ARKANSAS POWER & LIGHT COMPANY

ARKANSAS NUCLEAR ONE

STEAM ELECTRIC STATION

UNIT ONE

CYCLE 4

STARTUP REPORT

TO THE

U.S. NUCLEAR REGULATORY COMMISSION

LICENSE NUMBER DPR-51

DOCKET NUMBER 50-313

FOR THE

PERIOD ENDING 4 July 1979

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1.0 INTRODUCTION

On March 30, 1979, the third refueling outage of ANO Unit 1 began. Following the refueling outage, ANO Unit 1 achieved criticality during zero power physics testing on June 20, 1979.

Zero Power Physics Testing, which commenced on June 19, 1979, was successfully completed on June 22, 1979. This program was conducted at a nominal reactor coolant temperature of 532°F and below the level of nuclear heating to eliminate any temperature feedback effects.

Power escalation was begun on June 22, 1979. This testing program was carried out at three power plateaus during the power ascension:

Power Level(%FP)	Date
40	June 26, 1979
75	June 29, 1979
100	July 2-4, 1979

The startup and power escalation testing sequence was completed on July 4, 1979.

2.0 PRECRITICAL TEST SUMMARIES

2.1 Control Rod Drive Trip Time Test

2.1.1 Purpose

The purpose of the Control Rod Drive Trip Time Test was to verify the integrated, functional trip capability of the Control Rod Drive System and to determine for each control rod assembly, the total elapsed drop time from the initiation of the trip signal until the control rod assembly was three-fourths inserted.

2.1.2 Test Method

Initial Reactor Coolant System (RCS) conditions were established at a temperature of approximately 532°F, at a pressure of 2155 ± 30 psig, all four (4) reactor coolant pumps running, with Boron at a concentration of 1848 ppmB. Control Rod Groups 1 through 7 were fully withdrawn and Group 8(APSR's) was at 5% withdrawn. The Control Rod Drive Mechanisms(CRDM) were then tripped via the manual trip button. The insertion time for each control rod from its initial position to its 3/4 insertion point was measured by the plant computer Rod Drop Timer program. The printout of this program includes trip initiation time, initial position and trip insertion time for each control rod (excluding Group 8).

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2.1.3 Results and Evaluation

An analysis of the drop times indicates that rod 5-8, was fastest at 1.100 ± 0.017 seconds and rods 1-4, 1-5, 3-4, 4-3 and 6-5 were the slowest at 1.167 ± 0.017 seconds.

2.1.4 Conclusions

The rod drop times were well below the criteria stated in Section 4.7 of the Technical Specifications, which specifies a maximum rod drop time of 1.46 seconds at full flow conditions.

2.2 RCS Flow and Flow Coastdown Test

2.2.1 Purpose

The purpose of this test was to determine reactor coolant system four pump, steady-state flow and to determine flow versus time during two pump coastdown.

2.2.2 Test Method

The steady-state four pump flow was determined by collecting plant computer calculated flow rates over a six minute time period. These values were then adjusted to account for uncertainties and compared to the acceptance criteria. After the steady-state flow was determined, the pump with the higher flow in loop A (P32C) and the pump with the higher flow in loop B (P32A) were simultaneously tripped and flow recorded during pump coastdown.

2.2.3 Results and Evaluation

The measured steady state flow of 3.86×10^5 GPM after uncertainty adjustment was within the acceptance criteria of greater than 374,880 GPM and less than 405,150 GPM. The flow coastdown during the two seconds after flow reached 94% of initial steady state flow, was also acceptable. The acceptance criteria and the measured data are shown in Figure 2-1.

3.0 ZERO POWER PHYSICS TEST SUMMARIES

3.0.1 Purpose

The purpose of the Zero Power Physics Test was to verify the nuclear design parameters used in the safety analysis, the Technical Specification limits, and operating procedures. All acceptance criteria established for this test must be satisfied prior to commencing power escalation.

3.0.2 Test Method

Criticality was achieved by control rod withdrawal and Boron dilution of the RCS after system conditions had been established at 532°F and 2155 psig. During the approach to criticality, a plot of inverse neutron count rate ratio versus Boron concentration was maintained by using NI-1 and NI-2 of the nuclear instrumentation, and a plot of boron concentration versus time was also maintained. After achieving criticality, nuclear power was increased and the source and intermediate range nuclear instrumentation overlap was verified to be in excess of one decade. During this same increase in power, the point of sensible heating was determined to be 1 X 10^{-7} amps. The power established as the upper limit for Zero Power Physics testing was 5 X 10^{-8} amps.

Physics testing was then conducted which included the following measurements, listed in chronological order:

A. The "all rods out" Critical Boron Concentration.

B. Moderator Temperature Coefficient of Reactivity at the "all rods out" condition.

C. Differential and Integral Rod Worth of Control Rod Groups 7, 6, and 5 by the rod versus Boron swap technique.

D. Critical Boron Concentration at the regulating rods inserted condition.

E. Moderator Temperature Coefficient of Reactivity at the regulating rods inserted condition.

F. Ejected Rod Worth by the Boron swap and rod swap techniques.

3.1 DETERMINATION OF CRITICAL BORON CONCENTRATION

3.1.1 Purpose

The purpose of this test was to determine the Boron concentration required to maintain criticality at Hot Zero Power(approximately 10^{-9} amps) with all control rods withdrawn and Xenon free. The resultant value was used to verify the predicted fuel depletion curves used in OP 1103.15, Reactivity Balance Calculation, and to verify the accuracy of the "all rods out" Boron concentration predicted by the fuel vendor.

3.1.2 Test Method

Initial RCS conditions were established at a temperature of 532 ± 2°F. Equilibrium boron concentration was attained at 1524 ppm Boron with power stable at 10^{-9} amps, and control rod groups 1-6 at 100% withdrawn, group 7 at approximately 85% withdrawn, and group 8 at approximately 37.5% withdrawn.

The remaining reactivity held in the inserted portion of Group 7 was measured by withdrawal of Group 7 to its out limit and concurrent reactivity measurements. The reactivity was converted to equivalent Boron concentration change using the predicted Boron differential worth. The "all rods out" Boron concentration is the sum of the measured equilibrium Boron concentration and the equivalent Boron from the reactivity measurement.

The Critical Boron Concentration at the regulating rods inserted condition was determined after the Control Rod Reactivity Worth Measurements had been made. The predicted Critical Boron Concentration was determined by correcting the predicted all rods out boron concentration for control rod insertion using predicted rod worths. This reactivity worth was then converted to an equivalent Boron concentration change. The Critical Boron Concentration is the sum of the measured Boron concentration and the equivalent Boron concentration change.

3.1.3 Results and Evaluation

The results of the predicted Critical Boron Concentration and measured Critical Boron Concentration for "all rods out" and "regulating rods inserted" conditions are listed in Table 3-1. Both measured Critical Boron Concentrations are within $\pm$100 ppmB of the predicted values, and therefore satisfy the acceptance criteria.

3.2 DETERMINATION OF MODERATOR TEMPERATURE COEFFICIENT

3.2.1 Purpose

The purpose of this test was to determine the moderator temperature coefficient of reactivity at Hot Zero Power. The values measured are used to verify that the moderator temperature coefficient is within Technical Specification limits, that the moderator temperature coefficient is within specified limits of predicted values in the Physics Test Manual and to provide verification of the data used in OP 1103.15, Reactivity Balance Calculation.

3.2.2 Test Method

The moderator temperature coefficient at Hot Zero Power was measured by using a Reactivity Calculator. The first step was to achieve steady state critical conditions at approximately 10^{-9} amps on the intermediate range detectors. The Reactivity Calculator method measures reactivity changes as T_{ave} is varied in small increments (5-10°F). The reactivity change associated with the temperature change provides the data necessary to determine a moderator temperature coefficient.

The moderator temperature coefficient of reactivity at hot conditions with regulating control rod assembly groups inserted was measured after the Control Rod Reactivity Worth Measurements were made utilizing the same method.

3.2.3 Results and Evaluation

The measured and predicted values of moderator temperature coefficient for the conditions of "all rods out" and regulating rods inserted are listed in Table 3-2. The measured values of moderator temperature coefficient are within the acceptance criteria of $\pm$ 0.4 X 10^{-4} ΔK/K/°F of the predicted values and less than + 0.5 X 10^{-4} ΔK/K/°F at Hot Zero Power conditions. Extrapolation of the moderator coefficient to 95% of full power indicated that the coefficient would be negative for all expected Boron concentrations and allowable control rod configurations. See Table 3-3.

3.3 CONTROL ROD REACTIVITY WORTH MEASUREMENT

3.3.1 Purpose

The purpose of this test was to determine the integral worth of the regulating control rods at Hot Zero Power for the purpose of updating the integral control rod worth curves in the Reactivity Balance Calculation and for comparison with the predicted worths. This data was also used to verify the adequacy of the shutdown margin analysis for the reload core.

3.3.2 Test Method

This test was performed with Group 8 at its predicted maximum worth position. The initial Boron concentration of the RCS was first determined by sampling. Then, using the predicted control rod worths from the fuel vendor, the amount of Boron dilution required to bring the control rods from the "all rods out" conditions to the all regulating rods inserted configuration, was determined. Deboration was initiated and the reactor was maintained critical at approximately 10^{-9} amps by insertion of Group 7 until it was fully inserted then by periodic insertion of groups 6 and 5(without overlap), while making concurrent reactivity measurements, until deboration was complete. Frequent sampling of the RCS and Make Up Tank during deboration was done so that the Boron concentration versus time would be known.

Then using reactivity measurements and recorded positions of the CRA groups, the reactivity worth versus CRA group position was determined.

3.3.3 Results and Evaluation

The predicted and measured control rod group worths are tabulated in Table 3-4. The individual CRA group worths measured were within the acceptance criterion range of $\pm$ 15% of the predicted values and the total Group 5, 6 and 7 worths were well within the $\pm$ 10% acceptance criterion.

3.4 EJECTED ROD WORTH MEASUREMENT

3.4.1 Purpose

The purpose of this test was to determine the reactivity worth of the worst case ejected control rod as specified by the Cycle 4 Reload Report, to verify its worth is less than 1.0% $\Delta K/K$ at Hot Zero Power and that it is within acceptable agreement with the value predicted by the fuel vendor.

3.4.2 Test Method

Initial conditions were established with the Reactor critical at approximately 10^{-9} amps, Regulating Groups at approximately 0% wd, Group 8 at its maximum worth and Boron concentration at equilibrium. The initial (steady state) Boron concentration of the RCS was determined by sampling. Then, using the predicted ejected rod worth the amount of Boron addition required to bring the worst case ejected rod, Control Rod 7-3, to 100% withdrawn was determined. Boration was initiated and the reactor was maintained critical near 10^{-9} amps by withdrawal of Rod 7-3. Frequent sampling of the Reactor Coolant System and Makeup Tank during boration was done so that Boron concentration versus time would be known. The rods were fully withdrawn and additional reactivity compensation was made by withdrawal of Group 5. When steady state Boron concentration was re-established, Control Rod 7-3 was returned to 0% wd by using Group 5 withdrawal for reactivity compensation. The reactor was maintained critical near 10^{-9} amps during the swap. The other three rods quadrant-wise symmetric with 7-3 were also swapped for comparison. During the symmetric rod swap, rod 7-7 was found to have the maximum worth for an ejected rod.

Using reactivity measurements, the differential boron worth, and the position of control rods involved, the worst case ejected rod worth was determined.

3.4.3 Results and Evaluation

The measured worth of the worst case ejected rod, control rod 7-7 was compared acceptably with the predicted value and its worth met the acceptance criterion of $< 1.0\% \Delta K/K$. The test results are tabulated in Table 3-5.

4.0 POWER ASCENSION TEST SUMMARIES

4.1 CORE POWER DISTRIBUTION TEST

4.1.1 Purpose

The objective of the Core Power Distribution Test was to measure the power distribution of the reactor core at the power plateaus of 40%, 75% and 100% full power during power escalation in order to verify that the DNBR, LHR, quadrant power tilt, and power peaking factors did not exceed allowable limits.

The limits placed on the measured parameters were as follows:

i) The maximum linear heat rate, LHR, in the core is less than the LOCA limit per Technical Specifications for the axial location of the peak. When testing at a power level below rated power, the maximum LHR when extrapolated to rated power must also meet this criterion.

ii) The minimum DNBR must be greater than 1.30 at rated power conditions and when extrapolated to rated power conditions.

iii) The quadrant power tilt must not exceed the value allowed by the Technical Specifications.

iv) The highest measured radial and total power peaking factors shall not exceed the highest predicted peaks by more than 5% and 7.5% at the 75% and 100% power plateaus, respectively (8% and 12% at the 40% power plateau). The acceptance criteria for the power peaking factors is a comparison of highest predicted to highest measured and not a grid to grid comparison.

These acceptance criteria are established to verify that core nuclear and thermal hydraulic calculational models are conservative with respect to measured conditions thereby verifying the acceptability of data from these models for input to safety analysis. The acceptance criteria also serve to verify acceptable operating conditions at each test plateau and eventually at rated power conditions.

4.1.2 Test Method

Equilibrium conditions were established at 75% and 100% FP ensuring that Xenon was in three-dimensional equilibrium (equilibrium Xenon was not required for the 40% tests) with no APSR motion and minimal power fluctuations and/or controlling rod group motion. The incore monitoring system and the plant computer were used for data collection and analysis.

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4.1.3 Results and Evaluation

A summary of the test results is given in Table 4-1. This table indicates that all measured DNBR's were greater than the 1.30 minimum, all linear heat rates were less than the Technical Specification LOCA limit, Figure 3.5.2.4, (Attachment A) and all quadrant tilts were below the Technical Specification limits. The measured and total power peaking factors were within the acceptance criteria.

Figure 4-1 shows the core grid/Self Powered Neutron Detector (SPND) string correlation for the core locations used to measure the radial and total power peaking factors. The results of the power distribution measurements are tabulated in Figures 4-2 and 4-3 for the 40% FP plateau, Figures 4-4 and 4-5 for the 75% FP plateau, and in Figures 4-6 and 4-7 for the 100% FP plateau. These figures indicate that the predicted power peaking factors are in good agreement with measured values. All measured peaking factors were within acceptance criteria limits.

4.1.4 Conclusions

Measured DNBR's, Linear Heat Rates, and Quadrant Tilts verified that the core can be operated at rated power without exceeding Technical Specifications or ECCS LOCA power distribution criteria.

The measured power distributions verified the predicted distributions and the largest radial and total peaking factors were within the acceptance criteria.

The measured DNBR and Linear Heat Rates verified that the Reactor Protection System setpoints are sufficient to protect the core against exceeding DNBR or maximum linear heat rate limits and that Technical Specification Figure 3.5.2-3 limits are sufficient to protect against exceeding the LOCA limit heat rate.

4.2 POWER IMBALANCE DETECTOR CORRELATION TEST

4.2.1 Purpose

The Power Imbalance Detector Correlation test determined the relationship between out-of-core detector and incore detector measured imbalance.

4.2.2 Test Method

Imbalance measurements were made to determine the acceptability of the out-of-core detectors to detect imbalance. Prior to testing, the delta flux imbalance amplifier gain setting was adjusted to obtain an expected out-of-core to incore slope of 1.20 to allow for uncertainty in predicting the amplifier gain necessary to obtain the required out-of-core to incore slope of 1.15. The measurements were made by obtaining various core imbalance conditions at 75%FP while at equilibrium Xenon conditions by adjusting the axial power shaping rod positions. From this data plots of incore imbalance versus out-of-core imbalance were maintained and the slope was determined.

4.2.3 Results and Conclusions

The relationship between out-of-core imbalance and incore imbalance was found to be linear with an average slope of 1.23. The minimum slope was 1.22 on channels B and D, and the maximum was 1.24 on channels A and C. These values assure the RPS trip limits resulting from imbalance indications would be conservative since the RPS indication is from out-of-core detectors.

4.3 DETERMINATION OF REACTIVITY COEFFICIENTS AT POWER

4.3.1 Purpose

The purpose of this test was to measure the moderator temperature coefficient and power doppler coefficient at full power and to compare the results with predicted values.

Acceptance criteria for the test were that the power doppler coefficient be more negative than -0.55×10^{-4} $(\Delta K/K)/\%FP$, and that the moderator temperature coefficient measured at power operating conditions be non-positive above 95% FP.

4.3.2 Test Method

The moderator temperature coefficient at power operating conditions was measured by varying T_{ave} using the T_{ave} setpoint controller on the Reactor Demand Station and maintaining constant power with the ICS in automatic. The corresponding control rod motion is related to the reactivity change which is used to determine the moderator temperature coefficient.

The power doppler coefficient is measured by varying reactor power using the Integrated Control System Unit Load Demand(ICS ULD) station and recording the corresponding control rod motion. The corresponding control rod motion is related to reactivity change which is used to determine the power doppler coefficient.

The control rod reactivity worth was determined by a differential worth measurement with an on-line reactivity calculator.

4.3.3 Results and Evaluation

The results of the reactivity coefficients test are summarized in Table 4-2.

The power doppler coefficient at full power was below the maximum acceptable value. The moderator temperature coefficient was well below the non-positive limit.

4.3.4 Conclusion

The measured values of all reactivity coefficients were within the acceptable limits. The acceptance criteria of this test were met in full without deficiencies.

5.0 CONCLUSION

The results and conclusions summarized in the body of this report demonstrate that the Arkansas Nuclear One Unit 1 Cycle 4 reload has been properly designed and the unit can be operated in a manner that will not endanger the health and safety of the public.

Figure 2-1

RCS Flow Coastdown Test

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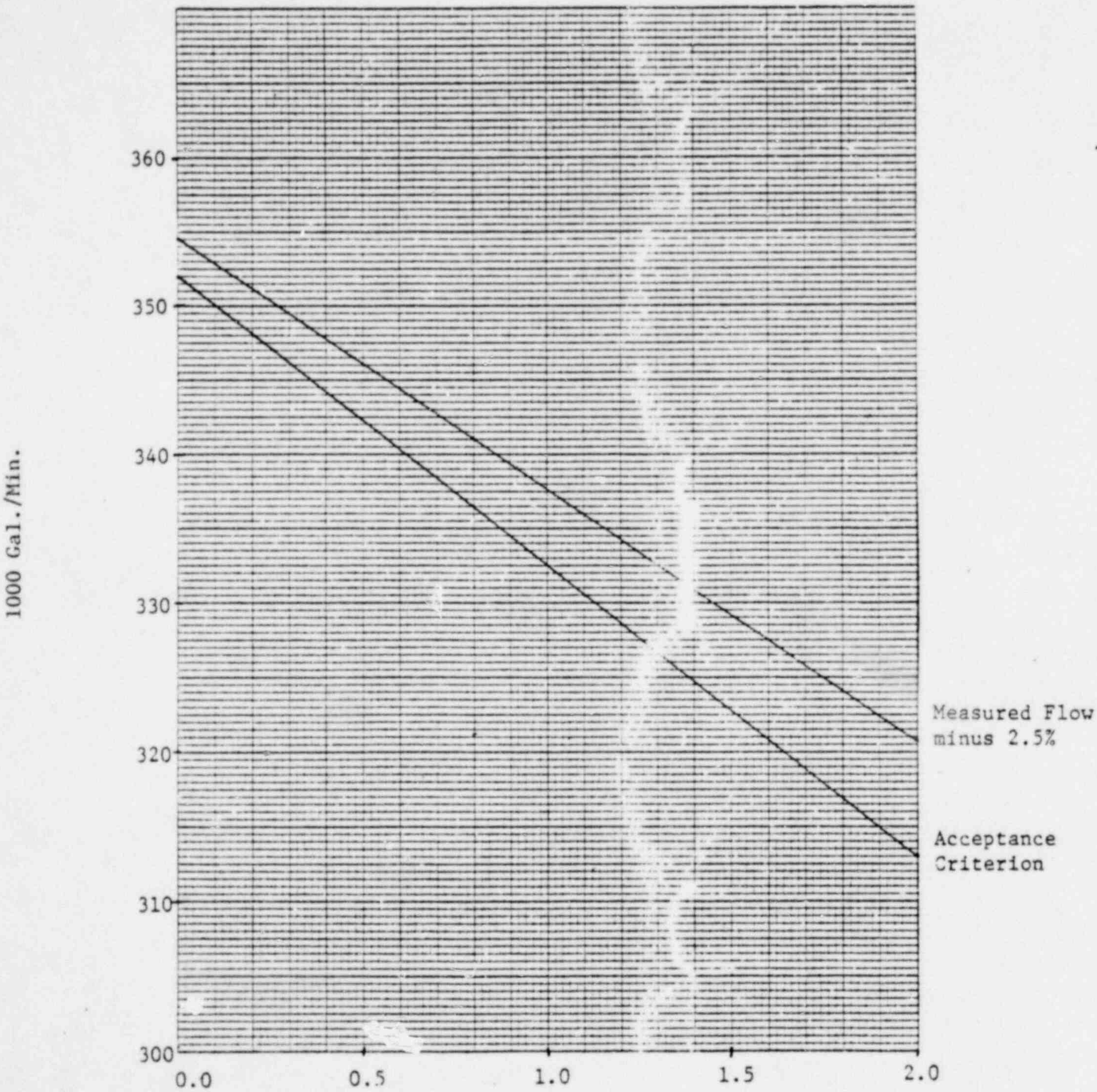

Time After Flow Equals 94% of Initial Flow Rate
(Sec.)

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TABLE 3-1

CRITICAL BORON CONCENTRATION AT HOT ZERO POWER

(GROUP 8 ~ 37.5% wd)

CONDITION	MEASURED VALUE	VENDOR PREDICTED VALUE
All Rods Out	1527 ppmB	1562 ppmB
Rods Inserted	1208 ppmB	1234 ppmB

TABLE 3-2

MODERATOR TEMPERATURE COEFFICIENT AT HOT ZERO POWER

CONDITION	MEASURED VALUE	VENDOR PREDICTED VALUE
All Rods Out	$0.10 \times 10^{-4} \Delta K/K/°F$	$0.015 \times 10^{-4} \Delta K/K/°F$
Rods Inserted	$-0.685 \times 10^{-4} \Delta K/K/°F$	$-0.613 \times 10^{-4} \Delta K/K/°F$

TABLE 3-3

MODERATOR COEFFICIENT EXTRAPOLATED TO 95%FP

CONDITION	COEFFICIENT
All Rods Out	-0.22 X 10-4 ΔK/K/°F
Rods Inserted	-0.67 X 10-4 ΔK/K/°F

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TABLE 3-4

CONTROL ROD REACTIVITY WORTHS

CRA GROUP	MEASURED WORTH (%ΔK/K)	VENDOR PREDICTED WORTH (%ΔK/K)	IN-HOUSE PREDICTED VALUE (%ΔK/K)	% ERROR BETWEEN MEASURED & VENDOR PREDICTED VALUES
5	0.92	0.96	1.01	4.3
6	1.16	1.09	1.09	-6.0
7	0.91	0.95	0.91	4.4
Total 5-7	2.99	3.00	3.01	0.3

TABLE 3-5

EJECTED CONTROL ROD WORTH

CRA/CORE GRID	MEASURED VALUE		PREDICTED VENDOR VALUE	% ERROR BETWEEN MEASURED & VENDOR PREDICTED VALUES	
	BORON SWAP	ROD SWAP		BORON SWAP	ROD SWAP
7-3/H-14	0.58%ΔK/K	0.65%ΔK/K	0.76%ΔK/K	31.0	16.9
7-5/P-8	N/A	0.66%ΔK/K	0.76%ΔK/K	N/A	15.2
7-7/H-2	N/A	0.70%ΔK/K	0.76%ΔK/K	N/A	8.6
7-1/B-8	N/A	0.68%ΔK/K	0.76%ΔK/K	N/A	11.8
Average	N/A	.67%ΔK/K	0.76%ΔK/K	N/A	13.4

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TABLE 4-1

SUMMARY OF POWER TESTING RESULTS

	DATE TIME	6/26/79 0349	6/29/79 2211	7/2/79 1935
Power Level (Nominal %)		40	75	100
Group 1-5 (%w/d)		100	100	100
Group 6(w/d)		88.2	90.7	89.9
Group 7 (%w/d)		10.1	11.0	8.4
Group 8 (%w/d)		21.2	12.8	9.1
Core Burnup (EFPD)		0.6	2.6	5.3
Boron Concentration (ppmB)		1118	989	951
Axial Imbalance (%FP)		-0.2	-1.1	-3.1
Max Quadrant Pwr Tilt (%) (Incore Detectors)		+2.76	+2.62	+2.44
DNBR		8.64	4.44	3.17
LHR		5.19	9.27	12.11
Max Measured Radial Pwr Peak		1.452	1.430	1.386
Max Measured Total Pwr Peak		1.811	1.765	1.709
Max Peak Measured At Core Grid/Level		M-4/5	E-4/5	M-12/5
Max Predicted Radial Pwr Peak		1.436	1.412	1.401
Max Predicted Total Pwr Peak		1.718	1.709	1.756
Max Total Peak Predicted at Core Grid		L-11	L-11	L-11
Percent Error * Max Radial Peak		-1.10	-1.26	-1.08
Percent Error * Max Total Peak		-5.14	-3.17	-2.75
Equilibrium Xenon		NO	YES, 3-D	YES, 3-D

$$* \text{ Percent Error} = \frac{\text{Predicted-Measured}}{\text{Measured}} \times 100\%$$

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TABLE 4-2

SUMMARY OF MEASURED AND PREDICTED REACTIVITY COEFFICIENTS AT POWER

PARAMETER		VALUE
Control Rod Assembly Group (% Withdrawn)	6	89
	7	10
	8	10
Boron Concentration(ppmB)		936
Temperature Coefficient $\frac{\Delta K/K}{°F}$	Measured	-1.03×10^{-4}
	Vendor Predicted	-1.32×10^{-4}
Power Doppler Coefficient $\frac{\Delta K/K}{\% \text{ Full Power}}$	Measured	-1.04×10^{-4}
	Vendor Predicted	-1.30×10^{-4}
Moderator Coefficient $\frac{\Delta K/K}{°F}$	Measured	-0.86×10^{-4}
	Vendor Predicted	-1.17×10^{-4}

FIGURE 4-1

CORE SPND STRING/CORE GRID CROSS REFERENCE

H-8 1	H-9 2	F-8 4	H-5 10	N-8 14	H-13 21	B-8 30	H-1 37
	G-9 3	F-7 6 *	E-9 5 *	K-12 20 *	C-9 29 *	B-7 31 *	R-7 45
		L-6 12	M-10 17 *	D-10 27 *	C-10 28 *	P-6 44 *	R-10 46
			E-11 26	D-5 33 *	0-5 42 *	M-14 49	
				N-4 41	0-12 48	D-14 51	
					C-13 52		

X - X	CORE GRID LOCATION
XX	DETECTOR NUMBER

* The radial and total peaking factors at these core locations were calculated using the average readings from all detectors symmetric to this location.

FIGURE 4-2

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE TOTAL PEAK POWER DISTRIBUTION AT 40% FP, EQUILIBIIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions	
Gps 1-4	100%wd
Gp 5	100%wd
Gp 6	88%wd
Gp 7	10%wd
Gp 8	21%wd

Core Power Level 40.3%FP

Boron Concentration 1118.0 ppm

Core Burnup 0.6 EFPD

Axial Imbalance -0.2%FP

Max Quadrant Tilt 2.76%

X.XXX X.XXX	Measured Values Predicted Value

Core Centerlines

0.917 0.776	1.06 0.993	1.203 1.182	1.515 1.466	1.320 1.294	1.463 1.392	0.958 0.739	0.486 0.474
	0.899 0.706	1.466 1.488	1.239 1.266	1.527 1.534	1.112 1.256	1.485 1.404	0.697 0.666
		1.566 1.643	1.722 1.718	1.323 1.387	1.633 1.572	1.221 1.202	0.543 0.502
			1.430 1.396	1.763 1.642	1.404 1.390	0.631 0.655	
				1.610 1.611	1.239 1.228	0.591 0.540	
					0.53[illegible] 0.500		

FIGURE 4-3

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE RADIAL PEAK POWER DISTRIBUTION AT 40% FP, EQUILIBIIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions	
Gps 1-4 100%wd	Core Power Level 40.3%FP
Gp 5 100%wd	Boron Concentration 1118.0 ppm
Gp 6 88%wd	Core Burnup 0.6 EFPD
Gp 7 10%wd	Axial Imbalance -0.2%FP
Gp 8 21%wd	Max Quadrant Tilt 2.76%

X.XXX X.XXX	Measured Values Predicted Value

Core Centerlines

0.784 0.711	0.943 0.904	0.983 1.010	1.281 1.270	1.091 1.081	1.225 1.190	0.717 0.669	0.405 0.416
	0.681 0.641	1.263 1.312	1.078 1.089	1.260 1.274	1.056 1.067	1.216 1.197	0.606 0.568
		1.350 1.412	1.398 1.436	1.057 1.061	1.305 1.298	1.008 1.013	0.442 0.425
			1.172 1.176	1.383 1.349	1.150 1.159	0.547 0.558	
				1.283 1.314	0.980 1.021	0.487 0.452	
					0.442 0.432		

FIGURE 4-4

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE TOTAL PEAK POWER DISTRIBUTION AT 75% FP, EQUILIBRIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions	
Gps 1-4	100%wd
Gp 5	100%wd
Gp 6	90.7%wd
Gp 7	11.0%wd
Gp 8	12%wd

Core Power Level 74.1%FP

Boron Concentration 989 ppm

Core Burnup 2.6 EFPD

Axial Imbalance -1.1%FP

Max Quadrant Tilt 2.62%

X.XXX X.XXX	Measured Values Predicted Value

Core Centerlines

0.926 0.811	1.120 1.024	1.201 1.211	1.490 1.471	1.345 1.309	1.446 1.393	0.960 0.749	0.492 0.492
	0.892 0.735	1.459 1.495	1.255 1.278	1.536 1.540	1.259 1.271	1.453 1.402	0.715 0.688
		1.549 1.626	1.707 1.709	1.379 1.418	1.602 1.575	1.208 1.216	0.538 0.523
			1.429 1.408	1.680 1.640	1.391 1.397	0.693 0.676	
				1.619 1.602	1.053 1.234	0.593 0.562	
					0.546 0.521		

FIGURE 4-5

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE RADIAL PEAK POWER DISTRIBUTION AT 75% FP, EQUILIBIIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions		
Gps 1-4	100%wd	Core Power Level 74.1%FP
Gp 5	100%wd	Boron Concentration 989 ppm
Gp 6	90.7%wd	Core Burnup 2.6 EFPD
Gp 7	11.0%wd	Axial Imbalance -1.1%FP
Gp 8	12.8%wd	Max Quadrant Tilt 2.62%

X.XXX (upper) Measured Values
X.XXX (lower) Predicted Value

Core Centerlines

0.804 0.729	0.968 0.914	0.996 1.014	1.276 1.261	1.096 1.085	1.227 1.189	0.721 0.678	0.432 0.431
	0.691 0.646	1.267 1.297	1.083 1.088	1.254 1.265	1.062 1.072	1.207 1.201	0.616 0.587
		1.355 1.398	1.375 1.412	1.037 1.056	1.285 1.289	1.013 1.021	0.446 0.441
			1.168 1.168	1.352 1.330	1.146 1.155	0.565 0.570	
				1.298 1.301	.9786 1.023	0.502 0.466	
					0.455 0.443		

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FIGURE 4-6

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE TOTAL PEAK POWER DISTRIBUTION AT 100% FP, EQUILIBIIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions		Core Power Level 99.7%FP
Gps 1-4	100%wd	Boron Concentration 989 ppm
Gp 5	100%wd	Core Burnup 5.3 EFPD
Gp 6	89.9%wd	Axial Imbalance -3.1%FP
Gp 7	8.4%wd	Max Quadrant Tilt 2.44%
Gp 8	9.1%wd	

X.XXX X.XXX	Measured Values Predicted Value

Core Centerlines

0.930 0.843	1.122 1.057	1.236 1.249	1.545 1.540	1.323 1.341	1.393 1.435	0.956 0.774	0.517 0.507
	0.868 0.720	1.445 1.555	1.266 1.342	1.476 1.582	1.237 1.302	1.077 1.446	0.722 0.706
		1.564 1.679	1.635 1.756	1.362 1.438	1.566 1.605	1.214 1.242	0.523 0.538
			1.407 1.438	1.694 1.668	1.401 1.416	0.645 0.697	
				1.614 1.632	1.154 1.273	0.590 0.580	
					0.559 0.560		

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FIGURE 4-7

COMPARISON OF PREDICTED AND CALCULATED STEADY STATE RADIAL PEAK POWER DISTRIBUTION AT 100% FP, EQUILIBIIUM XENON MEASUREMENT CONDITIONS

Control Rod Group Positions	Core Power Level 99.7%FP
Gps 1-4 100%wd	Boron Concentration 951 ppm
Gp 5 100%wd	Core Burnup 5.3 EFPD
Gp 6 89.9%wd	Axial Imbalance -3.1%FP
Gp 7 8.4%wd	Max Quadrant Tilt 2.44%
Gp 8 9.1%wd	

X.XXX Measured Values
X.XXX Predicted Value

Core Centerlines

0.812 0.734	0.970 0.916	1.017 1.014	1.299 1.256	1.085 1.084	1.192 1.186	0.740 0.683	0.458 0.440
	0.689 0.650	1.29 1.288	1.089 1.087	1.231 1.262	1.058 1.071	1.227 1.195	0.619 0.593
		1.360 1.375	1.347 1.401	1.029 1.059	1.282 1.285	1.026 1.023	0.443 0.450
			1.162 1.165	1.372 1.325	1.139 1.154	0.549 0.580	
				1.303 1.296	0.961 1.026	0.497 0.475	
					0.454 0.452		

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