1.228	1.186	1.020	1.186	1.228	1.169	1.249	1.131	1.116	0.225
	8.5	4.9	4.9	3.3	1.5	-0.4	-1.6	-3.2	-8.2	-5.3	-3.1	-2.6	-2.1	0.7	2.1
F		0.681	1.341	1.228	1.342	1.094	1.213	1.260	1.163	1.007	1.248	1.156	1.252	0.645	
		0.650	1.280	1.197	1.298	1.097	1.233	1.263	1.233	1.097	1.298	1.197	1.280	0.650	
		4.8	4.8	2.5	3.4	-0.3	-1.7	-0.3	-5.6	-8.2	-3.8	-3.5	-2.2	-0.9	
E		0.347	1.132	1.290	1.176	1.285	1.162	1.246	1.150	1.260	1.223	1.262	1.083	0.330	
		0.332	1.092	1.284	1.224	1.303	1.174	1.251	1.174	1.303	1.224	1.284	1.092	0.332	
		4.7	3.6	0.5	-3.9	-1.4	-1.0	-0.4	-2.1	-3.3	-0.1	-1.7	-0.9	-0.4	
D			0.427	1.168	1.269	1.189	1.251	0.971	1.255	1.182	1.234	1.136	0.423		
			0.421	1.152	1.285	1.201	1.254	0.966	1.254	1.201	1.285	1.152	0.421		
			1.3	1.4	-1.3	-0.9	-0.2	0.5	0.1	-1.5	-4.0	-1.4	0.5		
C				0.428	1.105	1.272	1.140	1.328	1.127	1.255	1.061	0.414			
				0.422	1.095	1.284	1.136	1.321	1.136	1.284	1.095	0.422			
				1.3	0.9	0.6	0.4	0.6	-0.8	-2.3	-3.1	-1.9			
B					0.339	0.666	1.125	0.867	1.086	0.636	0.326				
					0.332	0.653	1.121	0.874	1.121	0.653	0.332				
					2.1	2.1	0.4	-0.8	-3.1	-2.6	-1.9				
A							0.226	0.268	0.221						
							0.226	0.271	0.226						
							-0.2	-1.1	-2.4						

MEASURED F DELTA H
EXPECTED F DELTA H
DIFFERENCE

ROD POSITION

Bank	Location in Steps
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	158

Classification

Map No. FM4XII1

Power % 25

Axial Offset 5.22

Max $F^N_{\Delta H}$ 1.551

Max F^N_Q 2.038

INCORE TILT

N

1.0084	1.0050
1.0100	0.9766

★R1:1-yrz

15	14	13	1[illegible]	[illegible]	10	9	8	7	6	5	[illegible]	3	2	1	
						0.243 0.232 4.9	0.286 0.278 3.1	0.237 0.232 2.2							R
				0.348 0.338 3.2	0.674 0.653 3.2	1.156 1.101 5.0	0.908 0.873 4.0	1.117 1.101 1.4	0.659 0.653 1.0	0.349 0.338 3.2					P
			0.439 0.425 3.2	1.107 1.073 3.2	1.298 1.257 3.2	1.183 1.127 5.0	1.394 1.309 6.4	1.116 1.127 -0.9	1.270 1.257 1.0	1.108 1.073 3.2	0.435 0.425 2.2				N
		0.430 0.424 1.2	1.151 1.126 2.2	1.297 1.257 3.2	1.192 1.189 0.2	1.251 1.253 -0.1	1.010 0.996 1.4	1.263 1.253 0.8	1.194 1.189 0.5	1.271 1.257 1.1	1.129 1.126 0.3	0.425 0.424 0.2			M
	0.342 0.338 1.2	1.085 1.072 1.2	1.289 1.256 2.6	1.200 1.212 -1.0	1.223 1.296 -5.6	1.123 1.187 -5.3	1.268 1.268 0.0	1.185 1.187 -0.2	1.290 1.296 -0.4	1.225 1.212 1.1	1.237 1.256 -1.6	1.064 1.072 -0.7	0.339 0.338 0.3		L
	0.660 0.652 1.3	1.288 1.255 2.6	1.234 1.187 4.0	1.289 1.291 -0.1	1.059 1.111 -4.7	1.205 1.252 -3.8	1.260 1.286 -2.0	1.234 1.252 -1.4	1.100 1.111 -1.0	1.280 1.291 -0.8	1.176 1.187 -0.9	1.250 1.255 -0.4	0.653 0.652 0.2		K
0.234 0.231 1.3	1.128 1.099 2.6	1.169 1.124 4.0	1.299 1.249 3.9	1.179 1.182 -0.3	1.196 1.248 -4.2	1.169 1.221 -4.3	1.036 1.067 -2.9	1.187 1.221 -2.8	1.217 1.248 -2.4	1.149 1.182 -2.8	1.234 1.249 -1.2	1.128 1.124 0.4	1.124 1.099 2.2	0.237 0.231 2.5	J
0.298 0.276 8.0	0.924 0.872 6.0	1.358 1.305 4.0	1.012 0.993 1.9	1.260 1.268 -0.6	1.260 1.284 -1.9	1.054 1.067 -1.2	1.025 1.046 -2.0	1.043 1.067 -2.2	1.262 1.284 -1.8	1.228 1.268 -3.1	0.952 0.993 -4.1	1.376 1.305 5.4	0.902 0.872 3.4	0.283 0.276 2.5	H
0.250 0.231 8.0	1.188 1.099 8.0	1.214 1.124 8.0	1.296 1.249 3.7	1.174 1.182 -0.7	1.233 1.248 -1.1	1.224 1.221 0.3	1.053 1.067 -1.3	1.196 1.221 -2.0	1.214 1.248 -2.7	1.132 1.182 -4.2	1.212 1.249 -3.0	1.129 1.124 0.5	1.131 1.099 2.8	0.236 0.231 2.1	G
	0.704 0.652 8.0	1.356 1.255 8.0	1.250 1.187 5.3	1.292 1.291 0.1	1.086 1.111 -2.2	1.196 1.252 -4.5	1.279 1.286 -0.6	1.224 1.252 -2.3	1.062 1.111 -4.4	1.240 1.291 -3.9	1.119 1.187 -5.7	1.228 1.255 -2.2	0.661 0.652 1.4		F
	0.364 0.338 8.8	1.156 1.072 7.9	1.315 1.256 4.7	1.213 1.212 0.2	1.276 1.296 -1.5	1.153 1.187 -2.8	1.243 1.268 -2.0	1.158 1.187 -2.4	1.261 1.296 -2.7	1.191 1.212 -1.7	1.198 1.256 -4.6	1.001 1.072 -6.6	0.328 0.338 -2.8		E
		0.457 0.424 7.7	1.211 1.126 7.5	1.284 1.257 2.1	1.173 1.189 -1.3	1.255 1.253 0.1	1.000 0.996 0.4	1.225 1.253 -2.2	1.166 1.189 -1.9	1.236 1.257 -1.7	1.066 1.126 -5.4	0.378 0.424 -11.0			D
			0.458 0.425 7.7	1.071 1.073 -0.1	1.207 1.257 -4.0	1.116 1.127 -0.9	1.343 1.309 2.6	1.133 1.127 0.5	1.256 1.257 -0.1	1.070 1.073 -0.2	0.409 0.425 -3.9				C
				0.315 0.338 -6.8	0.609 0.653 -6.7	1.068 1.101 -3.0	0.856 0.873 -1.9	1.127 1.101 2.3	0.665 0.653 1.9	0.342 0.338 1.2					B
						0.221 0.232 -4.5	0.276 0.278 -0.7	0.234 0.232 0.9							A

MEASURED F DELTA H
EXPECTED F DELTA H
DIFFERENCE

N (arrow)

ROD POSITION

Bank	Location in Steps
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	166

Classification

Map No. FM4XII2

Power % 46.94

Axial Offset -.71

Max $F^{N}_{\Delta H}$ 1.523

Max F^{N}_{Q} 1.822

INCORE TILT

N

1.0073	0.9993
1.0122	0.9812

★R1:1-yrz

N ↑

Row	15	14	13	[illegible]	[illegible]	10	9	8	7	6	[illegible]	[illegible]	3	2	1
R							0.236 0.229 2.9	0.278 0.275 1.1	0.230 [illegible] 0.5						
P					0.343 0.332 3.3	0.659 0.644 2.3	1.120 1.088 2.9	0.883 0.868 1.7	1.087 1.088 -0.1	0.644 0.644 0.0	0.339 0.332 1.9				
N				0.433 0.415 4.3	1.088 1.053 3.3	1.276 1.247 2.3	1.163 1.130 2.9	1.386 1.342 3.3	1.110 1.130 -1.8	1.247 1.247 0.0	1.073 1.053 1.9	0.426 0.415 2.6			
M			0.430 0.414 3.8	1.127 1.099 2.6	1.241 1.226 1.3	1.175 1.175 0.0	1.280 1.284 -0.3	1.091 1.089 0.2	1.286 1.284 0.1	1.175 1.175 0.0	1.226 1.226 0.0	1.110 1.099 1.1	0.430 0.414 3.8		
L		0.343 0.332 3.3	1.086 1.052 3.3	1.215 1.225 -0.8	1.175 1.185 -0.8	1.261 1.290 -2.3	1.149 1.191 -3.5	1.287 1.289 -0.2	1.198 1.191 0.6	1.303 1.290 1.0	1.162 1.185 -1.9	1.218 1.225 -0.6	1.069 1.052 1.7	0.345 0.332 3.9	
K		0.664 0.643 3.3	1.274 1.245 2.3	1.180 1.173 0.6	1.276 1.286 -0.8	1.074 1.102 -2.5	1.219 1.251 -2.5	1.276 1.289 -1.0	1.253 1.251 0.2	1.097 1.102 -0.4	1.269 1.286 -1.3	1.155 1.173 -1.5	1.226 1.245 -1.6	0.630 0.643 -2.1	
J	0.235 0.228 2.8	1.107 1.085 2.0	1.146 1.127 1.6	1.298 1.281 1.3	1.188 1.187 0.1	1.213 1.246 -2.7	1.217 1.251 -2.8	1.096 1.098 -0.2	1.249 1.251 -0.2	1.237 1.246 -0.8	1.163 1.187 -2.0	1.268 1.281 -1.0	1.106 1.127 -1.8	1.099 1.085 1.2	0.243 0.228 6.5
H	0.282 0.274 3.1	0.889 0.867 2.5	1.364 1.337 2.0	1.104 1.086 1.7	1.311 1.289 1.7	1.282 1.287 -0.4	1.087 1.098 -1.0	1.156 1.156 0.0	1.099 1.098 0.0	1.286 1.287 0.0	1.277 1.289 -0.9	1.079 1.086 -0.6	1.366 1.337 2.2	0.894 0.867 3.1	0.292 0.274 6.5
G	0.235 0.228 3.1	1.119 1.085 3.1	1.156 1.127 2.5	1.305 1.281 1.9	1.209 1.187 1.8	1.248 1.246 0.2	1.250 1.251 -0.1	1.097 1.098 -0.1	1.255 1.251 0.3	1.238 1.246 -0.6	1.168 1.187 -1.6	1.266 1.281 -1.2	1.130 1.127 0.3	1.114 1.085 2.6	0.239 0.228 4.5
F		0.663 0.643 3.1	1.284 1.245 3.1	1.134 1.173 -3.3	1.244 1.286 -3.3	1.087 1.102 -1.4	1.238 1.251 -1.0	1.287 1.289 -0.2	1.242 1.251 -0.7	1.077 1.102 -2.2	1.247 1.286 -3.0	1.132 1.173 -3.5	1.228 1.245 -1.4	0.648 0.643 0.8	
E		0.339 0.332 2.1	1.060 1.052 0.8	1.209 1.225 -1.3	1.147 1.185 -3.2	1.258 1.290 -2.5	1.182 1.191 -0.8	1.283 1.289 -0.4	1.182 1.191 -0.8	1.260 1.290 -2.3	1.147 1.185 -3.2	1.185 1.225 -3.2	1.037 1.052 -1.4	0.334 0.332 0.8	
D			0.417 0.414 0.8	1.106 1.099 0.7	1.210 1.226 -1.3	1.136 1.175 -3.3	1.325 1.284 3.2	1.104 1.089 1.5	1.281 1.284 -0.2	1.153 1.175 -1.8	1.193 1.226 -2.6	1.068 1.099 -2.8	0.405 0.414 -2.2		
C				0.418 0.415 0.8	1.059 1.053 0.6	1.252 1.247 0.4	1.151 1.130 1.9	1.382 1.342 3.0	1.145 1.130 1.3	1.245 1.247 -0.2	1.045 1.053 -0.8	0.412 0.415 -0.8			
B					0.333 0.332 0.4	0.647 0.644 0.4	1.100 1.088 1.1	0.875 0.868 0.8	1.101 [illegible] 1.2	0.651 0.644 1.1	0.336 0.332 1.0				
A							0.230 0.229 0.5	0.278 0.275 0.8	0.231 0.229 1.0						

MEASURED F DELTA H
EXPECTED F DELTA H
DIFFERENCE

ROD POSITION

Bank	**Location in Steps**
SBA	228
SBB	228
CBA	228
CBB	228
CBC	228
CBD	224

Classification

Map No. FM4XII3

Power % 99.50

Axial Offset +2.46

Max $F^N_{\Delta H}$ 1.475

Max F^N_Q 1.920

INCORE TILT

N

1.0056	0.9997
1.0021	0.9926

★R1:1-yrz

6.0 CRITICAL BORON CONCENTRATION

Unit 4 Cycle XII

The critical boron concentration was calculated by adjusting a measured boron concentration to the equilibrium hot full power, all rods out condition. For Unit 4 Cycle XII this calculation was performed at 900 MWD/MTU.

The following is a summary of the results in PPM:

MEASURED[1]	WESTINGHOUSE	DIFF
1081	1068	-13

Acceptance Criteria is +/- 50 ppm

1) 1081 = Actual Boron concentration (adjusted to equilibrium, HFP, ARO conditions) + 34ppm (Predicted HZP, ARO C_B – Measured HZP, ARO C_B) per ANSI Standard 19.6.1.

★R1:1-yrz