DUKE POWER COMPANY

OCONEE NUCLEAR STATION

OCONEE 2, CYCLE 7

STARTUP TESTING REPORT

Part I Zero Power Physics Testing

Part II Power Escalation Testing

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OCONEE 2 CYCLE 7

Startup Testing Report

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OCONEE 2 CYCLE 7

STARTUP TESTING REPORT

PART I

ZERO POWER PHYSICS TEST

1.0 Introduction and Summary

The Oconee 2 Cycle 7 Zero Power Physics Test (ZPPT) program was conducted from 12/6/83 to 12/7/83 per Station Procedure TT/2/A/711/07 (Oconee 2 Cycle 7 Zero Power Physics Test). The purpose of this testing was to verify the nuclear parameters upon which the Oconee 2 Cycle 7 safety analysis and Technical Specifications are based.

The ZPPT measurements were made with reactor power controlled between 2.0 x 10^{-10} amps and 3.6 x 10^{-8} amps on the intermediate range instrumentation; reactivity insertions were maintained < ±1200 μρ. RCS pressure and temperature were maintained at ∿ 2155 PSIG and ∿ 532°F, respectively.

The following nuclear parameters were measured per the ZPPT:

(a) All rods out boron concentration (See Enclosure 1.0)

(b) Integral rod worth for CRA groups 5, 6, and 7 (See Enclosures 2.0-2.3)

(c) Differential boron worth (See Enclosure 1.0)

(d) Temperature and moderator coefficients of reactivity (See Enclosure 6.0)

The plant computer was used to record RC pressure, RC temperature, intermediate range NI power levels, and control rod positions. Reactivity was calculated by the plant computer and output to a chart recorder.

On 12/7/83 at 1230, the ZPPT was declared complete; all acceptance criteria were met.

2.0 Approach to Critical

The initial RCS heatup following the refueling outage began on 11/26/83. A return to cold shutdown was initiated from 295°F due to problems with the 2B2 seal return line. Hot shutdown was eventually reached on 12/5/83 at 1900. Performance ZPPT personnel recorded count rates and generated 1/m (inverse multiplication) vs RC temperature plots throughout both heatups.

Rod withdrawal for the Control Rod Drive Trip Time Test began at 1230 on 12/6/83. 1/M vs. withdrawn rod worth plots were maintained. The RCS boron concentration had been adjusted to approximately the all-rods-out critical concentration to achieve criticality near the all-rods-out conditions.

At 1535 initial criticality was achieved with Group 7 at 90%wd and Group 8 at 37.5%wd. CR Groups 1-7 were then tripped into the core to complete the trip time test. Due to the investigation and repair of a faulty position indication for a rod in Group 2, criticality was not reestablished until 2105 hours.

3.0 Pre-Physics Measurements

After establishing steady conditions with the reactor critical, the NI overlap and Sensible Heat determination measurements were performed. The power level of 3.6×10^{-8} amps on the intermediate range NIs (as indicated on the Control Room chart) was established as the upper limit for ZPPT.

An on-line reactimeter checkout* was then performed by making reactivity insertions of about ± 250, ± 750, and ± 1200 μρ and measuring the associated doubling times. These doubling times were input to an off-line reactivity calculation and the results were then compared to the on-line reactivity values.

*NOTE: An "off-line" reactimeter checkout was performed during RCS heatup. This checkout verified correct calculational and chart recorder response to three test cases in which simulated power ramps were input via floppy discs.

4.0 Physics Testing

A. All Rods Out Boron Concentration Measurement

The RCS equilibrium boron concentration was measured with CR Groups 1-7 at 100% wd and Group 8 at 37.7% wd. Group 8 was moved to 37.5% wd and the associated reactivity change was converted to ppmb. The resultant all-rods-out boron concentration was calculated to be 1562 ppmb.

B. Temperature Coefficient of Reactivity Measurements

Temperature coefficient measurements were made while maintaining equilibrium boron conditions at two approximate rod configurations: all-rods-out and all-regulating-rods-in. Each measurement was made by increasing RCS temperature about 10°F and observing the associated reactivity change. The change in reactivity was divided by the change in RCS temperature to calculate the temperature coefficient. The moderator coefficient was calculated by subtracting the isothermal doppler coefficient (-0.15×10^{-4} ΔK/K/°F) from the measured temperature coefficients.

C. Control Rod Group Integral Worths and Differential Boron Worth Measurement

The worths of Groups 5, 6, and 7 were measured by steadily deborating the RCS and compensating for the resulting positive reactivity ramp by inserting (in discrete steps of ~ - 800 μρ) the control rods from 100% wd on Group 7 to 0% wd on Group 5 (with no rod overlap). The reactivity changes resulting from the discrete control rod insertions were summed for each group to obtain the group integral worth.

The differential boron worth was calculated by dividing the reactivity change by the boron change, resulting from the control rod worth measurements. The initial and final values for reactivity and boron concentration were recorded at critical equilibrium conditions.

PART II

POWER ESCALATION TEST

1.0 Introduction and Summary

The Oconee 2 Cycle 7 Power Escalation Test was performed between 12/7/83 and 12/30/83 per Station Procedure TT/2/A/811/07. Testing was performed at 12%, 40% and 100% Full Power (FP) to verify the nuclear parameters upon which the Oconee 2 Cycle 7 safety analysis and Technical Specifications are based. The following tests and verifications were performed:

(A) Initial Core Power Distribution Check @ 12% FP

(B) Power Imbalance Detector Correlation @ 40% FP (See Enclosure 5.0)

(C) NSS Heat Balance (including RCS flow measurement at 100% FP) @ 12% FP, 40% FP, and 100% FP (See Enclosure 7.0)

(D) Incore Detector Checkout @ 40% FP and 100% FP

(E) Core Power Distribution @ 40% FP and 100% FP (See Enclosures 3.0-3.3 and 4.0)

(F) Reactivity Coefficients @ 100% FP (See Enclosure 6.0)

Oconee 2 reached 12% FP at 2250 hrs on 12/7/83. The initial core power distribution check and primary NSS heat balance were completed at 2340 on 12/7/83.

The unit achieved 40% FP at 0900 on 12/8/83. The incore detector checkout for this power level was completed at 1100 on 12/9/83.

While holding for equilibrium xenon, to enable completion of the 40% plateau testing, Unit 2 tripped. The RPS Channel D Pump Power Monitor Instrument Calibration (IP/2/A/0305/1D) was in progress at the time of the trip, which occurred at 1458 on 12/9/83. The Channel D (RCP-2B2) pump power monitor was disabled per procedure. A momentary loss of power on KVIC tripped the 2B1 RCP power monitor and resulted in alarms on all RPS Channel C parameters. The indicated loss of both RCPs in the B Loop tripped all four RPS Channels on RCP/Flux ratio. Oconee 2 Trip #67 transient analysis and associated data may be referenced for further details.

Testing at the 40% plateau resumed at 0800 on 12/11/83 and was completed by 2013 that same day.

As previously implemented on Oconee Unit 1 Cycle 8, the Intermediate Power (70% to 85% FP) testing was eliminated. The radial/total peaking factor criteria were satisfied for <u>100% FP</u> at the <u>40% FP</u> plateau.

The unit reached 100% FP at 0800 hrs on 12/19/83. The verification of RC Flow Constants (PT/0/A/275/03) was initially performed on the same day. A discrepancy in the B1 and B2 feedwater flow indications was discovered during the test. The feedwater flow transmitter calibration data was reverified. No errors were found. PT/0/A/275/03 was performed again on 1/26/84. Revision of the plant computer RC flow constants was subsequently completed on 2/7/84. Slope and reference RC flow adjustments for the ΔT power calculation were not required.

The incore detector checkout and Core Power Distribution tests for 100% FP were completed on 12/19/83. The reactivity coefficients measurement was performed on 12/30/83. Data reduction and analysis for this test were completed by 2/14/84. This completed the Oconee 2 Cycle 7 Power Escalation Test - all acceptance criteria were met.

2.0 NSS Heat Balance/RC Flow Verification

Off-line secondary and primary heat balances were performed at 12% (primary only), 40% and 100% FP. These tests verified the accuracy of CTPA, the on-line plant computer program which performs primary and secondary heat balances. The plant computer was used to average heat balance data (flows, temperatures, pressures, etc.) for 15 minutes. This data was input into the off-line heat balance programs and the results were compared to CTPA averages for the same period.

At full power, an off-line program was used to calculate RC flow based on a secondary heat balance and measured primary loop enthalpy changes. This demonstrated that the RC flow rate was above that assumed in the core design (106.5% design flow) and below that which would cause core lift at 470°F (113.8% design flow).

After establishing the primary flow rate at full power, the plant computer flow constant (used to calculate flow from the primary ΔP instrumentation) was normalized.

3.0 Core Power Distribution

Core Power Distribution tests were conducted at 40% and 100% FP. These tests verified that reactor power imbalance, quadrant power tilt, minimum DNBR, maximum LHR and radial/total power peaks did not exceed their respective specified limits. An initial Core Power Distribution was performed at 12% FP. However, due to the low power, only quadrant power tilt was verified to be within limits.

Specific checks were made as follows:

Incore imbalance was compared to the error adjusted imbalance LOCA limit curve and was verified to be within specified limits (based on Tech. Spec. 3.5.2.7).

The maximum positive quadrant power tilt was verified to be less than the error adjusted LOCA limit of +3.71% (based on Tech. Spec. 3.5.2.4).

The maximum LHR was verified to be within the LOCA limit maximum allowable heat rate (per Reload Report DPC-RD-2002).

The worst case minimum DNBR and maximum LHR, when extrapolated to the overpower trip, were verified to be within the fuel melt limits (per Technical Specification 2.1).

The radial and total peaking factors were measured and compared to the predicted values. The following acceptance criteria were applied:

(a) $\% \text{ Deviation} = \frac{(\text{Predicted - Measured})}{\text{Measured}} \times 100 \leq \pm 20\%$

(b) $\frac{\text{LMP - LPP}}{\text{LMP}} \times 100 \leq$

	Radial	Total
	8.0%	12.0% @ 40% FP
	5.0%	7.5% @ 100% FP

Where:

LMP is the largest measured peaking factor
LPP is the largest predicted peaking factor

(c) The full core root mean square radial peaking factor deviation (i) for all core locations with operable incore detector strings was limited as follows:

$$i = \sum_{1}^{N} \left[(PP - MP)^2/(N-1)\right]^{\frac{1}{2}} \leq \begin{matrix} 0.100 \text{ @ } 40\% \text{ FP} \\ 0.075 \text{ @ } 100\% \text{ FP} \end{matrix}$$

Where:

PP = Predicted radial peaking factor
MP = Measured radial peaking factor
N = Total number of operable incore detector strings
The following incore detector strings were inoperable:
*String 45, 1/8 core location A9
String 48, 1/8 core location C12
String 52, 1/8 core location C13

*Note: Corrections in software decreased the calculated % deviations for String 41 and allowed use of String 45 for 100% FP testing.

Per the "Oconee Generic Startup Test Program", the following criteria were verified at 40% FP to allow deletion of the Intermediate Power (70% to 85% FP) Testing:

a) $\frac{\text{LMP-LPP}}{\text{LMP}} \times 100 \leq$

	Radial	Total
	5.0%	7.5%

b) $\sum_{i}^{n} \left[(PP-MP)^2/(n-1)\right]^{\frac{1}{2}} \leq 0.075$

(Calculated for radial peaking factors only)

At 100% FP, tilt and imbalance were calculated using the backup incore recorder outputs and then compared to the full incore values.

4.0 Power Imbalance Detector Correlation

The Power Imbalance Detector Correlation test was performed at 40% FP. The purposes of this test were:

a) to measure the outcore to full incore power imbalance correlation slopes for NI Channels 5, 6, 7, and 8, and to verify these slopes to be conservative with respect to the FSAR,

b) to verify reasonable power imbalance agreement between the backup incore detector recorder system and the full incore detector system,

c) to verify the adequacy of the RPS flux/flow/imbalance and overpower trip envelope by demonstrating that the extrapolated values of minimum DNBR and maximum LHR were within the fuel melt limits of Technical Specification 2.1, and

d) to verify the adequacy of the LOCA imbalance limit curve by demonstrating that the extrapolated values of LHR were within the LOCA limits listed in the Reload Report (DPC-RD-2002).

After measuring the parameters above for three imbalance levels, it was apparent that the NI Δ flux gain settings needed to be adjusted. Once I&E had changed the gain settings, testing resumed. Correlation slopes were calculated for imbalance levels of +4.18, -0.17, -2.36, -5.76 and -8.29% FP. The remaining parameters (b-d) were measured/calculated for imbalance levels of +4.18, +2.45, +0.91, -0.03, -2.36, -5.76, and -8.29 % FP. These imbalance levels were achieved by positioning Group 8 (APSR).

The incore/outcore imbalance correlation slope for each NI Channel (5-8) was determined by a least squares fit of outcore to incore imbalance indications for the six imbalance levels. All the slopes were verified to be greater than 1.15.

The backup incore/full incore correlation was determined by plotting hand-calculated imbalance from backup incore recorder outputs versus the full incore imbalance value obtained from the plant computer. These points were required to be within a specified range.

Values for the minimum DNBR and maximum LHR were obtained from the plant computer. These values were extrapolated to the maximum allowable trip*, and were verified to be within the fuel melt limits: < 20.4kw/ft and > 1.30 DNBR.

* The maximum allowable trip being either the overpower trip or the flux/flow/imbalance trip, whichever would be encountered first.

Measured values of LHR were extrapolated to the LOCA imbalance window and verified to be less than the LOCA limits specified in the Oconee 2 Cycle 7 Reload Report (DPC-RD-2002).

5.0 Reactivity Coefficients at Power

Data for calculating the doppler and temperature coefficients was taken at ~ 100% FP. This test verified that the measured and extrapolated reactivity coefficients were conservative relative to the specified values in the FSAR.

The reactivity coefficients were calculated in the following manner:

Group 7 differential rod worth measurements were made over the range of rod motion encountered in the test. The B&W "push/ pull" differential rod worth measurement technique and the B&W "fuel power correction" calculation were used to determine the differential rod worths.

The temperature coefficient of reactivity was determined by varying the average RC temperature (thermal power was held as steady as possible) and measuring the resulting change in Group 7 position. The power doppler coefficient of reactivity was determined by varying reactor power level (average RC temperature was held as steady as possible) and measuring the resulting change in Group 7 position.

The measured differential rod worths were used with the temperature change and power changes to calculate the temperature and the power doppler coefficients, respectively. Corrections for xenon and temperature/power variations were also made.

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STARTUP REPORT

ENCLOSURE 1.0

ARO AND DIFFERENTIAL BORON WORTH RESULTS

PARAMETER	CONDITIONS	MEASURED VALUE	PREDICTED VALUE	DEVIATION	ACCEPTANCE CRITERIA
All Rods Out Boron Conc.	Gp 7 @ 100% wd Gp 8 at 37.5% wd*	1562 ppm	1537 ppm	25 ppm	Predicted ±50 ppm
Differential Boron Worth	1375 ppm Average During Measurement End Points: Gp 7 @ 100, Gp 8 @ 37.7 1560 ppm Gp 5 @ 9.6, Gp 8 @ 37.5 1185 ppm	-0.933% ΔK/K per 100 ppm	-0.886% ΔK/K per 100 ppm	-5.0%**	Measured < 1.33% ΔK/K per 100 ppm and ±15% Deviation

* Equilibrium conditions: Gp 7 @ 100% wd, Gp 8 @ 37.7% wd, B_{10} @ 1560 ppm

$$\text{**\% Deviation} = \frac{\text{predicted - measured}}{\text{measured}} \times 100$$

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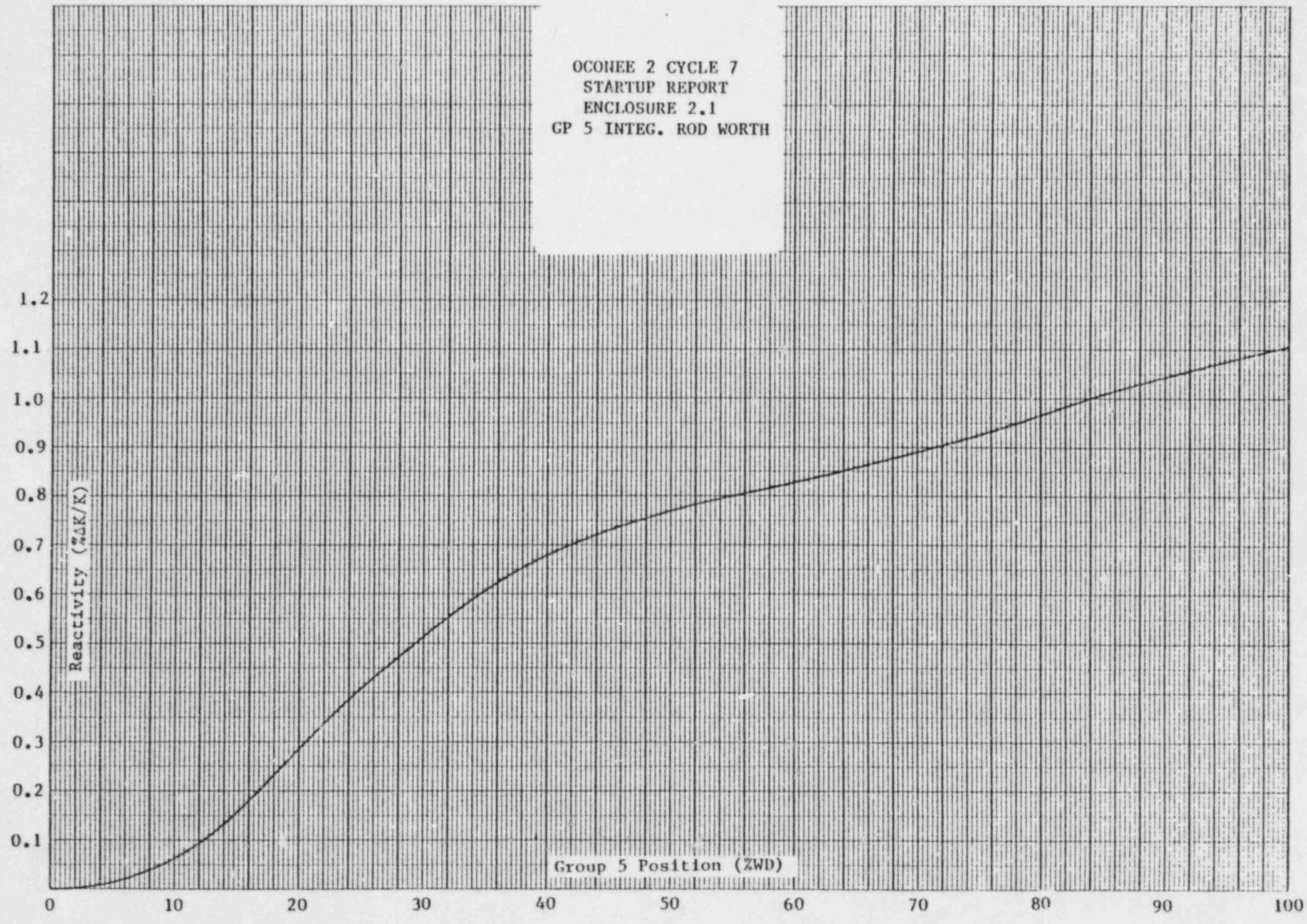
STARTUP REPORT
ENCLOSURE 2.0
INTEGRAL GROUP ROD WORTH MEASUREMENTS

PARAMETER	MEASURED VALUE (% ΔK/K)	PREDICTED VALUE (% ΔK/K)	DEVIATION* (%)	ACCEPTANCE CRITERION
Gp 7 Integral Worth	-1.42	-1.38	-2.8	± 15% Deviation
Gp 6 Integral Worth	-1.04	-1.08	+3.8	± 15% Deviation
Gp 5 Integral Worth	-1.11	-1.16	+4.5	± 15% Deviation
GP 5-7 Integral Worth	-3.57	-3.62	+1.4	± 10% Deviation

$$* \ \% \text{ Deviation} = \frac{\text{predicted} - \text{measured}}{\text{measured}} \times 100$$


OCONEE 2 CYCLE 7
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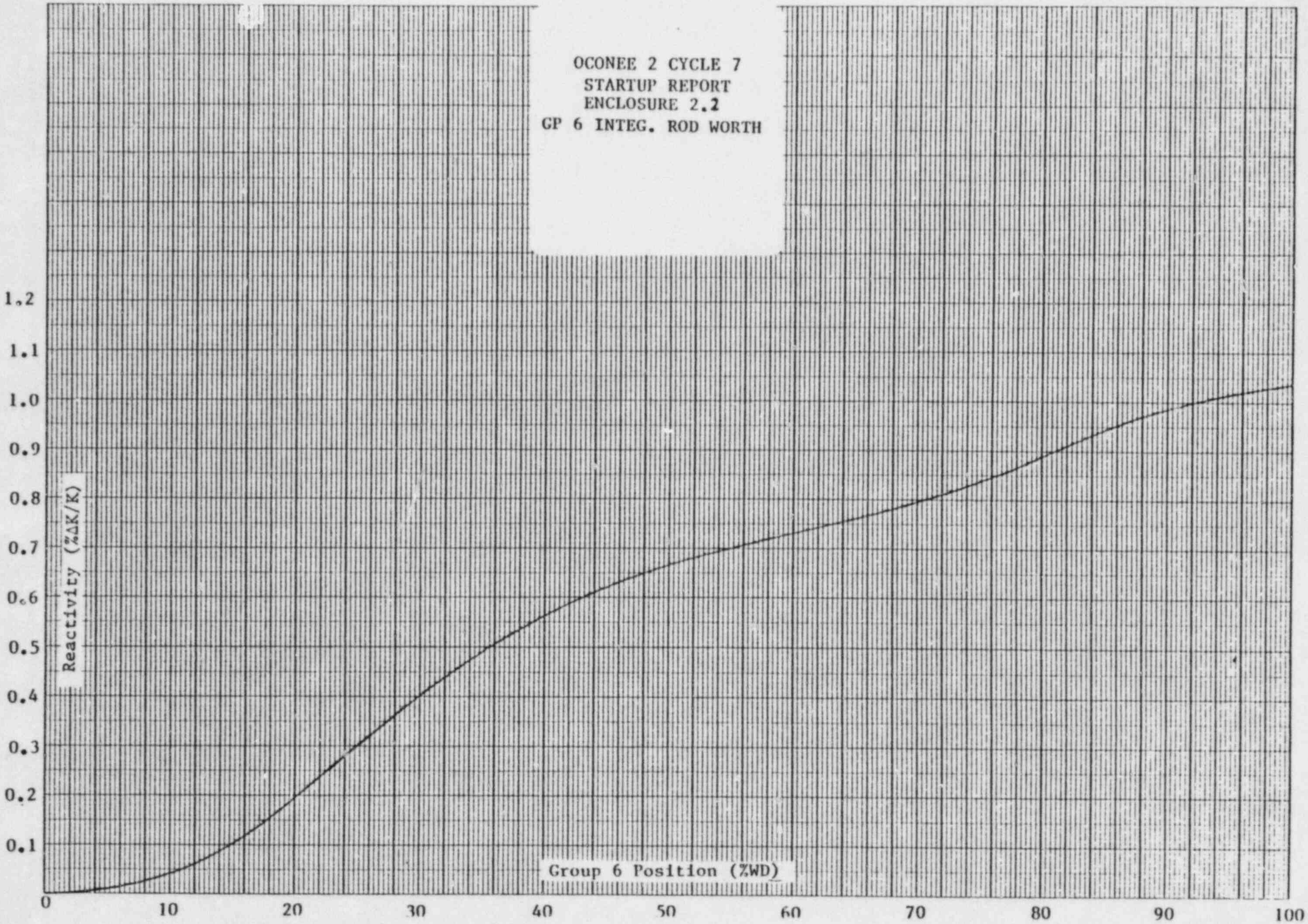
ENCLOSURE 2.1
GP 5 INTEG. ROD WORTH
Reactivity (%ΔK/K)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Group 5 Position (%WD)
0
10
20
30
40
50
60
70
80
90
100

MLE
2/27/84


OCONEE 2 CYCLE 7
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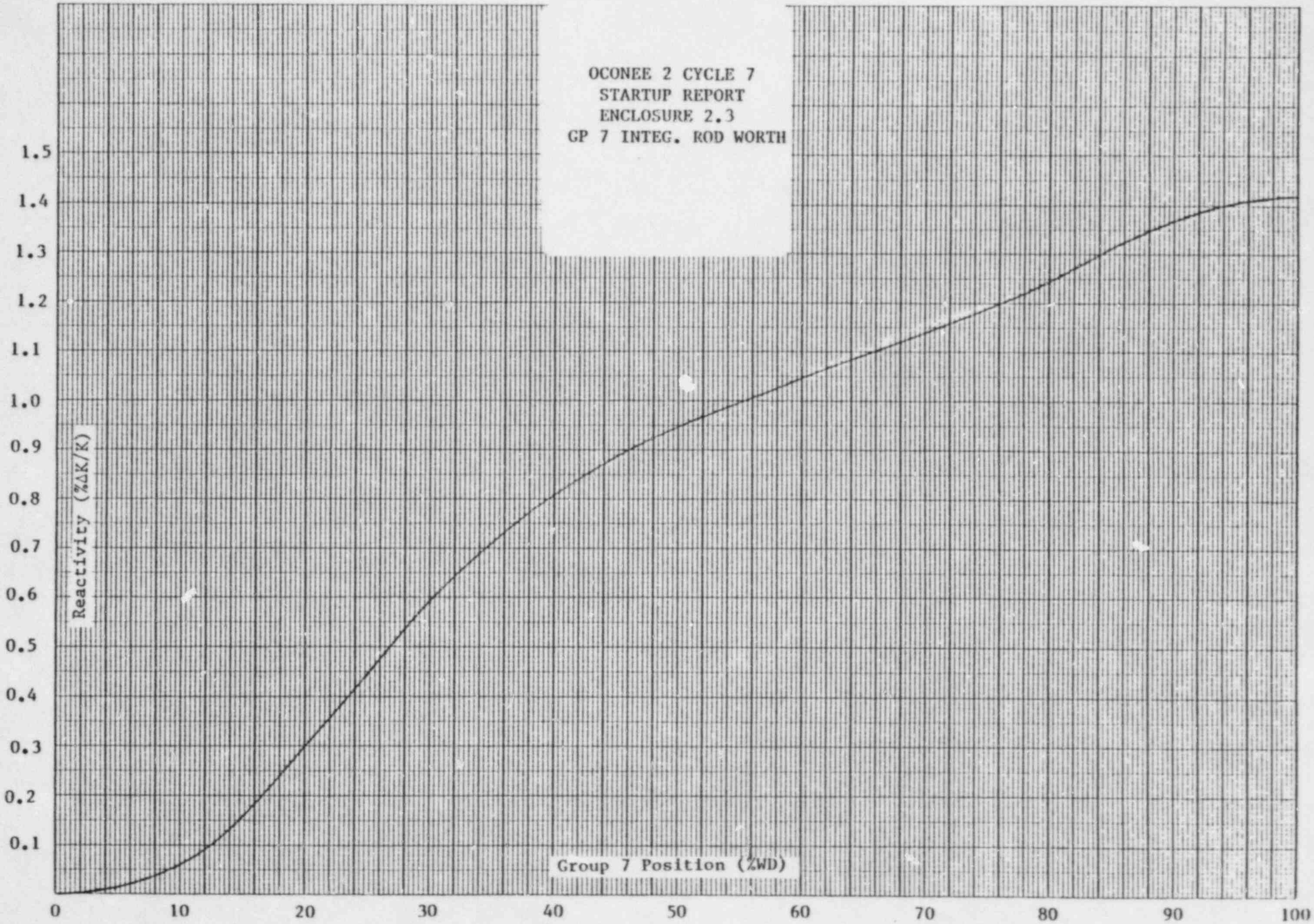
ENCLOSURE 2.2
GP 6 INTEG. ROD WORTH
Reactivity (%ΔK/K)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
70
80
90
100
Group 6 Position (%WD)

MCE
2/27/84


OCONEE 2 CYCLE 7
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ENCLOSURE 2.3
GP 7 INTEG. ROD WORTH
Reactivity (%ΔK/K)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Group 7 Position (%WD)
0
10
20
30
40
50
60
70
80
90
100

MCE
2/27/84

OCONEE 2 CYCLE 7
STARTUP REPORT
ENCLOSURE 3.0

Radial Peaking Factor Comparison 40.0 % FP

	H	G	F	E	D	C	B	A
Core Location	H-8	G-8	F-8	E-8	D-8	C-8	B-8	A-8
Predicted Peak	0.8631	0.9958	1.0086	1.2558	1.0605	1.3307	1.0226	0.5934
Measured Peak	0.92	1.05	1.02	1.21	1.10	1.29	1.05	0.61
% Deviation	-6.185	-5.16	-1.118	3.785	-3.59	3.155	-2.61	-2.72
Core Location		G-9	F-9	E-9	D-9	C-9	B-9	A-9 *
Predicted Peak		1.0864	1.2660	1.0439	1.2665	1.1876	1.2251	
Measured Peak		1.13	1.22	1.11	1.21	1.26	1.17	
% Deviation		-3.86	3.77	-5.95	4.67	-5.75	4.71	
Core Location			F-10	E-10	D-10	C-10	B-10	A-10
Predicted Peak			1.0723	1.2493	0.9327	1.2432	0.8835	0.3902
Measured Peak			1.15	1.24	0.99	1.23	0.92	0.41
% Deviation			-6.76	0.75	-5.79	1.073	-3.97	-4.83
Core Location				E-11	D-11	C-11	B-11	
Predicted Peak				1.1158	1.2397	1.0514	0.8631	
Measured Peak				1.19	1.24	1.12	0.87	
% Deviation				-6.24	-0.24	-6.125	-0.793	
Core Location					D-12	C-12 *	B-12	
Predicted Peak					1.0639		0.4756	
Measured Peak					1.24		0.51	
% Deviation					-14.20		-6.745	
Core Location						C-13 *		

KEY: Core Location / Predicted Peak / Measured Peak / % Deviation $\left(\frac{\text{pred.} - \text{meas.}}{\text{meas.}}\right) \times 100$

INCORE TILT

W-X	-0.14
X-Y	0.34
Y-Z	-0.40
Z-W	0.21

	ASSUMED CONDITIONS FOR PEAKING PREDICTIONS	ACTUAL MEASUREMENT CONDITIONS
BURNUP	2 EFPD	1.18 EFPD
GP 5	100.0 % wd.	100.0 % wd.
GP 6	100.0 % wd.	100.0 % wd.
GP 7	87.0 % wd.	86.9 % wd.
GP 8	35.3 % wd.	35.4 % wd.
IMB.	- 2.41% imb.	3.32% imb.
POWER	40.0 % FP	39.73 % FP
BORON		1247 ppm

HIGHEST % DEVIATION = -14.2 % in 1/8th Core Location D-12
RMS RADIAL PEAKING FACTOR DEVIATION = 0.0561
HIGHEST MEASURED RADIAL PEAK = 1.29 in 1/8th core location C-8

$\frac{LMP - LPP}{LMP} \times 100 = -3.155\ \%$

*Inoperable String

Total Peaking Factor Comparison 40 % FP

H-8	G-8	F-8	E-8	D-8	C-8	B-8	A-8
1.0442 / 1.15	1.2248 / 1.29	1.2635 / 1.32	1.5274 / 1.51	1.2419 / 1.32	1.6157 / 1.61	1.2739 / 1.40	0.7360 / 0.78
-9.20	-5.05	-4.28	1.152	-5.916	0.354	-9.01	-5.64

G-9	F-9	E-9	D-9	C-9	B-9	A-9 *
1.3478 / 1.38	1.5588 / 1.50	1.2539 / 1.37	1.5433 / 1.52	1.4226 / 1.54	1.5143 / 1.49	
-2.33	3.92	-8.474	1.533	-7.623	1.631	

F-10	E-10	D-10	C-10	B-10	A-10
1.2892 / 1.40	1.5338 / 1.55	1.2088 / 1.31	1.5252 / 1.55	1.0944 / 1.13	0.4859 / 0.51
-7.914	-1.045	-7.725	-1.60	-3.15	-4.725

E-11	D-11	C-11	B-11
1.3351 / 1.47	1.5384 / 1.55	1.2968 / 1.37	1.0704 / 1.10
-9.18	-0.748	-5.343	-2.69

D-12	C-12 *	B-12
1.3427 / 1.61		0.5855 / 0.64
-16.60		-8.52

C-13 *

INCORE TILT

W-X	-0.14
X-Y	0.34
Y-Z	-0.40
Z-W	0.21

	ASSUMED CONDITIONS FOR PEAKING PREDICTIONS	ACTUAL MEASUREMENT CONDITIONS
BURNUP	2 EFPD	1.18 EFPD
GP 5	100.0 % wd.	100.0 % wd.
GP 6	100.0 % wd.	100.0 % wd.
GP 7	87.0 % wd.	86.9 % wd.
GP 8	35.3 % wd.	35.4 % wd.
IMB.	-2.41 % imb.	3.32 % imb.
POWER	40.0 % FP	39.73 % FP
BORON		1247 ppm

KEY

Core Location	
Predicted Peak / Measured Peak	
% Deviation	$\left(\frac{\text{pred.}-\text{meas.}}{\text{meas.}}\right) \times 100$

HIGHEST % DEVIATION = -16.6 % in 1/8th Core Location D-12
HIGHEST MEASURED TOTAL PEAK = 1.61 in 1/8th core location C-8 and D-12

$$\frac{LMP - LPP}{LMP} \times 100 = -0.354 \%$$

*Inoperable String

Radial Peaking Factor Comparison 100.0% FP

Core Location	Predicted Peak	Measured Peak	% Deviation
H-8	0.8777	0.94	-6.63
G-8	1.0035	1.05	-4.43
F-8	1.0134	1.02	-0.65
E-8	1.2460	1.18	5.59
D-8	1.0590	1.08	-1.94
C-8	1.3120	1.25	4.96
B-8	1.0230	1.04	-1.64
A-8	0.6084	0.61	-0.26
G-9	1.0877	1.13	-3.74
F-9	1.2566	1.19	5.60
E-9	1.0444	1.08	-3.30
D-9	1.2532	1.19	5.31
C-9	1.1771	1.24	-5.07
B-9	1.2159	1.14	6.66
A-9	0.5756	0.59	-2.44
F-10	1.0718	1.14	-5.98
E-10	1.2384	1.19	4.07
D-10	0.9348	0.95	-1.60
C-10	1.2322	1.18	4.42
B-10	0.8911	0.92	-3.14
A-10	0.4047	0.42	-3.64
E-11	1.1115	1.16	-4.18
D-11	1.2291	1.21	1.58
C-11	1.0517	1.10	-4.39
B-11	0.8742	0.87	0.48
D-12	1.0635	1.11	-4.19
C-12 *			
B-12	0.4896	0.51	-4.00
C-13 *			

INCORE TILT

W-X	-0.18
X-Y	0.40
Y-Z	-0.29
Z-W	0.07

	ASSUMED CONDITIONS FOR PEAKING PREDICTIONS	ACTUAL MEASUREMENT CONDITIONS
BURNUP	4 EFPD	7.699 EFPD
GP 5	100.0 % wd.	100.0 % wd.
GP 6	100.0 % wd.	100.0 % wd.
GP 7	87.0 % wd.	87.1 % wd.
GP 8	28.8 % wd.	28.9 % wd.
IMB.	- 6.58 % imb.	- 2.72 % imb.
POWER	100.0 % FP	99.87 % FP
BORON		1040 ppm

KEY

Core Location

Predicted Peak / Measured Peak

% Deviation $\left(\frac{\text{pred.}-\text{meas.}}{\text{meas.}}\right) \times 100$

HIGHEST % DEVIATION = 6.66 % in 1/8th Core Location B-9
RMS RADIAL PEAKING FACTOR DEVIATION = 0.0453
HIGHEST MEASURED RADIAL PEAK = 1.25 in 1/8th core location C-8

$\frac{\text{LMP - LPP}}{\text{LMP}} \times 100 = -4.96\ \%$

*Inoperable String

OCONEE 2 CYCLE 7
STARTUP REPORT
ENCLOSURE 3.3

Total Peaking Factor Comparison 100.0 % FP

(Each cell: Predicted Peak / Measured Peak / % Deviation)

	H	G	F	E	D	C	B	A
8	H-8 1.0530 / 1.10 -4.27	G-8 1.2234 / 1.24 -1.34	F-8 1.2472 / 1.22 2.23	E-8 1.4845 / 1.34 10.78	D-8 1.2109 / 1.20 0.91	C-8 1.5628 / 1.45 7.78	B-8 1.2554 / 1.27 -1.15	A-8 0.7461 / 0.73 2.21
9		G-9 1.3328 / 1.31 1.74	F-9 1.5168 / 1.37 10.72	E-9 1.2251 / 1.20 2.09	D-9 1.4699 / 1.35 8.88	C-9 6 1.3756 / 1.42 -3.13	B-9 1.4789 / 1.35 9.55	A-9 0.6997 / 0.70 -0.04
10			F-10 1.2556 / 1.27 -1.13	E-10 1.4535 / 1.33 9.29	D-10 1.1460 / 1.17 -2.05	C-10 1.4571 / 1.36 7.14	B-10 1.0735 / 1.06 1.27	A-10 0.4979 / 0.48 3.73
11				E-11 1.2788 / 1.31 -2.38	D-11 1.4575 / 1.39 4.86	C-11 1.2471 / 1.26 -1.02	B-11 1.0583 / 1.02 3.76	
12					D-12 1.2866 / 1.33 -3.26	C-12 *	B-12 0.5892 / 0.61 -3.41	
13						C-13 *		

INCORE TILT

W-X	-0.18
X-Y	0.40
Y-Z	-0.29
Z-N	0.07

	ASSUMED CONDITIONS FOR PEAKING PREDICTIONS	ACTUAL MEASUREMENT CONDITIONS
BURNUP	4 EFPD	7.699 EFPD
GP 5	100.0 % wd.	100.0 % wd.
GP 6	100.0 % wd.	100.0 % wd.
GP 7	87.0 % wd.	87.1 % wd.
GP 8	28.8 % wd.	28.9 % wd.
IMB.	- 6.58 % imb.	2.72 % imb.
POWER	100.0 % FP	99.57 % FP
BORON		1040 ppm

KEY

Core Location

Predicted Peak / Measured Peak

% Deviation

$\left(\frac{\text{pred.}-\text{meas.}}{\text{meas.}}\right) \times 100$

HIGHEST % DEVIATION = 10.78% in 1/8th Core Location E-8

HIGHEST MEASURED TOTAL PEAK = 1.45 in 1/8th core location C-8

$\frac{LMP - LPP}{LMP} \times 100 = -7.78\ \%$

*Inoperable String

OCONEE 2 CYCLE 7

STARTUP REPORT

ENCLOSURE 4.0

MINIMUM DNBR AND MAXIMUM LHR CALCULATIONS AT

40% AND 100% FP TEST PLATEAUS

Power Level	Burnup (EFPD)	Gp6/7/8 Positions (% WD)	Boron CONC (PPM)	Incore Imbalance (% F.P)	Incore Tilt WX/XY YZ/ZW (%)	MDNBR	Extrapolated Worst Case MDNBR	MLHR (KW/FT)	Extrapolated Worse Case MLHR (KW/FT)
40	1.18	100/86.4/35.4	1247	3.32	-0.14/ 0.34 -0.40/ 0.21	9.08	3.26	4.55	12.16
100	7.70	100/87.1/28.9	1040	-2.72	-0.18/ 0.40 -0.29/ 0.07	3.71	N/A	10.21	N/A

NOTE: The 40% FP case was extrapolated to 105.5% FP. The 100% F.P case was not extrapolated.

OCONEE 2 CYCLE 7
STARTUP REPORT
ENCLOSURE 5.0
40% FP PIDC THERMAL CALCULATION AND CORRELATION SLOPE RESULTS

Full Incore Imbalance (% FP)	MLHR (KW/ft.)	Worst Case Extrapolated MLHR (KW/ft.)	MDNBR	Extrapolated MDNBR
+4.18	4.67	12.57	8.90	3.05
+2.45	4.41	11.87	9.41	3.35
+0.91	4.21	11.30	9.82	3.50
-0.03	4.24	11.09	10.13	3.69
-2.36	4.54	11.87	10.17	3.85
-5.76	4.99	13.13	9.10	3.31
-8.29	5.15	13.12	8.93	3.32

NOTE: All extrapolations are to 105.5% FP, except for the -8.29% FP imbalance case where ϕ/flux/imbalance reduces the maximum allowable trip setpoint to 102.1% FP.

	NI 5	NI 6	NI 7	NI 8
Correlation Slope	1.36	1.30	1.40	1.38
Differential Amp. Gain Setting	4.80	4.80	4.80	4.80

ENCLOSURE 6.0 REACTIVITY COEFFICIENTS

PARAMETER	CONDITIONS	MEASURED VALUE	PREDICTED VALUE	ACCEPTANCE CRITERION
Hot Zero Power Temperature Coefficient (ARO)	T_{av} = 532°F Gp 7 @ 97.0% wd Gp 8 @ 37.7% wd 1560 ppm	-0.08×10^{-4} ΔK/K per °F	-0.01×10^{-4} ΔK/K per °F	Predicted ± 0.3×10^{-4} ΔK/K per °F
Hot Zero Power Moderator Coefficient (ARO)	T_{av} = 532°F Gp 7 @ 97.0% wd Gp 8 = 37.7% WD 1560 ppm	$+0.07 \times 10^{-4}$ ΔK/K per °F	$+0.15 \times 10^{-4}$ ΔK/K per °F	Predicted ± 0.3×10^{-4} ΔK/K per °F and Measured ≤ $+0.5 \times 10^{-4}$ ΔK/K per °F
Hot Zero Power Temperature Coefficient (Control Rods In)	T_{av} = 533°F Gp 5, @ 10.3% WD Gp 6,7 @ 0% WD Gp 8 @ 37.5% WD 1185 ppm	-0.72×10^{-4} ΔK/K per °F	-0.68×10^{-4} ΔK/K per °F	Predicted ± 0.3×10^{-4} ΔK/K per °F
Hot Zero Power Moderator Coefficient (Control Rods In)	T_{av} = 533°F Gp 5, @ 10.3% WD Gp 6,7 @ 0% WD Gp 8 @ 37.5% WD 1185 ppm	-0.57×10^{-4} ΔK/K per °F	-0.53×10^{-4} ΔK/K per °F	Predicted ± 0.3×10^{-4} ΔK/K per °F and Measured ≤ $+0.5 \times 10^{-4}$ ΔK/K per °F
Hot Full Power BOC Temperature Coefficient Extrapolated to 95% FP	T_{av} = 579°F	-1.11×10^{-4} ΔK/K per °F	-1.11×10^{-4} ΔK/K per °F	Temperature Coefficient more negative than -0.14×10^{-4} ΔK/K per °F at 95% FP
Hot Full Power BOC Temperature Coefficient Extrapolated to 100% FP	T_{av} = 579°F	-1.13×10^{-4} ΔK/K per °F	-1.21×10^{-4} ΔK/K per °F	N/A
Hot Full Power BOC Temperature Coefficient Extrapolated to 100% FP at EOC	T_{av} = 579°F	-3.02×10^{-4} ΔK/K per °F	-3.09×10^{-4} ΔK/K per °F	Temperature Coefficient more positive than -3.17×10^{-4} ΔK/K per °F at 100% FP
Hot Full Power BOC Power Doppler Coefficient Extrapolated to 100% FP	T_{av} = 579°F	-0.93×10^{-4} ΔK/K per %FP	-1.09×10^{-4} ΔK/K per %FP	Power Doppler Coefficient more negative than -0.55×10^{-4} ΔK/K per % FP at 100% FP

OCONEE 2 CYCLE 7

STARTUP REPORT

ENCLOSURE 7.0

NSS HEAT BALANCE/RC FLOW VERIFICATION

Test Plateau	Plant Computer On Line Primary Power Level	Plant Computer On Line Secondary Power Level	Plant Computer "Delta Temp" Power Level	Off Line Calculated Primary Power Level	Off Line Calculated Secondary Power Level	RC Flow
12% FP	11.3	N/A	12.1	11.0	N/A	N/A
40% FP	39.8	39.9	39.7	41.7	39.8	N/A
100% FP	100.1	100.0	100.5	100.8	99.8	*113.09% D.F.
100% FP (after adjusting constants)	99.4	100.0	99.6	N/A	N/A	113.33% D.F.

*Calculated by the off-line secondary heat balance program (SECHT) per PT/0/A/275/03 Verification of RC Flow Constants

DUKE POWER COMPANY
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CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

March 26, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. J. F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station
Docket No. 50-270

Dear Sir:

Please find attached the Startup Test Report for Oconee 2, Cycle 7.

Very truly yours,

H.B. Tucker / [signature]

Hal B. Tucker

JCP/php

Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

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