

SURRY UNIT 1, CYCLE 5
STARTUP PHYSICS TEST REPORT

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PREFACE

The purpose of this report is to present the analysis and evaluation of the physics tests which were performed to verify that the Surry 1, Cycle 5 reload core could be operated safely and to make an initial evaluation of the expected performance of the core. It is not the intent of this report to discuss the particular methods of testing or to present the detailed data taken. Standard test techniques and methods of data analysis were used. The test data, results and evaluations, together with the detailed startup procedures, are on file at the Surry Power Station. Therefore, only a cursory discussion of these items is included in this report. The analyses presented includes a brief summary of each test, a comparison of the test results with design predictions, and an evaluation of the results.

The Surry 1, Cycle 5 Startup Physics Test Results and Evaluation Sheets have been included as an appendix to provide additional information on the startup test results. Each data sheet provides the following information: 1) test identification, 2) test conditions (design), 3) test conditions (actual), 4) test results, 5) acceptance criteria, and 6) comments concerning the test. These sheets provide a compact summary of the startup test results in a consistent format. The design test conditions and design values of the measured parameters were completed prior to startup physics testing. Except where noted, the entries for the design values were based on calculations performed by Vepco's Nuclear Fuel Engineering Group.¹ During the tests, the data sheets were used as guidelines both to verify that the proper test conditions were met and to serve as a preliminary comparison between measured and predicted values of measured parameters, thus enabling a quick identification of possible problems occurring during the tests. The appendix to this report contains the final completed and approved version of the Startup Physics Test Results and Evaluation Sheets.

INTRODUCTION AND SUMMARY

On April 22, 1978, Unit No. 1 of the Surry Power Station was shut down for its fourth refueling. During this shutdown, 73 of the 157 fuel assemblies in the core were replaced with eight once-burned assemblies from Cycle 3 of Unit 1, one once-burned assembly from Cycle 2 of Unit 2, and 64 fresh fuel assemblies. The fifth cycle core consists of seven regions of fuel: five once-burned regions from Cycles 3 and 4 of Unit 1 and Cycle 2 of Unit 2 (Regions 5, 6A, 6B, 6C, and S2/4A, respectively, and two fresh regions (Regions 7A and 7B). The actual core loading pattern and the design parameters for each region are shown in Figure 1.1. Each fuel assembly and its location in the core is identified in Figure 1.2 together with the incore instrumentation locations. Figure 1.3 identifies the location and number of burnable poison rods in the Cycle 5 core. Figure 1.4 identifies the location and number of control rods in the Cycle 5 core.

On July 6, 1978 at 1025, the fifth cycle core achieved initial criticality. Following criticality, startup physics tests were performed as outlined in Table 1.1. A summary of the results of these test follows:

1. Individual control rod bank worths for control banks A through D were measured to be within 5.0% of the design predictions and the total control rod bank worth was measured to be within 1.2% of the design prediction. These results are within the design tolerance of $\pm 15\%$ for individual bank worths and $\pm 10\%$ for the total of the control bank worths.
2. Isothermal temperature coefficients over the range of normal operating control rod bank insertions were measured to be within 2 pcm/ $^{\circ}$ F of the design predictions. These results are within the design tolerance of ± 3 pcm/ $^{\circ}$ F and also met the accident analysis acceptance criterion.
3. Critical boron concentrations for five basic control bank configurations were measured to be within 19 ppm of the design

predictions. These results are within the design tolerances and met the accident analysis acceptance criterion.

4. The boron worth coefficient was measured to be within 2.7% of the design prediction, which is within the design tolerance of $\pm 10\%$ and met the accident analysis acceptance criterion.
5. Core power distributions for various HZP and at-power conditions were generally within 3% of the predicted power distributions. For all maps, the hot channel factors were measured to be within the limits of the Technical Specifications. All measurement parameters met their respective design value tolerances and accident analysis acceptance criteria.
6. The power coefficient at 95% power was measured to be within 0.1 pcm/%pwr of the design prediction. This result is within the design value tolerance of ± 3.2 pcm/%power.

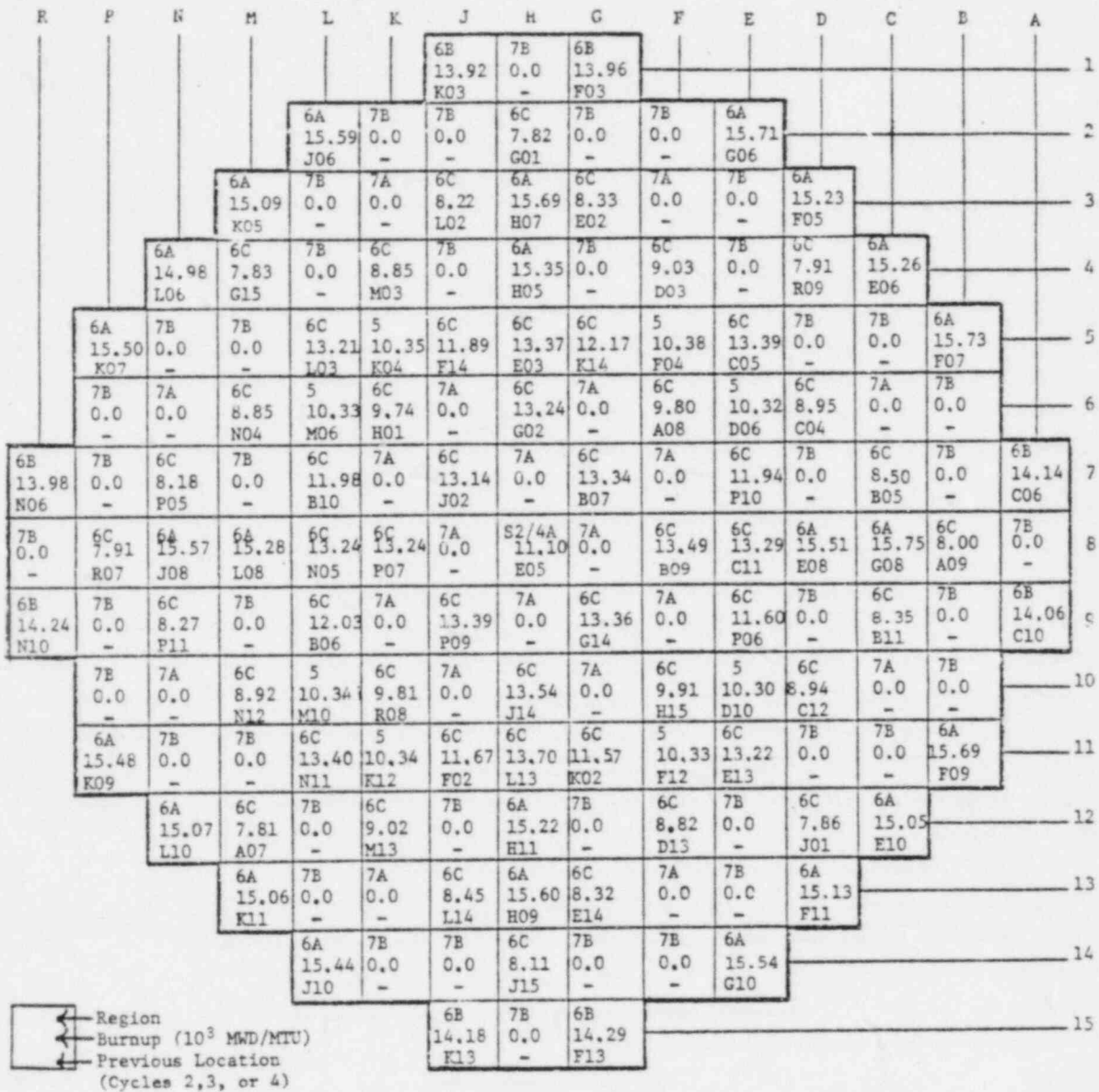
In summary, all startup physics test results were within their design tolerances. Detailed results together with specific design tolerances and acceptance criteria for each measurement are presented in the appropriate sections of this report.

Table 1.1

SUPPLY UNIT 1 - BOL CYCLE 5 PHYSICS TESTSCHRONOLOGY OF TESTS

Test	Date	Time	Power	Reference Procedure
Reactivity Computer Checkout	7-6-78	1504	HZP	PT-28.11(B)
Boron Endpoint-ARO	7-6-78	2012	HZP	PT-28.11(C)
Temperature Coefficient - ARO	7-6-78	2100	HZP	PT-28.11(D)
HZP M/D Flux Map - ARO	7-7-78	0113	HZP	PT-28.2
Bank D Worth	7-7-78	0500	HZP	PT-28.11(E)
Boron Endpoint-D In	7-7-78	1015	HZP	PT-28.11(C)
Temperature Coefficient-D In	7-7-78	1030	HZP	PT-28.11(D)
HZP M/D Flux Map-D In	7-7-78	1804	4%	PT-28.2
Bank C Worth	7-7-78	2108	HZP	PT-28.11(E)
Boron Endpoint-C In	7-8-78	0037	HZP	PT-28.11(C)
Temperature Coefficient-C In	7-8-78	0210	HZP	PT-28.11(D)
Bank B Worth	7-8-78	1100	HZP	PT-28.11(E)
Boron Endpoint-B In	7-8-78	1515	HZP	PT-28.11(C)
Bank A Worth	7-8-78	1530	HZP	PT-28.11(E)
Boron Endpoint-A In	7-8-78	1900	HZP	PT-28.11(C)
Banks A → D Worth in Overlap	7-8-78	1915	HZP	PT-28.11(E)
I/E Calibration-APDM Flux Map	7-9-78	1648	50%	PT-28.8
I/E Calibration-APDM Flux Map	7-9-78	1920	50%	PT-28.8
I/E Calibration-APDM Flux Map	7-10-78	0129	57%	PT-28.8
I/E Calibration-APDM Flux Map	7-10-78	0940	67%	PT-28.8
I/E Calibration-APDM Flux Map	7-10-78	1846	88%	PT-28.8
I/E Calibration-APDM Flux Map	7-11-78	0530	98%	PT-28.8
HFP M/D Flux Map-Eq. Xenon	7-13-78	0911	100%	PT-28.2
Power Coefficient	8-10-78	2352	100%- 90%	PT-28.12

CORE LOADING MAP



FUEL ASSEMBLY DESIGN PARAMETERS

	Batch						
	5	6A	6B	6C	7A	7B	S2/4A
Initial Enrichment (w/o U235)	2.11	2.62	2.60	2.90	2.90	2.39	2.61
Burnup At BOC-5(MWD/MTU)	10,337	15,397	14,097	10,557	0	0	11,098
Assembly Type	15x15	15x15	15x15	15x15	15x15	15x15	15x15
No. of Assemblies	8	24	8	52	20	44	1
Fuel Rods per Assembly	204	204	204	204	204	204	204

Figure 1.2

SURREY UNIT 1 - CYCLE 5

ASSEMBLY ID'S AND INCORE INSTRUMENTATION LOCATIONS

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						K02	2A3	K04							1
				H20	3A6	3A9	J24	5A1	5A3	H02					2
			H03	2A2	0A3	J38	H14	J33	0A8	6A1	H10				3
		H19	J15	2A8	J34	4A6	H08	4A7	J20	4A3	J09	H23			4
	H04	4A4	3A5	J29	G15	J14	J31	J30	G06	J12	3A8	2A1	H15		5
	5A0	1A0	J23	G13	J21	1A6	J49	1A7	J47	G03	J01	0A2	3A4		6
K05	3A0	J37	5A8	J46	2A0	J02	0A4	J32	1A3	J44	5A6	J45	4A9	K06	7
6A4	J52	H12	H11	J18	J35	1A4	S16	1A1	J41	J50	H09	H07	J27	4A8	8
K07	4A5	J51	5A5	J36	1A2	J22	0A7	J28	0A9	J43	2A9	J05	6A0	K01	9
	2A7	0A1	J16	G11	J11	1A5	J48	0A6	J06	G10	J08	0A5	3A7		10
	H01	5A4	4A2	J04	G05	J10	J26	J40	G07	J25	5A7	5A9	H06		11
		H05	J42	6A3	J17	2A4	H16	6A2	J13	2A5	J03	H17			12
			H24	3A2	1A9	J39	H18	J19	1A8	2A6	H13				13
				H22	3A3	4A1	J07	4A0	3A1	H21					14
						K08	5A2	K03							15

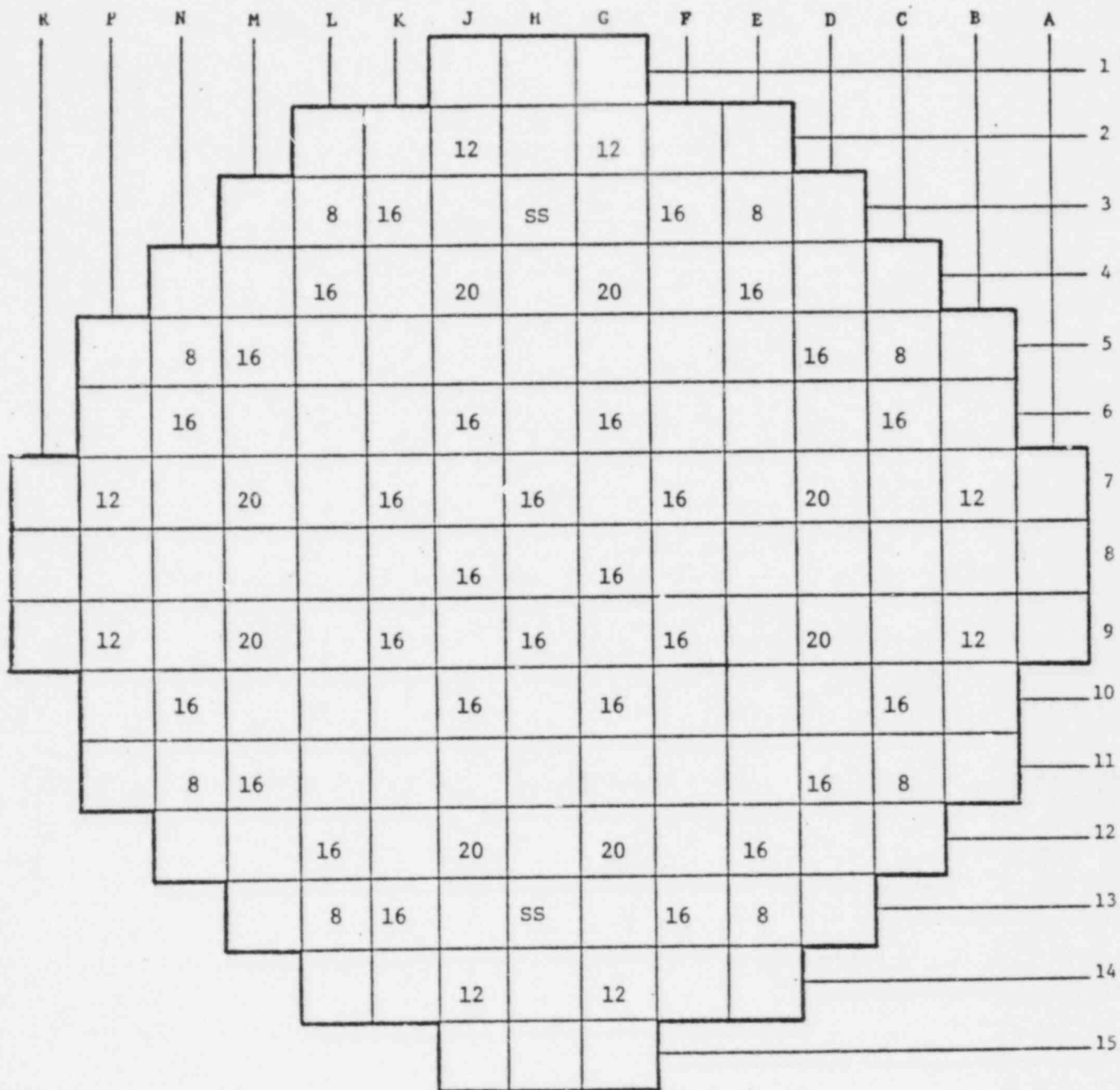
← Fuel Assembly I. D. Number
 ← Indicates Location & Type of Incore Instrumentation

- M/D
- T/C
- ⊙ Both M/D & T/C

Figure 1.3

SURRY UNIT 1 - CYCLE 5

BURNABLE POISON AND SOURCE ASSEMBLY LOCATIONS



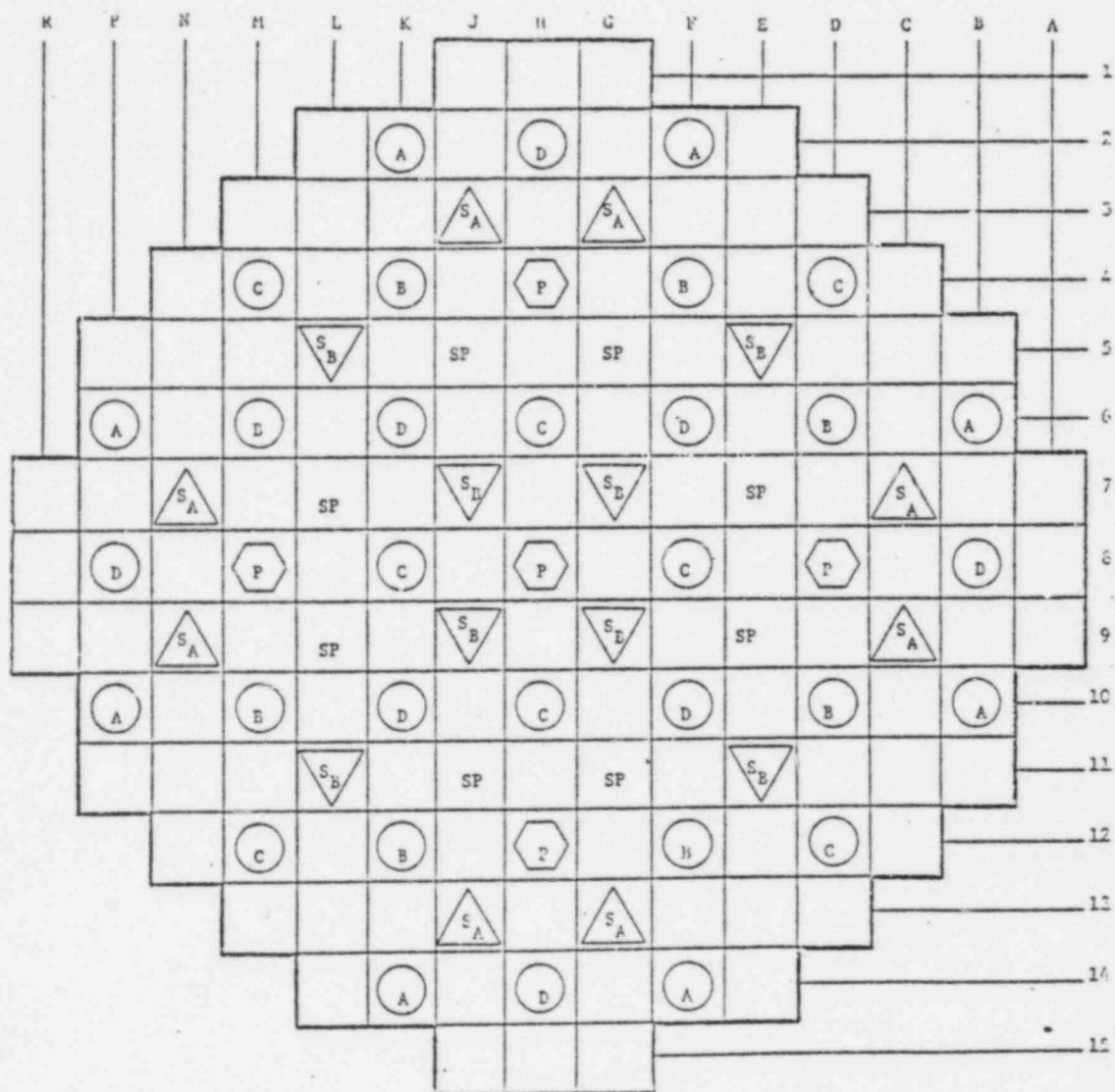
SS - Secondary Source

768 Fresh Burnable Poison Rods

Figure 1.4

SURRY UNIT 1 - CYCLE 5

CONTROL ROD LOCATIONS



Function
 Control Bank D
 Control Bank C
 Control Bank B
 Control Bank A
 Shutdown Bank S_B
 Shutdown Bank S_A
 Part Length P
 SP (Spare Rod Locations)

Number of Clusters
 8
 8
 8
 8
 8
 8
 5
 8

CONTROL ROD BANK WORTH MEASUREMENTS

Differential and integral control bank worths were obtained by monitoring reactivity changes associated with boron/RCCA exchanges. Following the establishment of a constant RCS boron dilution/boration rate, the controlling RCCA bank was periodically inserted/withdrawn in order to provide reactivity compensation for the changing RCS boron concentration. The reactivity changes resulting from the control bank movements were recorded continuously by the reactivity computer.² The differential reactivity worth is defined as the ratio of the change in reactivity to the corresponding change in bank position about an average bank position, and the integral worth was obtained by summing the individual reactivity changes between measurement endpoints.

A summary of the results for these tests is given in Table 2.1. As shown by this table and the Startup Physics Test Results and Evaluation Sheets given in the Appendix, the individual measured bank worths for control banks D, C, B, and A were within the design tolerance of $\pm 15\%$. The total bank worth (non-overlap mode) for control banks A through D was measured to be within 1.2% of the design prediction. This is well within the design tolerance of $\pm 10\%$ for total control bank worth. In addition, a second independent measurement of total bank worth (in overlap mode) was performed. This measured value was within 1.0% of the design prediction.

The integral and differential reactivity worths for rod banks D through A (non-overlap mode) are shown in Figures 2.1 through Figure 2.8, respectively. The design predictions and the measured data (non-overlap mode) are plotted together in order to illustrate their agreement. The rod worth measurements are quite exact in defining the shape of the individual differential rod worth curves, as illustrated by the distinct depressions occurring at

the assembly grid locations. The integral and differential worth for control banks A through D operating in the overlap mode are shown in Figures 2.9 and 2.10, respectively.

In summary, all measured rod worth values were satisfactory.

Table 2.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TESTSCONTROL BANK WORTH SUMMARY

Bank	Measured Worth (pcm)	Predicted Worth (pcm)	Percent Difference $\left(\frac{M-P}{P}\right) \times 100$
D	1207	1188	+1.6
C	1082	1056	+2.5
B	1999	2040	-2.0
A	1304	1242	+5.0
$\Sigma A \rightarrow D$	5592	5526	+1.2
A \rightarrow D In Overlap Mode	5577	5526	+0.92

Figure 2.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK D INTEGRAL ROD WORTH-HZP

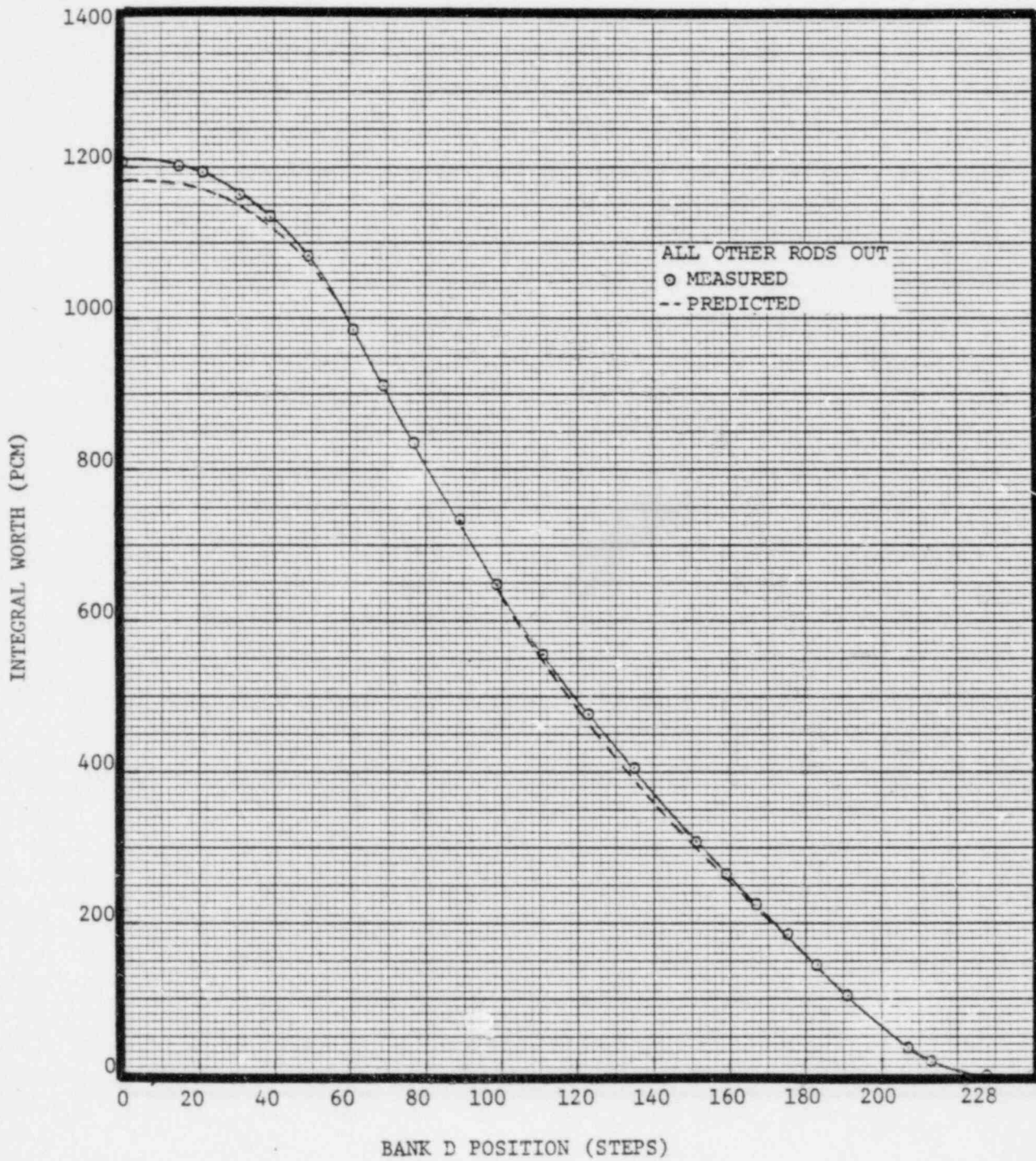


Figure 2.2

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK D DIFFERENTIAL ROD WORTH-HZP

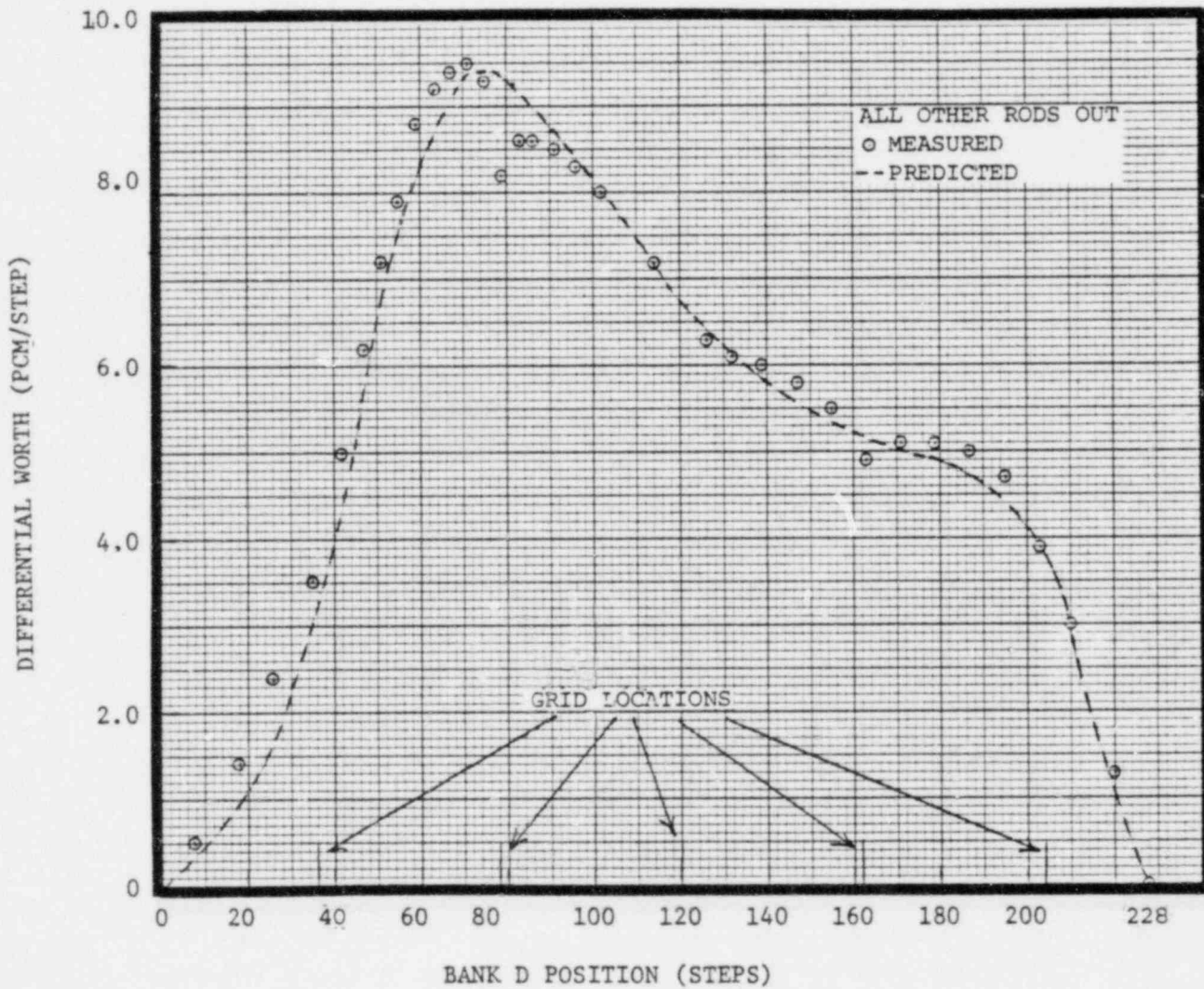


Figure 2.3

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK C INTEGRAL ROD WORTH - HZP

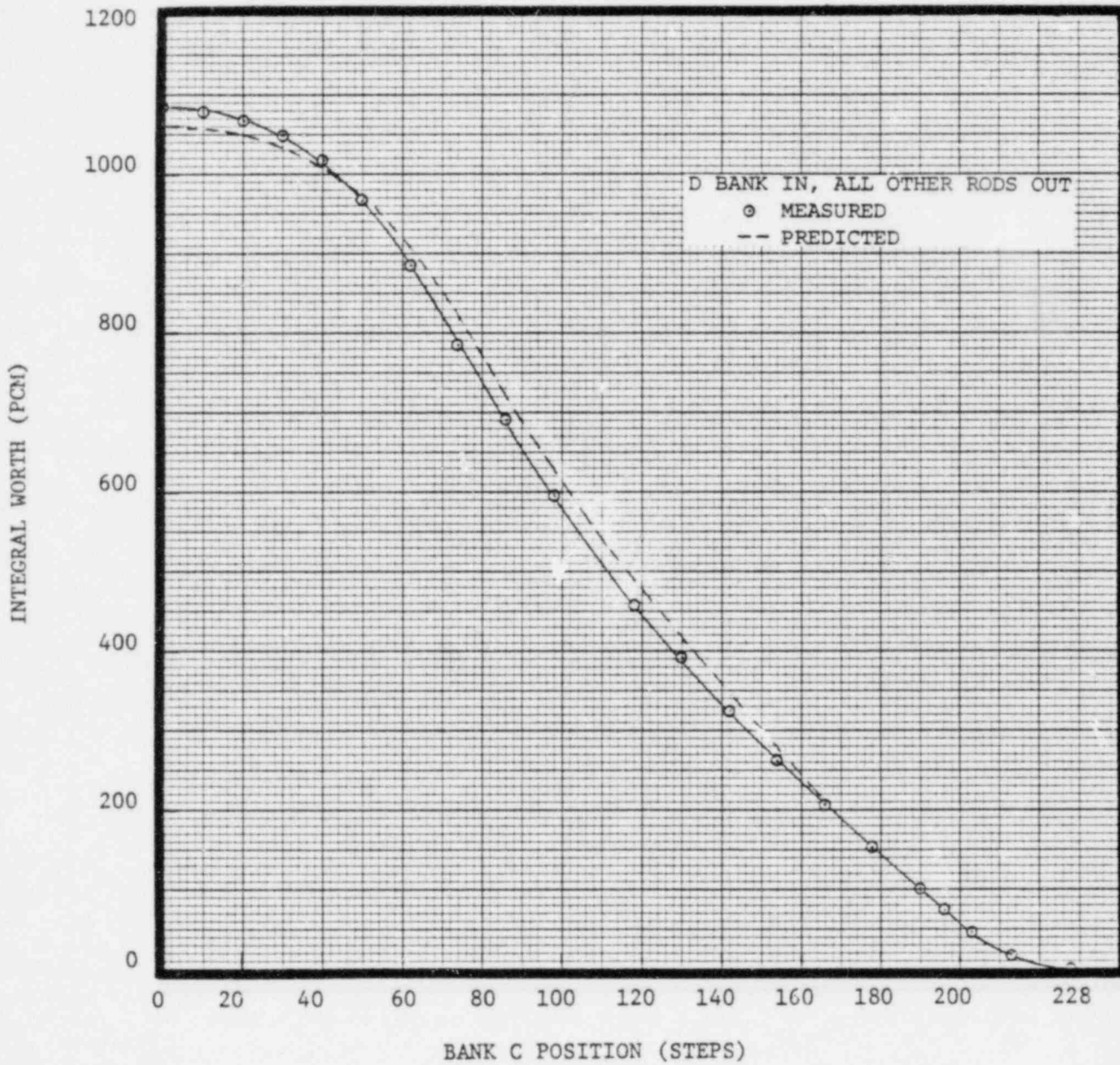


Figure 2.4

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK C DIFFERENTIAL ROD WORTH-HZP

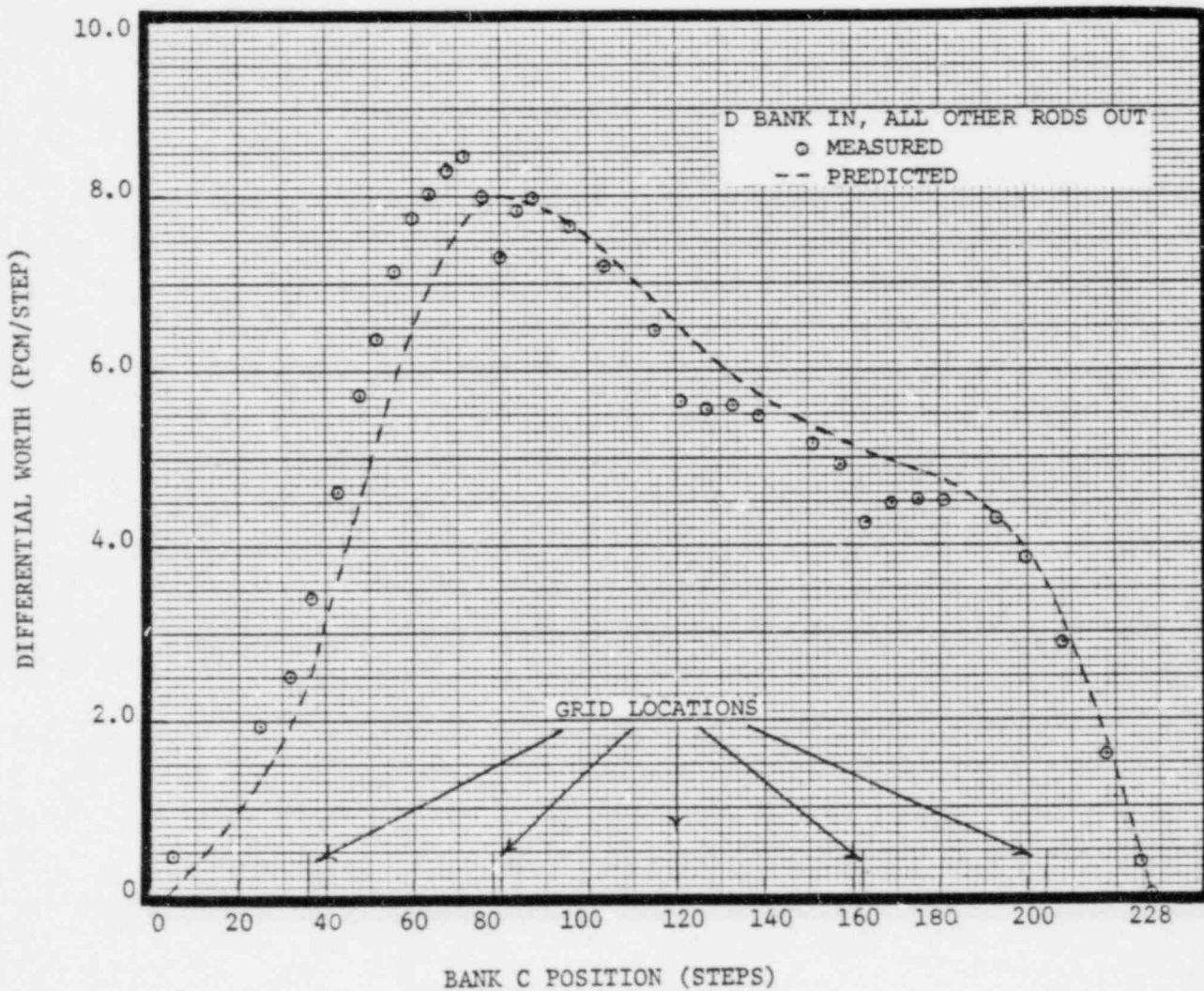


Figure 2.5

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK B INTEGRAL ROD WORTH-HZP

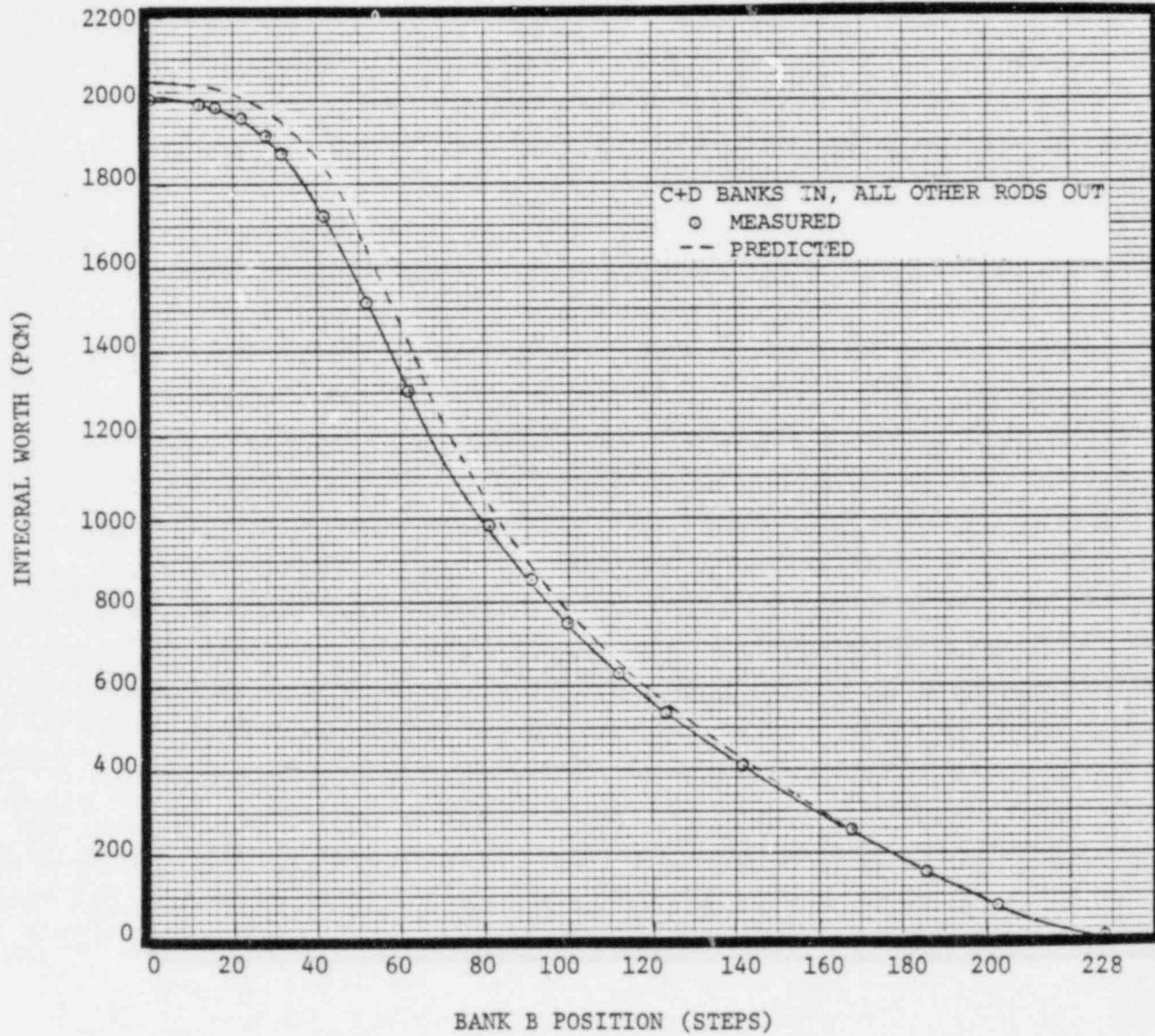


Figure 2.6

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK B DIFFERENTIAL ROD WORTH-HZP

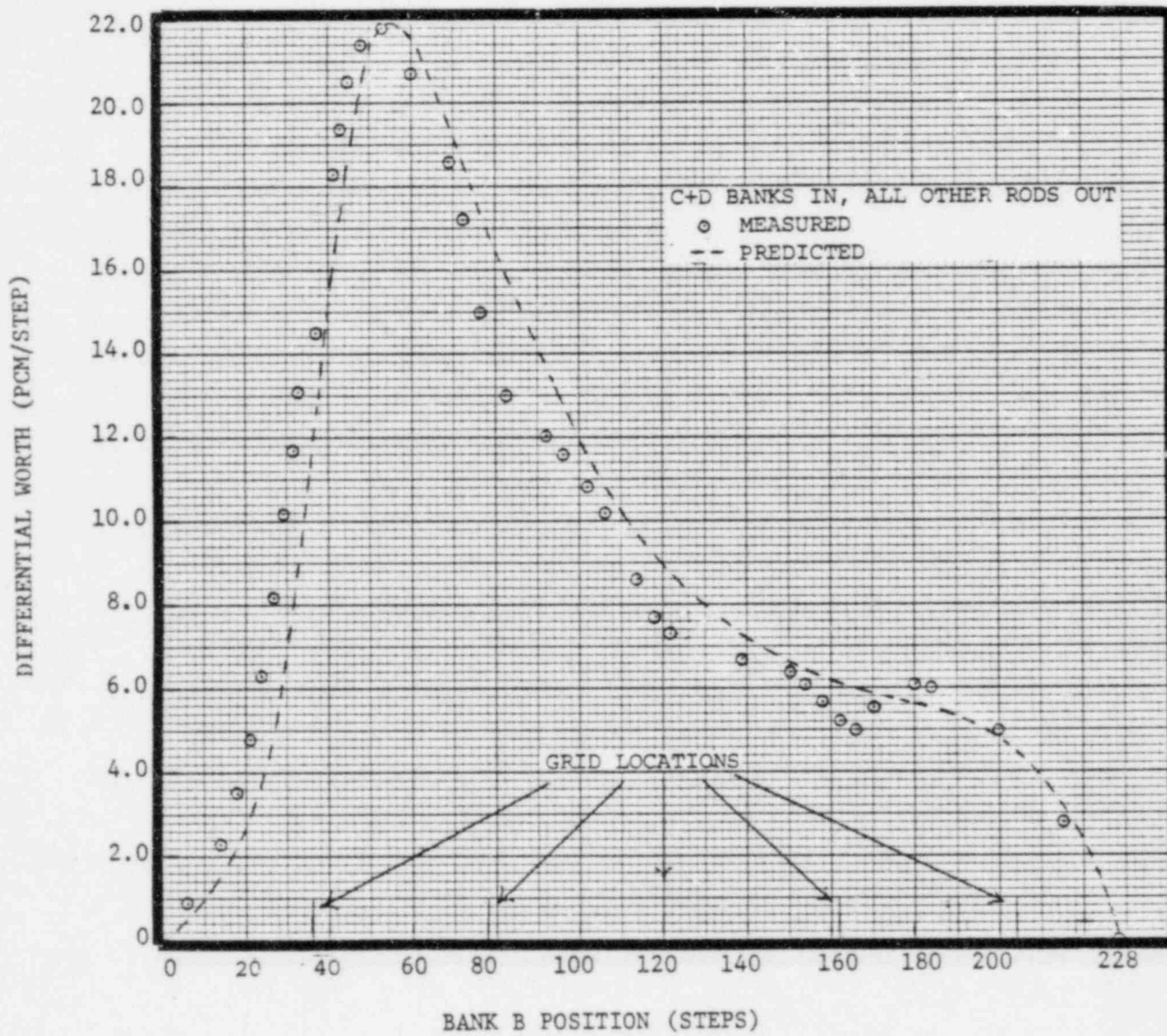


Figure 2.7
SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST
BANK A INTEGRAL ROD WORTH-HZP

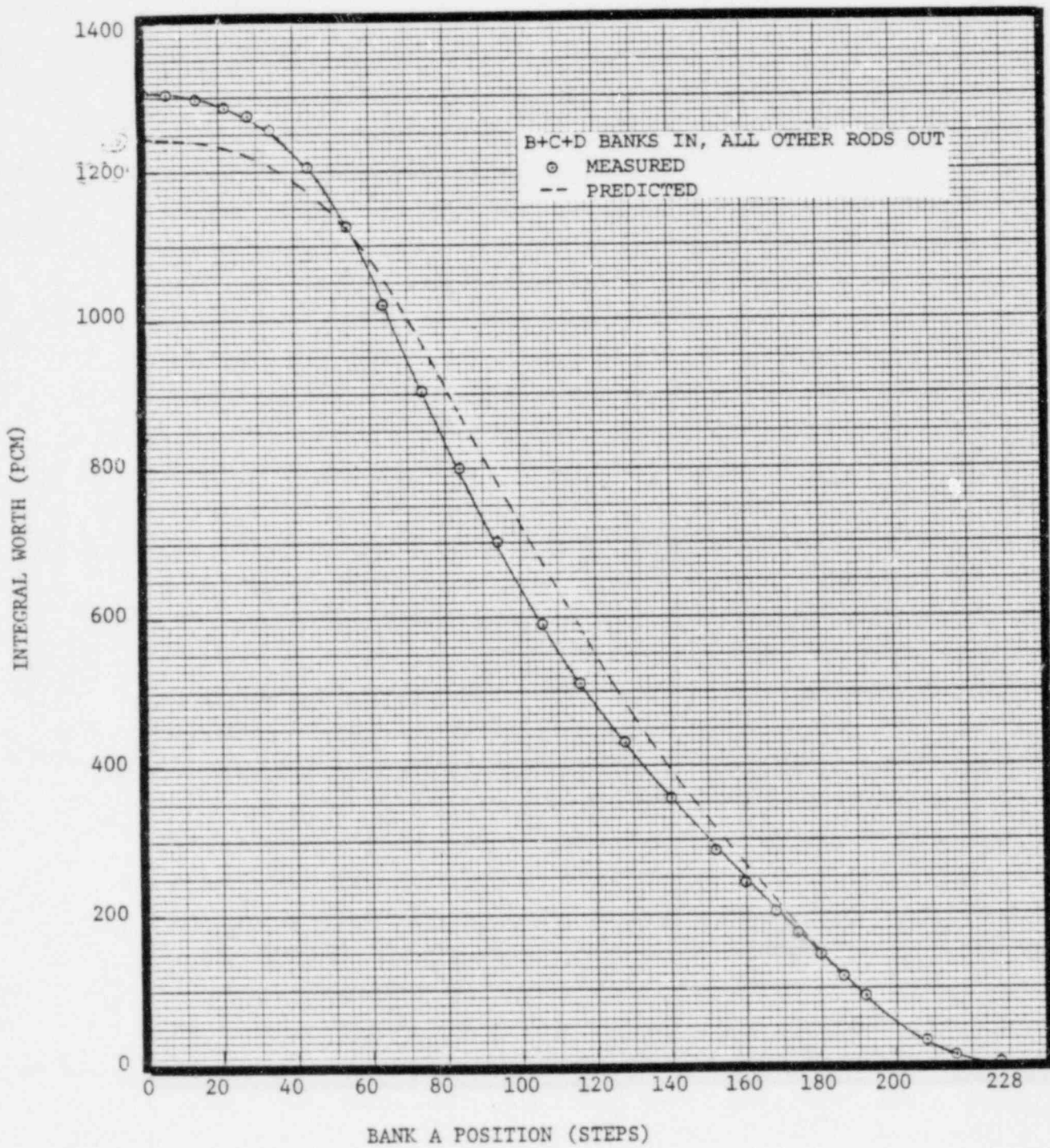


Figure 2.8

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BANK A DIFFERENTIAL ROD WORTH-HZP

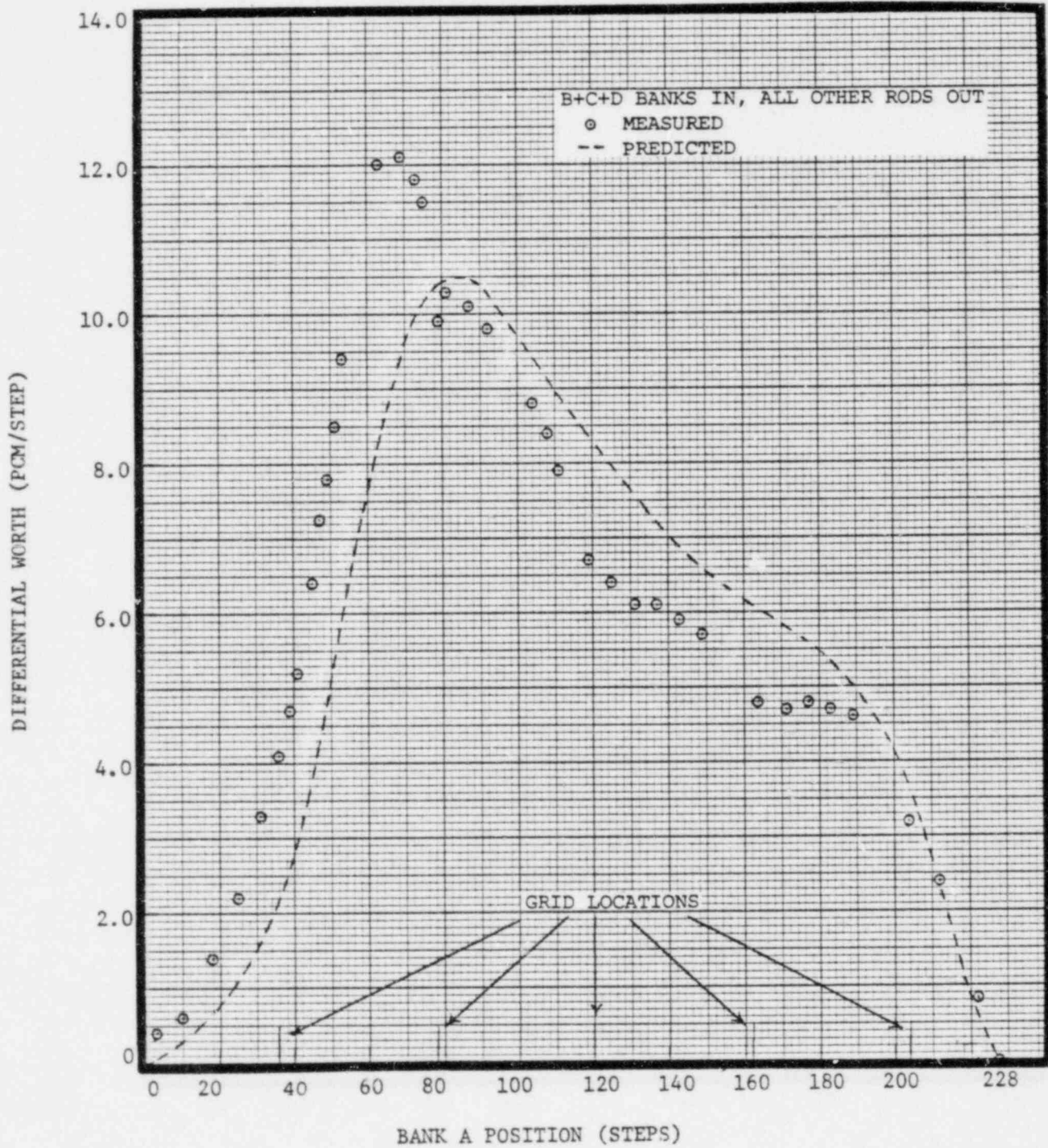


Figure 2.9

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

INTEGRAL WORTH OF CONTROL BANKS A

THROUGH D IN OVERLAP MODE

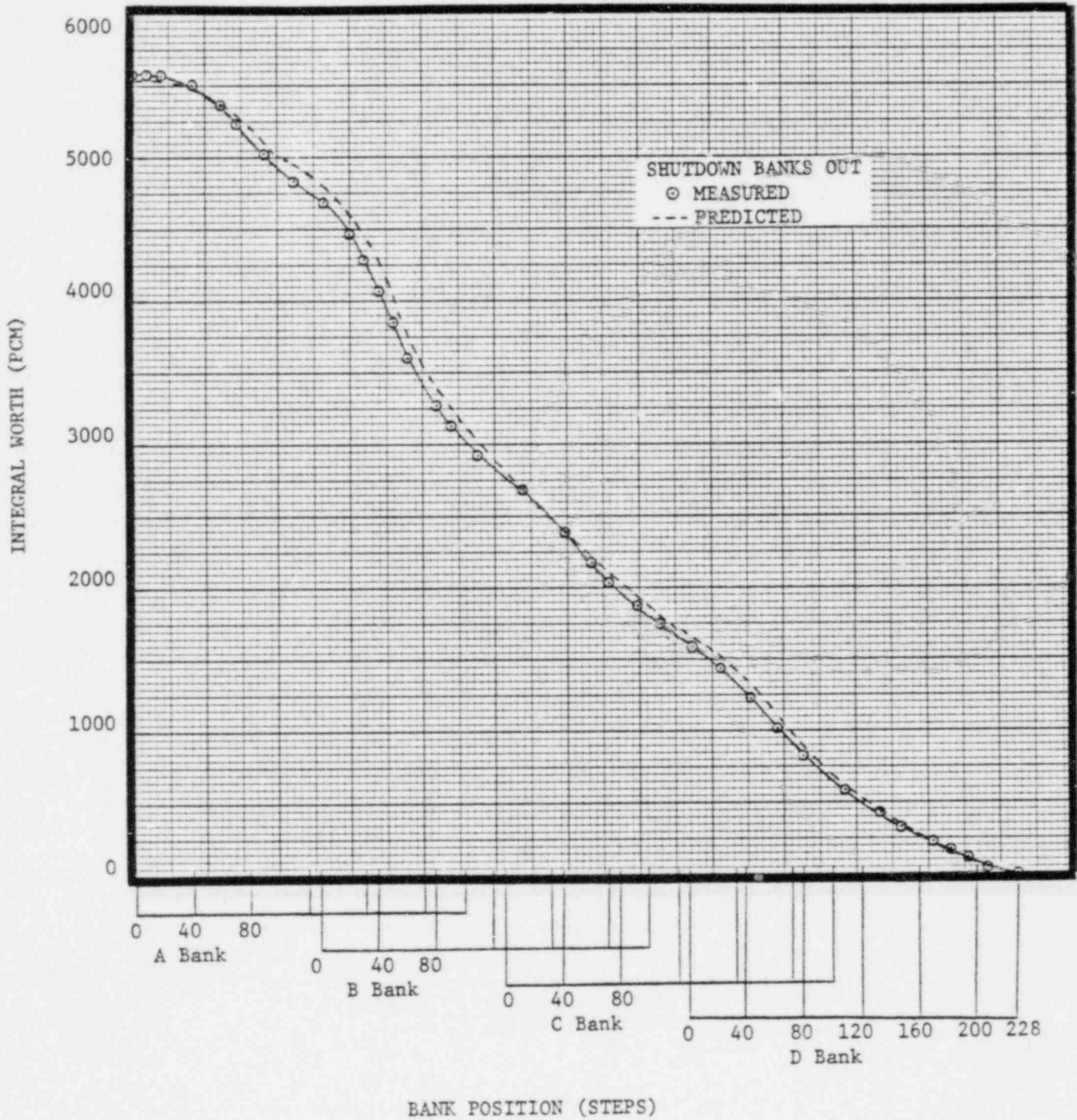
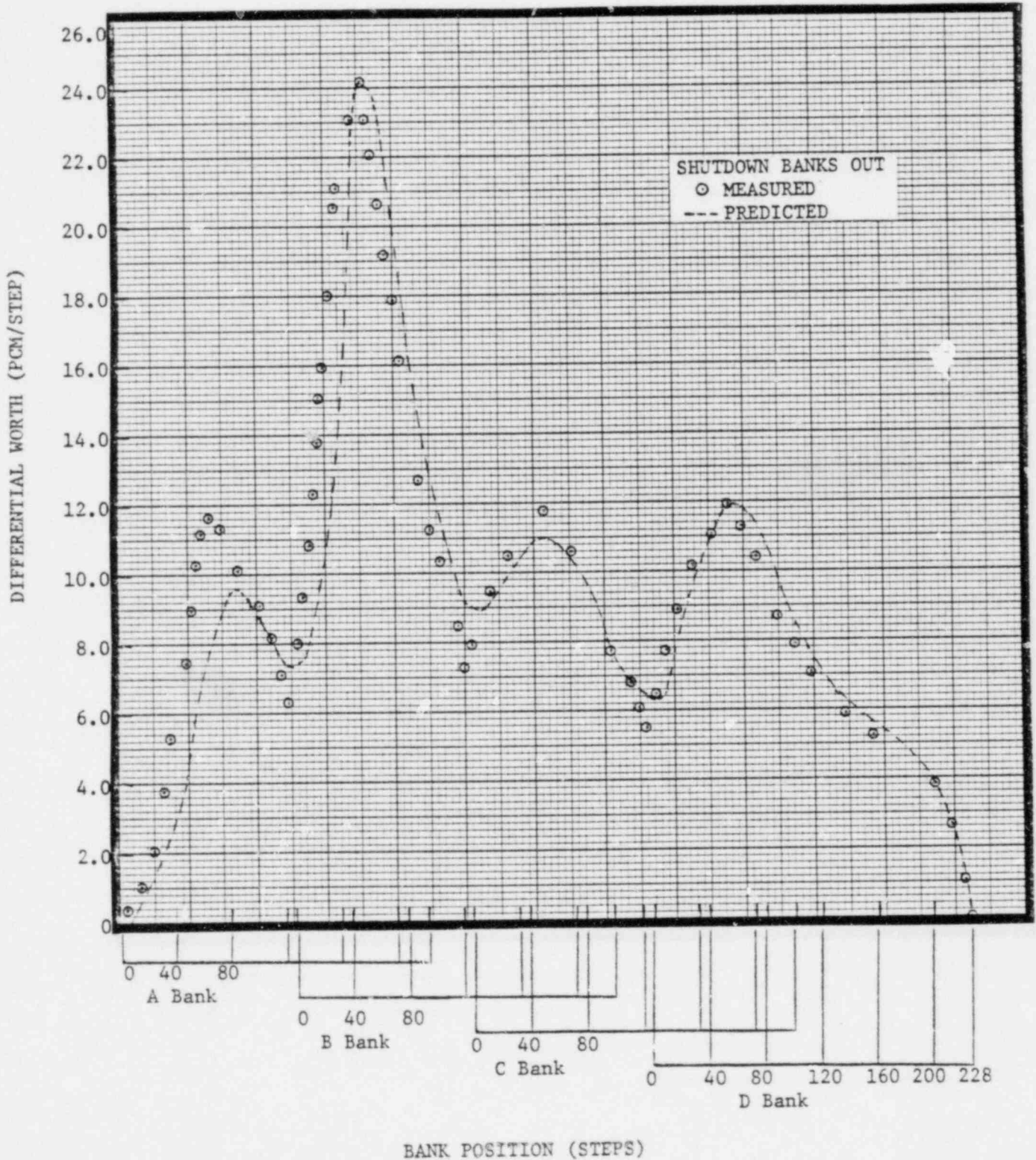


Figure 2.10

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

DIFFERENTIAL WORTH OF CONTROL BANKS

A THROUGH D IN OVERLAP MODE



TEMPERATURE COEFFICIENT MEASUREMENTS

The isothermal temperature coefficient measurements were accomplished by controlling the RCS heat gains/losses with the steam dump valves to the condenser, establishing a constant and uniform heatup/cooldown rate, and then monitoring the resulting reactivity changes on the reactivity computer. These measurements were performed at very low power levels in order to minimize the effects of non-uniform nuclear heating, thus, the moderator and fuel were approximately at the same temperature (between 540-550°F) during these measurements. To eliminate the boron reactivity effect of outflow from the pressurizer, the pressurizer level was maintained constant or slightly increasing during these measurements.

Isothermal temperature coefficient measurements were performed at various control rod configurations. For each rod configuration, reactivity measurements were taken during both RCS heatup and cooldown ramps during which the RCS temperature varied approximately 30°F. Reactivity was determined using the reactivity computer and was plotted against the RCS temperature on an x-y recorder. The temperature coefficient was then determined from the slope of the plotted lines. The x-y recorder plots of reactivity change vs. RCS temperature for each measurement are shown in Figures 3.1 through 3.3.

The predicted and measured isothermal temperature coefficient values are compared in Table 3.1. As can be seen from this summary and from the Start-up Physics Test Results and Evaluation Sheets given in the Appendix, all measured isothermal temperature coefficient values were within the design tolerance of $\pm 3 \text{ pcm}/^\circ\text{F}$ and met the accident analysis acceptance criterion.

In summary, all measured results were satisfactory.

Table 3.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TESTSISOTHERMAL TEMPERATURE COEFFICIENT SUMMARY

Bank Position (steps)			Temperature Range (°F)	Boron Concentration (ppm)	Isothermal Temperature Coefficient (pcm/°F)				
B	C	D			Heatup	Cooldown	Average	Predicted	Difference (M-P)
228	228	223	544-547	1311	-2.7	-2.7	-2.7	-3.7	+1.0
228	222	0	544-546	1173	-5.8	-6.0	-5.9	-6.9	+1.0
213	0	0	544-547	1052	-9.0	-9.0	-9.0	-10.4	+1.4

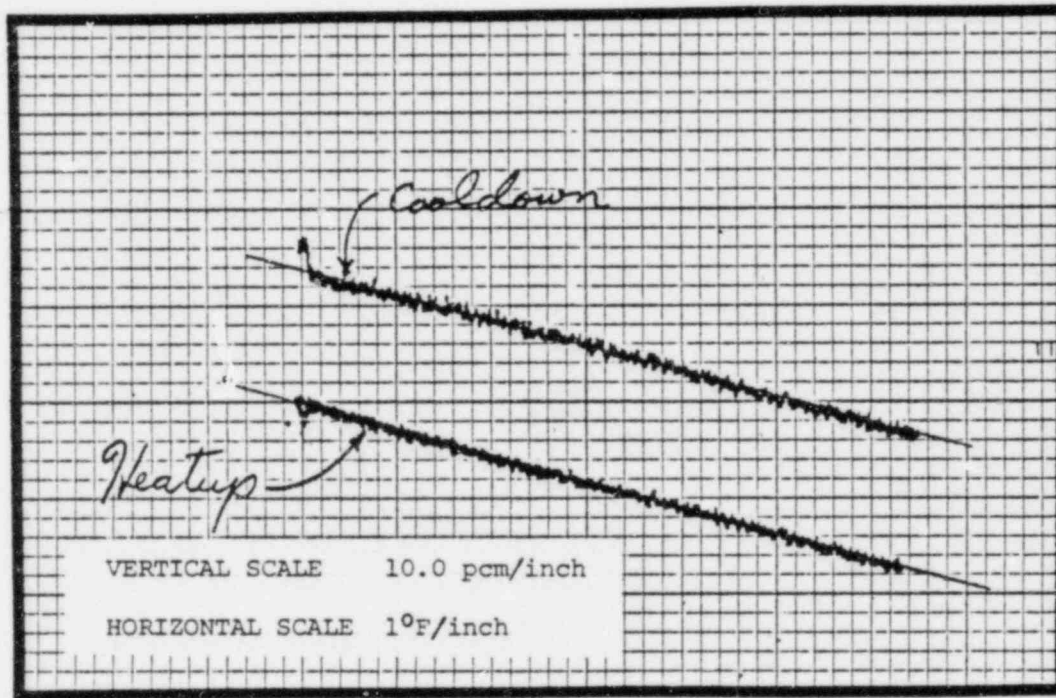
Figure 3.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ISOTHERMAL TEMPERATURE COEFFICIENT

HZP, ARO

REACTIVITY (PCM)



TEMPERATURE (°F)

Figure 3.2

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ISOTHERMAL TEMPERATURE COEFFICIENT

HZP, D-BANK IN

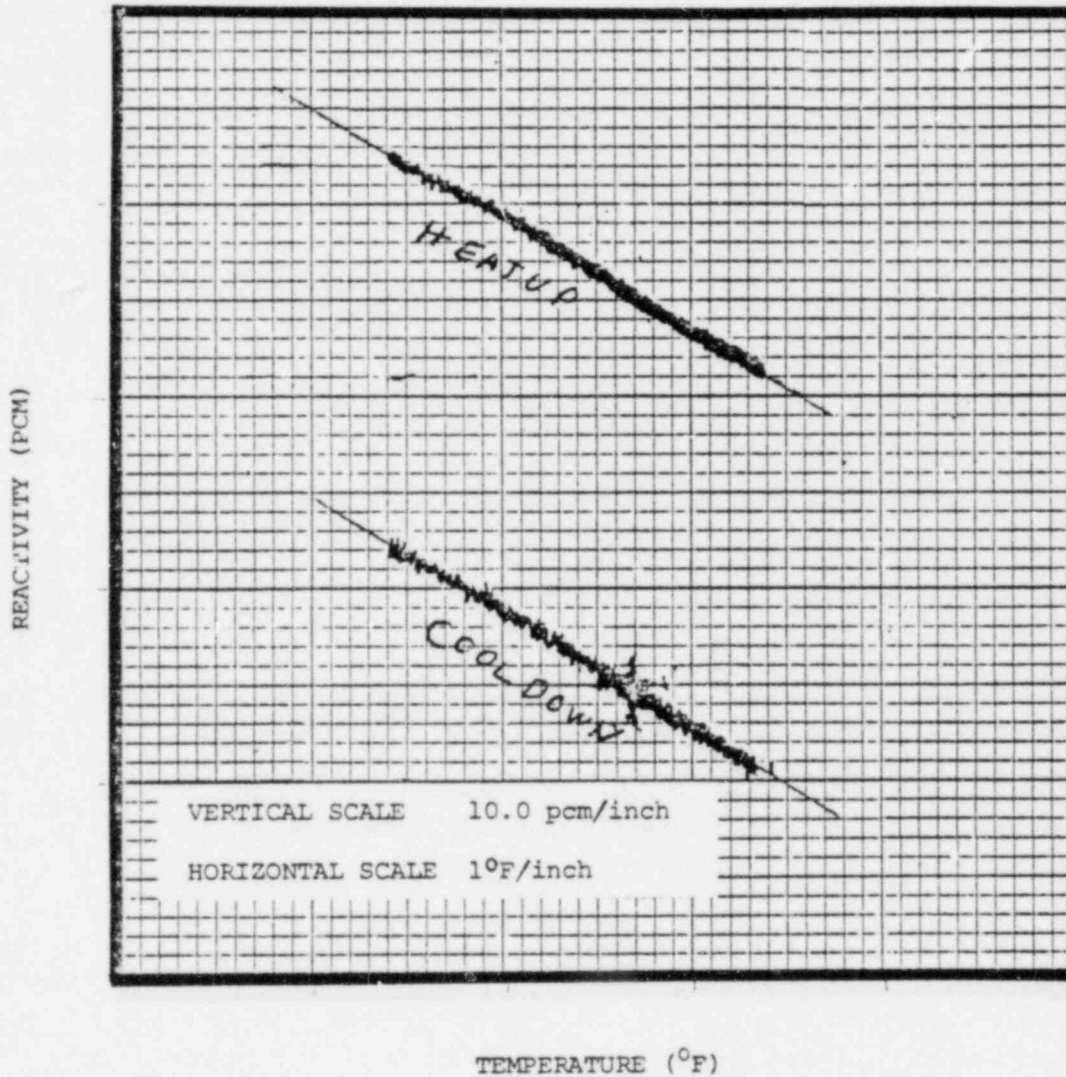
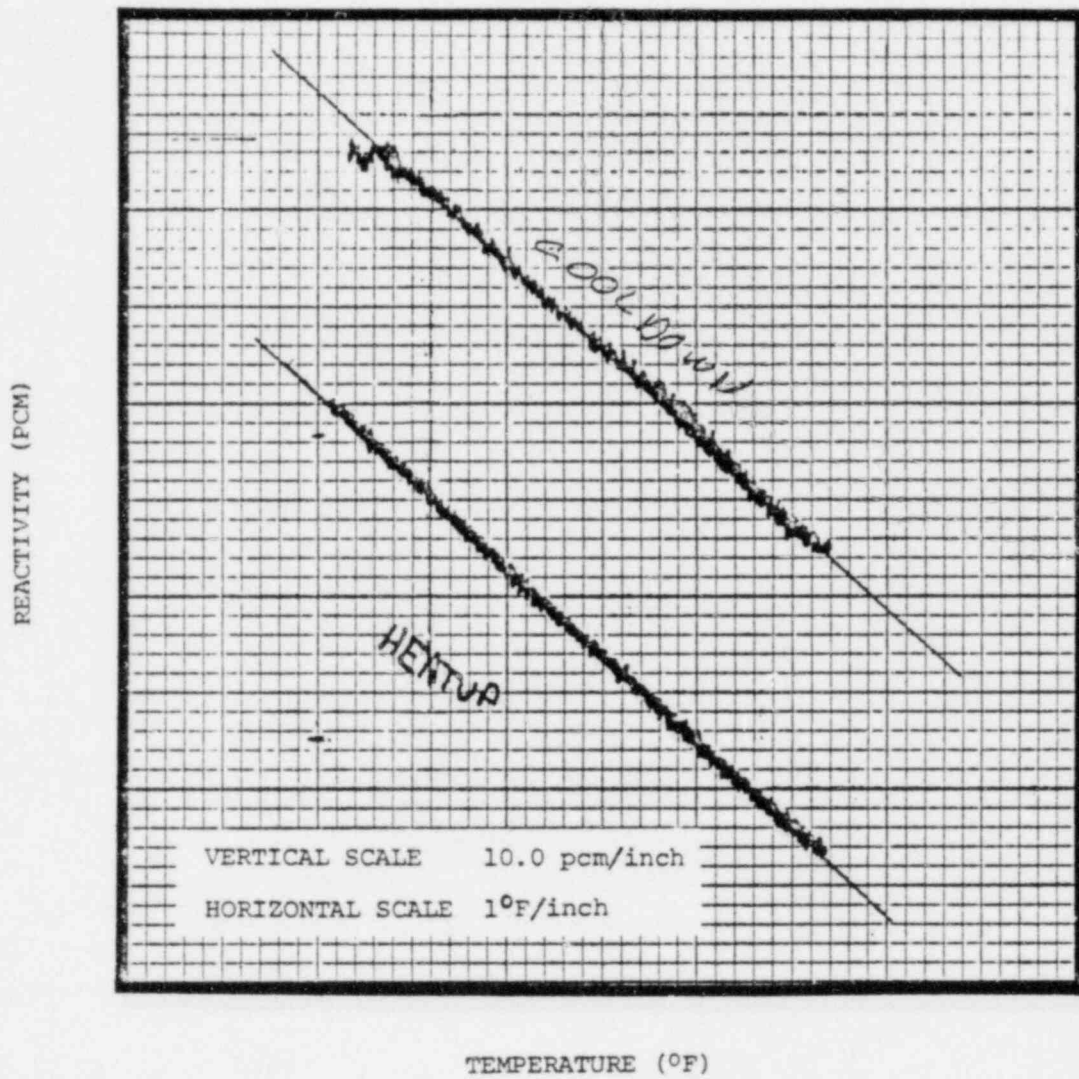


Figure 3.3

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ISOTHERMAL TEMPERATURE COEFFICIENT

HZP, C+D BANKS IN



Section 4

BORON ENDPOINT AND WORTH MEASUREMENTS

Boron Endpoints

With the reactor critical at hot zero power, reactor coolant system boron concentrations were measured at selected rod bank configurations to enable a direct comparison of measured boron endpoints with design predictions. For each measurement, the RCS conditions were stabilized with the control bank at or very near a selected endpoint position. The critical boron concentration was then measured. If necessary, an adjustment to the measured critical boron concentration value was made to account for off-nominal core conditions, i.e., for rod position and moderator temperature.

The results of these measurements are given in Table 4.1. As shown in this table and in the Startup Physics Test Results and Evaluation Sheets given in the Appendix, all measured critical boron endpoint values were within 19 ppm of their design prediction which is within the design tolerances. All measured values met the accident analysis acceptance criterion.

In summary, all results were satisfactory.

Boron Worth Coefficient

Concurrent with the control bank reactivity worth measurements, samples of RCS water were obtained for boron analysis. Frequent sampling (taken at approximately 15 minute intervals) is necessary during the dilution and boron phases of the rod worth measurement program in order to provide adequate statistics for the determination of the boron worth coefficient.

Relevant data logged during this measurement were the control bank position (and hence integrated reactivity) as a function of time and the RCS boron concentration as a function of time. This second item contains a small correction factor (5 minutes) to account for the transit time of the RCS sample from the RCS coolant loop to the sample sink tap. With these data, a plot of boron concentration as a function of integrated reactivity can be constructed, since the core is kept nominally critical. The value of the boron worth

coefficient over this range of boron concentration is obtained directly from this plot.

The boron worth plot is shown in Figure 4.1. As indicated in this figure and in the Appendix, the boron worth coefficient of reactivity was measured to be -8.94 pcm/ppm. The measured boron worth coefficient is within 2.8% of the predicted value of -9.19 pcm/ppm. The measurement result falls well within the design tolerance of $\pm 10\%$. Also, the measurement result met the accident analysis acceptance criterion.

In summary, this result was satisfactory.

Table 4.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TESTSBORON ENDPOINTS SUMMARY

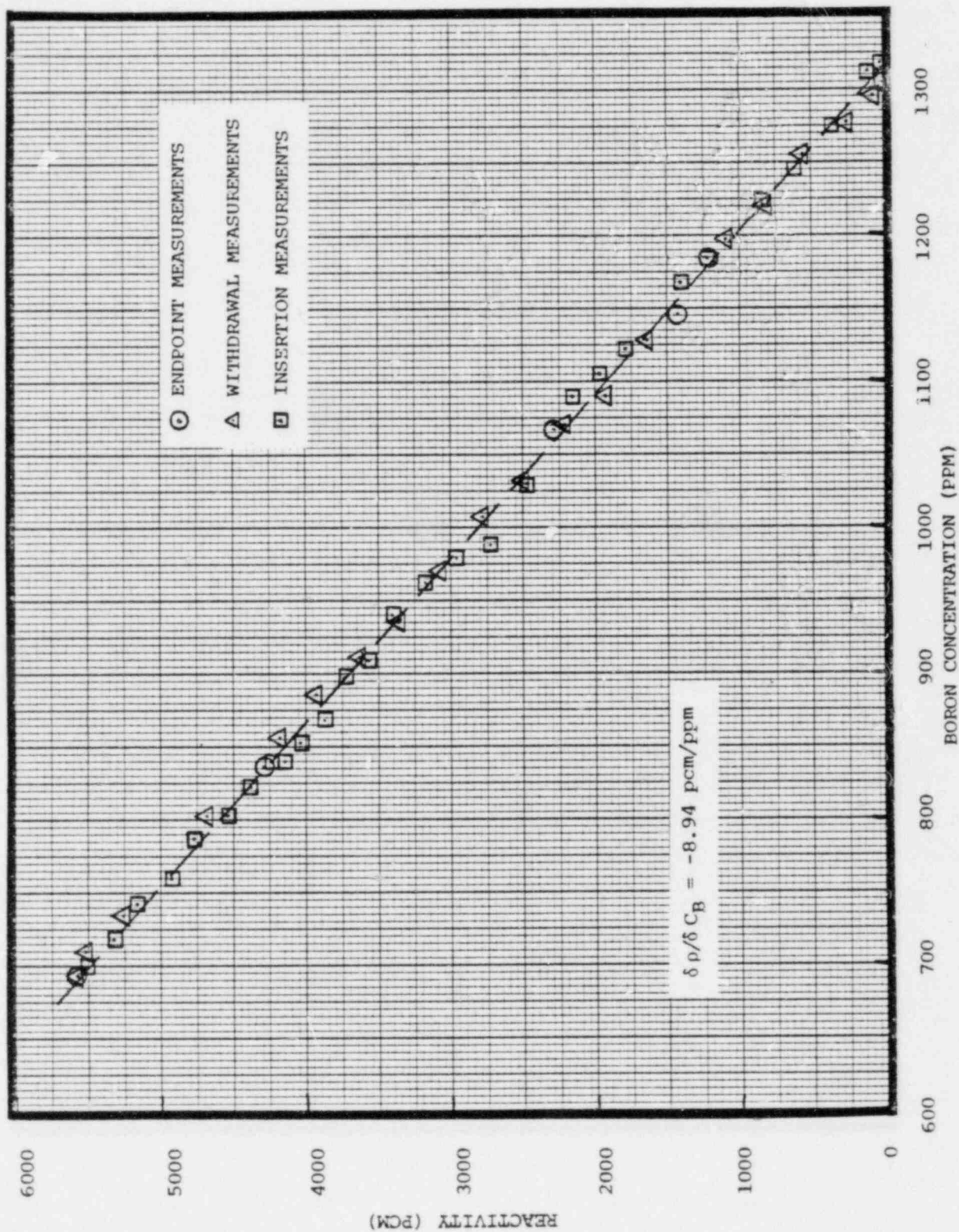
Control Rod Configuration	Measured Endpoint (ppm)	Predicted Endpoint (ppm) *	Difference M-P (ppm)
ARO	1304	1321	-17
D Bank In	1184	1165	+19
D+C Banks In	1067	1075	+8
D+C+B Banks In	836	846	-10
D+C+B+A Banks In	693	700	-7

*Predicted endpoints have been adjusted for the difference between the measured and predicted values of the previous endpoint as shown in the boron endpoint Startup Physics Test Results and Evaluation Sheets in the Appendix.

Figure 4.1

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

BORON WORTH COEFFICIENT



POWER DISTRIBUTION MEASUREMENTS

The core power distributions were measured using the incore movable detector flux mapping system. This system consists of five fission detectors which traverse fuel assembly instrumentation thimbles in 50 core locations (see Figure 1.2). For each traverse, the detector output is continuously monitored on a strip chart recorder. The output is also scanned for 61 discrete axial points by the PRODAC P-250 process computer. Full core, three-dimensional power distributions are then determined by analyzing this data using the Westinghouse computer program, INCORE.³ INCORE couples the measured flux map data with predetermined analytic power-to-flux ratios in order to determine the power distribution for the whole core.

A list of all the flux maps taken during the test program together with a list of the measured values of the important power distribution parameters is given in Table 5.1. Flux maps 1 and 3 were taken at approximately zero power. These flux maps serve as base case design checks and verify that the core was loaded properly. Figures 5.1 and 5.2 show the resulting radial power distributions associated with these flux maps. As seen by Figures 5.1 and 5.2, the measured relative assembly power values are generally within 4% of the predicted values. Flux maps 4 through 10 were taken over a wide range of power levels and control rod configurations. These flux maps were taken to check the at-power design predictions and to measure core power distributions at various operating conditions. These maps also provide incore/excore calibration data for the nuclear instrumentation system as well as base data for axial power distribution surveillance. The radial power distributions for these maps are given in Figures 5.3 through 5.9. As seen by Figures 5.3 through 5.9, the measured relative assembly power values are generally within 3% of the predicted values.

The measured power distribution parameters are compared with their Technical Specifications limits in Table 5-2. The power distribution parameters for all flux maps met their design and accident analysis acceptance criteria and Technical Specifications limits (see Appendix).

In conclusion, all power distribution measurement results were considered acceptable with respect to the design tolerance, accident analysis acceptance criteria and Technical Specifications limits. It is therefore anticipated that the core will continue to operate safely throughout Cycle 5.

Table 5.1

SURREY UNIT 1 - CYCLE 5 BOL PHYSICS TESTS

SUMMARY OF INCORE FLUX MAPS

MAP DESCRIPTION	MAP NO.	PWR (%)	BANK POSITION (STEPS)		F_Q^T Hot CHANNEL FACTOR*				$F_{\Delta H}^N$ HOT CHANNEL FACTOR**			CORE \bar{F}_Z MAX		F_{xy}^+	QPTR ^x	AXIAL OFFSET (%)	NO OF THIMBLES
					ASSY.	PIN	AXIAL POINT	F_Q^T	ASSY.	PIN	$F_{\Delta H}^N$	AXIAL POINT	F_Z				
Zero Power M/D Map - ARO	1	~ 0	228	218	K14	LM	20	2.40	K14	LM	1.55	20	1.50	1.52	1.014	+27.36	40
Zero Power M/D Map - B In	3 ^{xx}	~ 4	219	0	E04	GH	21	2.57	M05	HG	1.68	21	1.46	1.64	1.013	+22.68	43
I/E Calibration APDM Flux Map	4	~ 50	228	200	P10	ML	23	1.99	P10	ML	1.44	23	1.32	1.44	1.002	+6.30	43
I/E Calibration APDM Flux Map	5	~ 50	228	185	P10	ML	33	2.04	P10	ML	1.43	33	1.32	1.41	1.004	-2.01	43
I/E Calibration APDM Flux Map	6	~ 57	228	162	K14	LM	36	2.16	K14	KL	1.47	36	1.39	1.42	1.007	-16.95	43
I/E Calibration APDM Flux Map	7	~ 67	228	196	P10	LK	23	1.90	P10	LK	1.43	23	1.27	1.41	1.004	+3.45	40
I/E Calibration APDM Flux Map	8	~ 88	228	218	P10	LK	32	1.80	P10	LK	1.41	23	1.21	1.39	1.007	+4.04	41
I/E Calibration APDM Flux Map	9	~ 98	228	224	K14	KL	34	1.84	K14	KL	1.42	35	1.22	1.39	1.007	-2.90	40
Full Power Map Eq. Xenon	10	~100	228	221	K14	KL	34	1.84	K14	KL	1.42	34	1.22	1.38	1.007	-1.48	42

NOTES: Hot spot locations are specified by giving assembly locations (e.g. H-8 is the center-of-core assembly location), followed by the pin location (denoted by the "Y" coordinate with the fifteen rows of fuel rods lettered A through R, and the "X" coordinate designated in a similar manner). In the "Z" direction the core is divided into 61 axial points starting from the top of the core.

* F_Q^T includes a total uncertainty of 1.08.⁴

** $F_{\Delta H}^N$ including a measurement uncertainty of 1.04.

⁺ F_{xy} is evaluated at the midplane of the core.

^xQPTR - Quadrant Power Tilt Ratio.

^{xx}Map 2 was aborted.

Table 5.2

SURREY UNIT 1 - CYCLE 5 BOL PHYSICS TESTS

COMPARISON OF MEASURED POWER DISTRIBUTION PARAMETERS WITH THEIR TECHNICAL SPECIFICATIONS LIMIT

Map	$F_{\Delta H}^N$ Hot Channel Factor ^a			$F_{\Delta H}^N$ LOCA Hot Channel Factor ^a ASSY			$F_{\Delta H}^N$ LOCA Hot Channel Factor ^a ROD			F_Q^T Hot Channel Factor ^b			Quadrant Power Tilt Ratio	
	Measured	Limit	Margin (%)	Measured	Limit	Margin (%)	Measured	Limit	Margin (%)	Measured	Limit	Minimum Margin (%)	Measured	Nominal ^c Limit
1	1.55	1.75	11.4	1.33	>50.00	>97.3	1.56	>50.00	>96.9	2.40	3.77	36.3	1.014	1.020
3 ^d	1.68	1.74	3.4	1.51	34.50	95.6	1.69	36.25	95.3	2.57	3.78	32.0	1.013	1.020
4	1.44	1.61	10.6	1.31	2.76	52.5	1.46	2.90	49.7	1.99	3.80	47.6	1.002	1.020
5	1.43	1.61	11.2	1.31	2.76	52.5	1.44	2.90	50.3	2.04	3.88	47.4	1.004	1.020
6	1.47	1.58	7.0	1.31	2.42	45.9	1.47	2.54	42.1	2.16	3.40	36.5	1.007	1.020
7	1.43	1.56	8.3	1.30	2.06	36.9	1.44	2.16	33.3	1.90	2.84	33.1	1.004	1.020
8	1.41	1.49	5.4	1.29	1.57	17.8	1.43	1.65	13.3	1.80	2.21	18.6	1.007	1.020
9	1.42	1.47	3.4	1.30	1.41	7.8	1.43	1.48	3.4	1.84	1.98	7.1	1.007	1.020
10	1.42	1.46	2.7	1.29	1.39	7.2	1.43	1.46	2.1	1.84	1.95	5.6	1.007	1.020

^aThe measured values for the enthalpy rise hot channel factors, $F_{\Delta H}^N$, $F_{\Delta H}^N$ | LOCA, and $F_{\Delta H}^N$ | LOCA, include 4% measurement uncertainty. The limit on $F_{\Delta H}^N$ includes the maximum penalty associated with the interim thimble cell rod bow penalty which is 6%.

^bThe Technical Specifications limit for the heat flux hot channel factor, Factor, F_Q^T , is a function of core height. The value for F_Q^T listed above is the maximum value of F_Q^T in the core. The Technical Specifications limit listed above is evaluated at the plane of maximum F_Q^T . The minimum margin values listed above are the minimum percent difference between the measured values of $F_Q^T(z)$ and the Technical Specifications limit for each map. All measured F_Q^T hot channel factors include 8% total uncertainty.

^cThis is the full-power operating limit for normal operation. The limit does not apply during physics testing.

^dMap 2 was aborted.

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

H2P, ARO

PREDICTED	0.43	0.63	0.43	PREDICTED		
MEASURED	0.41	0.77	0.41	MEASURED		
PCT DIFFERENCE	-3.3	-3.3	-0.9	PCT DIFFERENCE		
0.40	1.00	1.14	1.15	1.14	1.00	0.40
0.40	0.99	1.12	1.12	1.11	0.98	0.39
-1.2	-0.8	-1.8	-2.3	-2.7	-2.3	-2.3
0.41	1.02	1.12	1.27	1.05	1.27	1.12
0.40	1.01	1.11	1.26	1.05	1.26	1.10
-1.2	-1.2	-0.9	-0.7	-0.1	-1.0	-1.8
0.43	0.92	1.20	1.26	1.18	1.04	1.13
0.40	0.91	1.19	1.27	1.20	1.03	1.13
-1.9	-0.3	-0.6	1.0	1.4	0.8	-0.6
0.40	1.02	1.10	1.14	0.99	1.14	1.20
0.39	1.00	1.21	1.17	1.01	1.20	1.18
-1.9	-1.9	0.4	2.1	2.3	3.7	2.1
1.00	1.12	1.26	0.99	1.17	1.10	1.12
0.99	1.11	1.27	1.01	1.20	1.12	1.14
-1.3	-1.3	0.7	2.2	2.6	2.5	1.8
0.43	1.14	1.27	1.13	1.16	1.10	1.08
0.41	1.12	1.26	1.18	1.19	1.12	1.10
-4.2	-1.8	-0.8	-0.0	2.1	1.6	1.6
0.40	1.15	1.05	1.04	1.15	1.12	1.04
0.76	1.13	1.04	1.03	1.15	1.13	1.03
-4.2	-2.2	-1.0	-0.6	0.3	1.0	1.7
0.43	1.14	1.27	1.18	1.16	1.10	1.08
0.41	1.12	1.27	1.18	1.16	1.10	1.10
-4.2	-1.5	-0.1	0.1	0.3	0.3	1.7
1.00	1.12	1.26	0.99	1.17	1.10	1.12
1.01	1.13	1.27	1.00	1.19	1.11	1.13
0.8	0.8	1.0	1.1	1.1	0.8	0.8
0.40	1.02	1.20	1.14	0.99	1.16	1.15
0.41	1.04	1.22	1.17	0.99	1.15	1.16
1.8	1.8	1.8	2.0	0.4	-0.6	0.6
0.41	0.92	1.20	1.26	1.18	1.04	1.18
0.42	0.94	1.22	1.25	1.16	1.03	1.16
2.7	2.4	2.0	-0.4	-1.7	-1.1	-0.1
0.41	1.02	1.12	1.27	1.05	1.27	1.12
0.43	1.11	1.16	1.24	1.02	1.21	1.07
5.5	6.3	3.2	-2.1	-2.5	-4.3	-4.9
0.40	1.00	1.14	1.15	1.14	1.00	0.40
0.43	1.03	1.17	1.13	1.08	0.95	0.38
8.3	7.3	2.6	-1.6	-5.4	-5.3	-4.7
STANDARD	0.43	0.63	0.43	AVERAGE		
DEVIATION	0.45	0.81	0.40	PCT DIFFERENCE		
=0.021	5.8	1.2	-5.8	= 1.8		

MAP NO: SL-5-1

DATE: 7/7/78

POWER = 0%

CONTROL ROD POSITIONS:

 $F_{\Delta H}^N = 1.545$

QPTR:

D BANK AT 218 STEPS

 $F_Q^T = 2.400$

NW - 1.001

C BANK AT 228 STEPS

 $\bar{F}_z = 1.497$

NE - 1.002

A.O = 27.357

SW - 1.014

BURNUP = 0 MWD/MTU

SE - 0.983

SURREY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

HZP, D-BANK IN

P	N	M	L	K	J	H	G	F	E	D	C	B	A
PREDICTED													
MEASURED													
PCT DIFFERENCE													
0.32	0.49	0.32											
0.32	0.50	0.32											
2.0	2.0	0.9											
0.47	1.06	0.95	0.50	0.95	1.06	0.47							
0.48	1.08	0.97	0.51	0.95	1.06	0.48							
2.5	1.4	1.7	1.0	0.3	-0.6	1.1							
0.52	1.23	1.26	1.26	0.94	1.26	1.23	0.52						
0.53	1.25	1.26	1.28	0.95	1.27	1.26	0.54						
2.2	1.0	0.6	1.3	1.0	0.2	0.1	1.7	3.8					
0.52	1.14	1.43	1.42	1.26	1.09	1.26	1.42	1.43	1.14	0.52			
0.52	1.15	1.43	1.43	1.27	1.10	1.27	1.43	1.44	1.15	0.52			
0.1	0.6	-0.0	0.5	0.7	0.6	0.8	1.0	0.9	0.7	1.4			
0.47	1.23	1.43	1.25	0.95	1.16	1.20	1.16	0.95	1.25	1.43	1.23	0.47	
0.46	1.22	1.44	1.27	0.97	1.17	1.21	1.19	0.93	1.27	1.40	1.24	0.49	
-1.4	-1.4	0.8	1.7	1.3	0.3	0.7	2.1	2.6	1.2	-2.4	0.2	3.4	
1.06	1.26	1.42	0.95	0.60	0.98	1.12	0.93	0.60	0.95	1.42	1.26	1.06	
1.06	1.25	1.44	1.00	0.62	0.99	1.13	1.01	0.63	0.97	1.40	1.26	1.08	
-0.8	-0.8	1.6	4.3	2.4	1.1	1.4	3.2	4.8	1.9	-1.3	-0.0	1.5	
0.32	0.95	1.26	1.26	1.16	0.98	1.04	1.05	1.04	0.93	1.16	1.26	1.26	0.32
0.31	0.95	1.26	1.28	1.22	1.01	1.06	1.07	1.06	1.00	1.19	1.26	1.27	0.32
-0.5	-0.2	-0.2	1.3	4.8	3.1	1.9	2.0	2.6	2.6	0.5	-0.5	0.2	-0.2
0.49	0.50	0.94	1.09	1.20	1.12	1.05	1.04	1.05	1.12	1.23	1.09	0.94	0.49
0.49	0.50	0.94	1.09	1.19	1.13	1.07	1.06	1.06	1.12	1.21	1.06	0.95	0.51
-0.5	-0.2	0.2	-0.2	-0.7	0.6	1.9	2.3	1.3	0.2	0.4	-3.3	0.5	1.4
0.32	0.95	1.26	1.26	1.16	0.98	1.04	1.05	1.04	0.93	1.16	1.26	1.26	0.32
0.31	0.95	1.27	1.26	1.16	0.97	1.03	1.02	1.03	0.99	1.16	1.22	1.24	0.33
-0.5	0.1	0.4	-0.1	-0.7	-0.7	1.9	-2.3	0.8	1.2	-0.4	-5.5	-1.5	1.5
1.06	1.26	1.42	0.95	0.60	0.93	1.12	0.93	0.60	0.95	1.42	1.26	1.06	
1.07	1.26	1.41	0.94	0.60	0.96	1.09	0.97	0.60	0.94	1.37	1.22	1.05	
0.5	0.5	-0.6	-1.4	-1.4	-2.3	-2.3	-0.4	-0.2	-2.0	-3.2	-2.9	-1.7	
0.47	1.23	1.43	1.25	0.95	1.16	1.20	1.16	0.95	1.25	1.43	1.23	0.47	
0.47	1.24	1.43	1.23	0.94	1.15	1.18	1.14	0.93	1.22	1.40	1.21	0.48	
0.9	0.9	-0.4	-2.0	-1.6	-1.6	-2.1	-2.3	-2.9	-3.0	-2.5	-1.8	-1.3	
0.52	1.14	1.43	1.42	1.26	1.09	1.26	1.42	1.43	1.14	0.52			
0.52	1.14	1.40	1.40	1.25	1.07	1.23	1.39	1.39	1.11	0.52			
1.2	-0.1	-2.0	-1.4	-1.3	-2.2	-2.4	-2.2	-2.7	-2.7	-0.0			
0.52	1.23	1.26	1.26	0.94	1.26	1.26	1.23	0.52					
0.52	1.26	1.26	1.04	0.91	1.23	1.23	1.21	0.51					
1.8	2.4	0.7	-2.1	-3.1	-2.8	-1.9	-2.3	-1.7					
0.47	1.06	0.95	0.50	0.95	1.06	0.47							
0.48	1.09	0.95	0.49	0.92	1.04	0.48							
2.4	2.4	0.2	-2.0	-5.3	-2.6	-1.7							
STANDARD													
DEVIATION													
=0.019													
0.32	0.49	0.32											
0.32	0.49	0.31											
2.4	0.1	-3.5											
AVERAGE													
PCT DIFFERENCE													
= 1.5													

MAP NO: S1-5-3

DATE: 7/7/78

POWER = 4%

CONTROL ROD POSITIONS:

 $F_{\Delta H}^N = 1.684$

QPTR:

D BANK AT 0 STEPS

 $F_Q^T = 2.570$

NW - 1.013

C BANK AT 219 STEPS

 $\bar{F}_Z = 1.463$

NE - 1.008

A.O. = 22.681

SW - 1.000

BURNUP = 0 MWD/MTU

SE - 0.979

I/E CALIBRATION - APDM FLUX MAP

MAP NO: S1-5-4

POWER = 50%

$$F_{\Delta H}^N = 1.442$$

OPTR:

$$F_Q^T = 1.994$$

NW - 0.998

$$\overline{F}_2 = 1.315$$

NE - 1.001

SW - 1.002

SE - 0.999

Figure 5.4

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

I/E CALIBRATION - APDM FLUX MAP

P	N	H	L	R	J	H	G	F	E	D	C	B	A
PREDICTED													
MEASURED													
PCT DIFFERENCE													
0.43	0.78	0.43											
0.42	0.77	0.42											
-1.3	-1.4	-1.5											
0.41	1.00	1.12	1.09	1.12	1.09	0.41							
0.42	1.00	1.11	1.05	1.10	0.93	0.42							
2.7	-0.5	-0.8	-1.0	-1.6	-1.9	0.6							
0.43	1.03	1.12	1.25	1.04	1.25	1.12	1.03	0.43					
0.44	1.04	1.11	1.24	1.04	1.24	1.11	1.05	0.44					
2.4	1.2	-0.4	-0.4	0.2	-0.4	-1.1	1.4	4.6					
0.43	0.93	1.20	1.25	1.18	1.05	1.18	1.25	1.20	0.93	0.43			
0.43	0.94	1.21	1.25	1.18	1.05	1.19	1.26	1.23	0.95	0.44			
1.3	1.3	0.3	-0.0	-0.4	0.6	0.4	0.1	1.7	2.4	3.0			
0.41	1.03	1.20	1.15	0.99	1.16	1.16	1.16	0.99	1.15	1.20	1.03	0.41	
0.41	1.04	1.22	1.17	1.00	1.15	1.16	1.16	1.00	1.17	1.21	1.05	0.43	
0.5	0.5	1.1	2.0	0.5	-1.2	-0.0	-0.2	0.2	1.8	0.4	2.2	4.4	
1.00	1.12	1.25	0.99	1.14	1.10	1.13	1.10	1.14	0.99	1.25	1.12	1.00	
1.01	1.12	1.27	1.01	1.15	1.10	1.14	1.10	1.11	1.00	1.27	1.13	1.02	
0.3	0.3	1.2	1.7	0.8	-0.0	0.4	-0.4	-2.1	0.3	1.1	1.1	1.6	
0.43	1.12	1.25	1.18	1.16	1.10	1.09	1.06	1.09	1.10	1.16	1.12	0.43	
0.42	1.12	1.25	1.19	1.18	1.12	1.11	1.06	1.10	1.09	1.15	1.16	1.24	1.11
-1.9	-0.1	0.3	0.9	1.6	1.3	1.1	0.8	0.3	-0.5	-0.9	-1.4	-0.8	-1.2
0.78	1.09	1.04	1.05	1.16	1.13	1.06	1.03	1.06	1.13	1.16	1.05	1.04	0.78
0.77	1.09	1.05	1.05	1.16	1.13	1.07	1.04	1.06	1.13	1.17	1.03	1.04	0.79
-2.0	-0.2	1.1	0.4	-0.7	0.3	1.3	1.0	0.4	0.2	0.3	-1.5	-0.6	-0.3
0.43	1.12	1.25	1.18	1.16	1.10	1.09	1.06	1.09	1.10	1.16	1.12	0.43	
0.42	1.12	1.25	1.19	1.16	1.09	1.11	1.04	1.10	1.10	1.16	1.16	1.24	1.13
-1.9	0.2	1.2	0.4	-0.7	-0.6	1.2	-1.5	0.4	0.4	-0.2	-1.5	-0.8	1.3
1.00	1.12	1.25	0.99	1.14	1.10	1.13	1.10	1.14	0.99	1.25	1.12	1.00	
1.01	1.13	1.26	0.99	1.13	1.08	1.11	1.09	1.14	0.99	1.24	1.10	1.00	
1.0	1.0	0.0	-0.8	-1.0	-1.7	-1.6	-0.6	0.2	-0.5	-1.4	-1.4	-0.5	
0.41	1.03	1.20	1.15	0.99	1.16	1.16	1.16	0.99	1.15	1.20	1.03	0.41	
0.42	1.06	1.22	1.14	0.99	1.16	1.15	1.15	0.99	1.15	1.21	1.04	0.42	
2.6	2.6	1.2	-0.9	-0.1	-0.3	-1.3	-1.6	-0.0	-0.3	0.1	0.7	1.0	
0.43	0.93	1.20	1.25	1.18	1.05	1.18	1.25	1.20	0.93	0.43			
0.44	0.95	1.19	1.26	1.19	1.04	1.17	1.25	1.20	0.93	0.44			
4.6	2.5	-0.9	0.3	0.5	-0.9	-1.3	-0.2	-0.5	-0.2	3.8			
0.43	1.03	1.12	1.25	1.04	1.25	1.12	1.03	0.43					
0.44	1.05	1.13	1.24	1.02	1.23	1.11	1.03	0.43					
3.2	1.3	1.4	-0.6	-1.8	-1.2	-0.4	-0.6	1.2					
0.41	1.00	1.12	1.09	1.12	1.00	0.41							
0.42	1.02	1.13	1.05	1.10	0.99	0.41							
1.3	2.2	0.7	-0.7	-1.3	-0.8	-0.3							
STANDARD													
DEVIATION													
#0.012													
0.43	0.78	0.43											
0.44	0.79	0.42											
2.6	1.1	-1.3											
AVERAGE													
PCT DIFFERENCE													
# 1.1													

MAP NO: S1-5-5

DATE: 7/9/78

POWER = 50%

CONTROL ROD POSITIONS:

 $F_N = 1.434$

QPTR:

D BANK AT 185 STEPS

 $F_Q^T = 2.037$

NW - 1.002

C BANK AT 228 STEPS

 $\bar{F}_Z = 1.321$

NE - 1.001

A.O. = -2.006

SW - 1.004

BURNUP = 0 MWD/MTU

SE - 0.993

Figure 5.5

SURREY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

I/E CALIBRATION - APDM FLUX MAP

P	N	M	L	K	J	H	G	F	E	D	C	B	A
PREDICTED													
MEASURED													
PCT DIFFERENCE													
0.42	0.77	0.42											
0.42	0.76	0.42											
-1.2	-1.2	-1.2											
0.42	1.01	1.11	1.06	1.11	1.01	0.42							
0.44	0.98	1.09	1.04	1.10	0.99	0.42							
5.0	-2.6	-2.0	-1.8	-1.2	-1.3	1.6							
0.43	1.04	1.13	1.25	1.04	1.25	1.13	1.04	0.43					
0.45	1.05	1.10	1.22	1.02	1.23	1.11	1.06	0.46					
4.4	2.0	-1.9	-2.4	-1.8	-1.2	-1.3	2.0	6.3					
0.43	0.99	1.22	1.26	1.19	1.05	1.19	1.26	1.22	0.94	0.43			
0.44	0.95	1.21	1.25	1.17	1.04	1.17	1.25	1.23	0.96	0.45			
1.1	1.1	-0.2	-0.9	-1.5	-1.1	-1.1	-1.0	0.9	2.3	4.0			
0.42	1.04	1.22	1.16	0.99	1.17	1.17	1.17	0.99	1.16	1.22	1.04	0.42	
0.41	1.03	1.22	1.16	0.99	1.16	1.16	1.16	0.99	1.16	1.21	1.07	0.41	
-1.3	-1.3	0.1	0.0	0.3	-0.8	-0.5	-0.6	-0.5	0.1	-0.2	3.0	6.2	
1.01	1.23	1.26	0.99	1.11	1.09	1.13	1.09	1.11	0.99	1.26	1.13	1.01	
1.00	1.11	1.27	1.01	1.12	1.10	1.14	1.10	1.10	0.99	1.26	1.14	1.03	
-1.1	-1.1	0.4	2.0	0.8	0.1	0.4	0.3	-1.0	-0.1	-0.0	1.6	2.5	
0.42	1.11	1.25	1.19	1.17	1.09	1.09	1.06	1.09	1.09	1.17	1.19	1.25	1.11
0.62	1.10	1.24	1.19	1.11	1.13	1.07	1.10	1.09	1.15	1.17	1.23	1.09	0.41
-3.9	-0.9	-0.9	-0.1	2.2	1.5	1.1	1.0	1.0	-0.3	-1.0	-1.4	-1.7	-1.5
0.77	1.06	1.04	1.05	1.17	1.13	1.06	1.03	1.06	1.13	1.17	1.05	1.04	0.77
0.76	1.04	1.03	1.04	1.16	1.13	1.07	1.04	1.06	1.12	1.16	1.03	1.04	0.77
-1.0	-1.0	-1.1	-1.0	-0.8	0.2	1.2	1.4	0.3	-0.9	-0.4	-1.6	-1.9	-1.8
0.42	1.11	1.25	1.19	1.17	1.09	1.09	1.06	1.09	1.09	1.17	1.19	1.25	1.11
0.42	1.11	1.25	1.18	1.16	1.09	1.10	1.04	1.09	1.10	1.16	1.17	1.24	1.13
-0.9	-0.2	0.0	-0.3	-0.8	-0.6	1.1	-1.5	0.1	0.6	-0.4	-1.6	-1.0	1.7
1.31	1.13	1.26	0.99	1.11	1.09	1.13	1.09	1.11	0.99	1.26	1.13	1.01	
1.03	1.14	1.26	0.98	1.10	1.03	1.11	1.09	1.11	0.99	1.24	1.12	1.02	
1.2	1.1	-0.0	-0.9	-1.0	-1.6	-1.5	-0.2	0.3	-0.6	-1.5	-0.5	1.2	
0.42	1.04	1.22	1.16	0.99	1.17	1.17	1.17	0.99	1.16	1.22	1.04	0.42	
0.43	1.05	1.23	1.14	0.99	1.16	1.15	1.15	0.99	1.15	1.23	1.05	0.43	
3.3	3.3	1.4	-1.1	-0.4	-0.5	-1.3	-1.5	-0.7	-0.7	0.3	1.4	2.1	
0.43	0.99	1.22	1.26	1.19	1.05	1.19	1.26	1.22	0.94	0.43			
0.45	0.97	1.20	1.26	1.19	1.04	1.17	1.25	1.21	0.95	0.45			
5.4	2.9	-1.1	-0.1	-0.0	-1.3	-1.7	-0.6	-0.3	1.1	4.0			
0.43	1.04	1.13	1.25	1.04	1.25	1.13	1.04	0.43					
0.45	1.10	1.16	1.23	1.01	1.22	1.11	1.04	0.44					
5.4	5.5	3.0	-1.2	-2.6	-2.0	-1.0	-0.3	2.2					
0.42	1.01	1.11	1.06	1.11	1.01	0.42							
0.44	1.06	1.13	1.05	1.08	0.99	0.41							
5.5	5.3	1.6	-1.0	-2.3	-1.6	-0.9							
STANDARD													
DEVIATION													
=0.016													
0.42	0.77	0.42											
0.44	0.78	0.41											
4.5	1.8	-2.4											
AVERAGE													
PCT DIFFERENCE													
= 1.5													

MAP NO: S1-5-6

DATE: 7/10/78

POWER = 57%

CONTROL ROD POSITIONS:

 $F_{\Delta H}^N = 1.465$

QPTR:

D BANK AT 162 STEPS

 $F_Q^T = 2.163$

NW - 0.992

C BANK AT 228 STEPS

 $\bar{F}_z = 1.385$

NE - 1.007

A.O. = -16.953

SW - 1.004

BURNUP = 0 MWD/MTU

SE - 0.997

I/E CALIBRATION - APDM FLUX MAP

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Figure 5.7

SURREY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

I/E CALIBRATION - APDM FLUX MAP

P	N	M	L	K	J	H	G	F	E	D	C	B	A
PREDICTED													
MEASURED													
PCT DIFFERENCE													
0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
0.42	0.97	1.10	1.12	1.10	0.97	0.42							
0.43	0.95	1.08	1.10	1.09	0.93	0.43							
2.5	-1.7	-1.7	-1.6	-0.4	0.3	1.5							
0.43	1.00	1.03	1.03	1.05	1.03	1.03	1.03	0.43					
0.44	1.01	1.05	1.05	1.03	1.01	1.07	1.01	0.45					
2.2	1.2	-1.1	-1.7	-1.0	-1.2	-0.9	0.9	3.2					
0.43	0.92	1.16	1.23	1.16	1.06	1.16	1.03	1.16	0.92	0.43			
0.43	0.92	1.16	1.23	1.15	1.04	1.14	1.21	1.16	0.93	0.44			
0.8	0.7	0.1	-0.6	-1.4	-1.7	-2.0	-2.0	0.0	1.5	2.6			
0.42	1.00	1.16	1.15	1.03	1.19	1.12	1.19	1.03	1.15	1.16	1.03	0.42	
0.41	0.99	1.16	1.16	1.03	1.18	1.17	1.17	1.02	1.15	1.17	1.02	0.43	
-0.3	-0.3	0.1	0.2	-0.0	-0.8	-1.0	-1.5	-1.4	-0.7	1.0	2.3	3.3	
0.97	1.03	1.23	1.03	1.01	1.13	1.16	1.13	1.21	1.03	1.23	1.03	0.97	
0.97	1.07	1.23	1.04	1.22	1.12	1.15	1.13	1.20	1.03	1.24	1.10	0.99	
-0.5	-0.5	0.1	0.3	0.2	-0.7	-0.5	-0.3	-1.1	-0.4	0.5	1.8	2.1	
0.44	1.10	1.23	1.16	1.19	1.13	1.13	1.08	1.13	1.13	1.19	1.16	1.23	1.10
0.44	1.09	1.22	1.16	1.20	1.14	1.12	1.08	1.13	1.13	1.17	1.17	1.22	1.10
-1.1	-1.0	-0.8	-0.4	0.9	0.9	-0.6	0.2	0.6	-0.1	-1.2	0.6	-0.5	0.1
0.60	1.12	1.05	1.05	1.16	1.16	1.08	1.05	1.08	1.16	1.13	1.03	1.05	1.12
0.60	1.11	1.04	1.04	1.16	1.14	1.09	1.07	1.10	1.13	1.21	1.04	1.24	1.10
-1.1	-1.1	-1.2	-1.2	-1.6	-1.6	1.0	1.0	1.5	1.3	2.3	-1.0	-1.3	-1.6
0.44	1.10	1.23	1.16	1.19	1.13	1.13	1.08	1.13	1.13	1.19	1.16	1.23	1.10
0.44	1.10	1.24	1.16	1.17	1.11	1.11	1.06	1.15	1.15	1.20	1.15	1.21	1.10
-1.1	0.3	0.9	-0.2	-1.6	-1.6	-1.7	-1.7	2.3	2.3	1.0	-1.0	-1.3	0.7
0.97	1.03	1.23	1.03	1.21	1.13	1.16	1.13	1.21	1.03	1.23	1.03	0.97	
1.00	1.11	1.24	1.02	1.20	1.11	1.14	1.13	1.23	1.03	1.23	1.07	0.97	
3.1	3.1	0.6	-1.3	-1.3	-1.7	-1.7	0.3	1.1	-0.1	-1.0	-0.7	0.3	
0.42	1.00	1.16	1.13	1.03	1.19	1.16	1.19	1.03	1.15	1.16	1.03	0.42	
0.43	1.02	1.17	1.14	1.03	1.19	1.17	1.17	1.02	1.14	1.16	1.03	0.42	
2.6	2.6	1.0	-1.0	-0.0	-0.0	-1.3	-1.7	-0.6	-0.9	-0.5	0.0	0.4	
0.43	0.92	1.16	1.23	1.16	1.06	1.16	1.03	1.16	0.92	0.43			
0.44	0.92	1.15	1.24	1.17	1.04	1.14	1.03	1.15	0.91	0.44			
2.1	0.8	-1.0	0.6	0.9	-1.2	-1.8	-0.4	-0.8	-0.7	1.2			
0.43	1.02	1.03	1.23	1.05	1.23	1.05	1.20	0.43					
0.44	1.03	1.10	1.01	1.02	1.20	1.07	0.99	0.43					
2.6	3.0	2.3	-0.9	-2.8	-1.7	-0.3	-0.5	-0.0					
0.42	0.97	1.10	1.12	1.10	0.97	0.42							
0.43	1.00	1.10	1.11	1.08	0.96	0.41							
3.0	3.1	0.5	-1.1	-1.4	-0.6	-0.2							
STANDARD													
DEVIATION													
0.013													
0.44	0.80	0.44											
0.46	0.81	0.44											
3.1	1.4	-1.3											
AVERAGE													
PCT DIFFERENCE													
= 1.2													

MAP NO: S1-5-8

DATE: 7/10/78

POWER = 88%

CONTROL ROD POSITIONS:

 $F_{\Delta H}^N = 1.408$

QPTR:

D BANK AT 218 STEPS

 $F_Q^T = 1.798$

NW - 0.996

C BANK AT 228 STEPS

 $\bar{F}_Z = 1.213$

NE - 1.000

A.O. = 4.043

SW - 1.007

BURNUP = 0 MWD/MTU

SE - 0.997

Figure 5.8

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

I/E CALIBRATION - APDM FLUX MAP

R P N H L K J H G F E D C B A														
PREDICTED													PREDICTED	
MEASURED													MEASURED	
PCT DIFFERENCE													PCT DIFFERENCE	
0.44	0.81	0.44											0.44	0.81
0.44	0.79	0.44											0.44	0.79
-1.6	-1.6	-1.3											-1.6	-1.6
0.41	0.97	1.10	1.12	1.10	0.97	0.41							0.41	0.97
0.42	0.98	1.09	1.11	1.09	0.98	0.42							0.42	0.98
2.2	-0.8	-1.1	-1.3	-1.1	-0.8	1.1							2.2	-0.8
0.43	1.00	1.08	1.23	1.05	1.23	1.08	1.00	0.43					0.43	1.00
0.44	1.01	1.07	1.22	1.05	1.21	1.06	1.01	0.45					0.44	1.01
2.0	1.2	-0.4	-0.8	-0.8	-0.9	-1.0	1.1	3.9					2.0	1.2
0.43	0.91	1.16	1.23	1.16	1.06	1.16	1.23	1.16	0.91	0.43			0.43	0.91
0.44	0.92	1.17	1.23	1.15	1.05	1.15	1.22	1.17	0.93	0.44			0.44	0.92
2.2	1.0	0.4	-0.4	-1.1	-0.8	-1.0	-1.1	0.4	1.4	2.8			2.2	1.0
0.41	1.00	1.16	1.15	1.03	1.19	1.13	1.19	1.03	1.15	1.16	1.00	0.41	0.41	1.00
0.41	1.00	1.17	1.16	1.03	1.17	1.17	1.17	1.03	1.15	1.16	1.00	0.43	0.41	1.00
-0.7	0.4	0.4	0.4	-0.2	-1.6	-1.2	-0.9	-0.7	-0.1	-0.2	2.3	4.7	-0.7	0.4
0.97	1.08	1.23	1.03	1.22	1.13	1.16	1.13	1.22	1.03	1.23	1.08	0.97	0.97	1.08
0.98	1.07	1.23	1.04	1.22	1.11	1.15	1.13	1.21	1.03	1.23	1.09	0.99	0.98	1.07
-0.7	-0.7	0.2	0.7	-0.0	-1.7	-0.3	0.1	-0.6	-0.3	-0.1	1.3	2.1	-0.7	-0.7
0.44	1.10	1.23	1.16	1.19	1.13	1.13	1.08	1.13	1.13	1.19	1.16	1.23	1.10	0.44
0.44	1.09	1.22	1.16	1.19	1.14	1.14	1.09	1.13	1.13	1.17	1.16	1.21	1.09	0.44
0.1	-0.5	-0.7	-0.3	0.7	0.7	1.0	1.0	0.8	-0.4	-1.1	-0.5	-1.1	-0.7	-1.1
0.81	1.12	1.05	1.06	1.18	1.16	1.08	1.06	1.03	1.16	1.18	1.06	1.05	1.12	0.81
0.81	1.12	1.05	1.05	1.17	1.14	1.09	1.07	1.03	1.15	1.18	1.04	1.11	0.81	0.81
0.1	-0.4	-0.6	-0.6	-1.0	-1.0	1.0	1.0	0.3	-0.7	-0.1	-1.8	-1.4	-1.2	0.3
0.44	1.10	1.23	1.16	1.19	1.13	1.13	1.08	1.13	1.13	1.19	1.16	1.23	1.10	0.44
0.44	1.11	1.24	1.17	1.17	1.12	1.11	1.05	1.13	1.15	1.19	1.14	1.21	1.11	0.44
0.1	0.4	1.2	0.3	-1.0	-1.0	-1.0	-2.3	0.7	1.5	-0.9	-1.8	-1.0	1.1	3.6
0.97	1.08	1.23	1.03	1.22	1.13	1.16	1.13	1.22	1.03	1.23	1.08	0.97	0.97	1.08
1.00	1.11	1.24	1.02	1.20	1.10	1.13	1.13	1.22	1.02	1.21	1.07	0.98	1.00	1.11
3.1	3.1	0.6	-1.3	-1.3	-2.3	-2.3	-0.2	0.6	-0.8	-1.7	-0.5	1.2	3.1	3.1
0.41	1.00	1.16	1.15	1.03	1.19	1.13	1.19	1.03	1.15	1.16	1.00	0.41	0.41	1.00
0.43	1.02	1.17	1.13	1.03	1.13	1.16	1.16	1.03	1.14	1.16	1.01	0.42	0.43	1.02
3.0	3.0	1.0	-1.6	-0.5	-0.5	-2.0	-2.3	-1.5	-1.4	-0.1	1.3	2.1	3.0	3.0
0.43	0.91	1.16	1.23	1.16	1.06	1.16	1.23	1.16	0.91	0.43			0.43	0.91
0.44	0.92	1.14	1.23	1.17	1.04	1.15	1.24	1.16	0.92	0.45			0.44	0.92
2.8	1.1	-2.6	0.1	0.5	-1.4	-1.1	0.8	0.2	0.8	3.4			2.8	1.1
0.43	1.00	1.08	1.23	1.05	1.23	1.08	1.00	0.43					0.43	1.00
0.44	1.03	1.10	1.21	1.03	1.22	1.10	1.01	0.44					0.44	1.03
3.1	3.4	2.3	-1.0	-2.6	-0.7	2.0	1.7	1.9					3.1	3.4
0.41	0.97	1.10	1.12	1.10	0.97	0.41							0.41	0.97
0.43	1.01	1.11	1.12	1.09	0.98	0.42							0.43	1.01
3.4	3.6	1.1	-0.7	-1.0	0.6	2.4							3.4	3.6
STANDARD													AVERAGE	
DEVIATION													PCT DIFFERENCE	
=0.015													= 1.2	

MAP NO: S1-5-9

DATE: 7/11/78

POWER = 98%

CONTROL ROD POSITIONS:

 $F_{NH}^N = 1.415$

QPTR:

D BANK AT 224 STEPS

 $F_Q^T = 1.841$

NW - 0.998

C BANK AT 228 STEPS

 $\bar{F}_z = 1.220$

NE - 0.998

 $P_{THRESHOLD} = 98\%$

A.O. = -2.899

SW - 1.007

BURNUP = 0 MWD/MTU

SE - 0.997

SURRY UNIT 1 - CYCLE 5 BOL PHYSICS TEST

Figure 5.9

ASSEMBLYWISE POWER DISTRIBUTION

HFP, EQ. XENON

K P N H L R J H G F E D C B A														
PREDICTED					0.44 0.60 0.44					PREDICTED				
MEASURED					0.43 0.78 0.43					MEASURED				
PCT DIFFERENCE					-3.0 -3.1 -2.7					PCT DIFFERENCE				
0.42 0.97 1.10 1.12 1.10 0.97 0.42					0.43 0.97 1.08 1.10 1.07 0.95 0.42					2.9 -0.6 -1.5 -2.1 -2.5 -2.1 0.6				
0.44 1.01 1.07 1.22 1.05 1.22 1.06 1.01 0.43					2.6 1.5 -0.3 -0.5 -0.1 -0.7 -1.3 1.4 4.8					0.43 0.92 1.16 1.23 1.16 1.06 1.16 1.23 1.16 0.92 0.43				
0.44 0.92 1.17 1.23 1.16 1.06 1.16 1.23 1.17 0.93 0.44					1.1 1.0 0.4 -0.2 -0.4 0.2 0.0 -0.3 0.9 1.8 2.8					0.42 1.00 1.15 1.15 1.03 1.19 1.18 1.19 1.03 1.15 1.16 1.00 0.42				
0.42 1.00 1.17 1.16 1.03 1.18 1.18 1.19 1.03 1.15 1.16 1.01 0.43					-0.0 -0.0 0.4 0.5 0.0 -0.9 -0.2 -0.1 0.0 0.4 -0.4 1.8 4.1					0.97 1.08 1.23 1.03 1.21 1.13 1.18 1.13 1.21 1.03 1.23 1.05 0.97				
0.96 1.27 1.23 1.04 1.22 1.12 1.16 1.13 1.21 1.03 1.23 1.10 1.09					-0.9 -0.9 0.1 1.1 0.3 -0.5 -0.0 -0.2 -0.4 0.0 -0.0 1.7 2.9					0.44 1.10 1.23 1.16 1.19 1.13 1.13 1.03 1.13 1.13 1.19 1.16 1.23 1.10 0.44				
0.44 1.09 1.21 1.16 1.10 1.14 1.13 1.08 1.12 1.13 1.13 1.10 1.23 1.11 0.44					-0.9 -1.1 -1.5 -0.6 1.2 1.2 0.1 -0.1 -0.2 -0.4 -0.4 1.6 0.5 1.2 0.5					0.80 1.12 1.05 1.06 1.18 1.16 1.08 1.06 1.08 1.16 1.18 1.06 1.05 1.12 0.80				
0.80 1.11 1.05 1.05 1.17 1.15 1.03 1.03 1.08 1.16 1.16 1.04 1.05 1.12 0.80					-0.9 -0.9 -0.6 -0.9 -0.9 -0.2 -0.2 0.2 -0.1 0.5 -1.0 -0.1 -0.4 1.6					0.44 1.10 1.23 1.16 1.19 1.13 1.13 1.08 1.13 1.13 1.19 1.16 1.23 1.10 0.44				
0.44 1.10 1.23 1.16 1.18 1.12 1.12 1.08 1.14 1.15 1.19 1.14 1.21 1.11 0.44					-0.9 0.1 0.6 -0.1 -0.9 -0.9 -0.9 -1.9 1.0 1.6 0.2 -1.0 -1.1 1.0 3.5					0.97 1.08 1.23 1.03 1.21 1.13 1.16 1.13 1.21 1.03 1.23 1.08 0.97				
0.99 1.09 1.23 1.02 1.20 1.11 1.13 1.13 1.22 1.03 1.21 1.07 0.97					1.6 1.6 0.1 -1.0 -1.0 -1.9 -1.9 0.0 0.9 -0.5 -1.7 -1.1 0.2					0.42 1.00 1.16 1.15 1.03 1.19 1.10 1.19 1.03 1.15 1.16 1.00 0.42				
0.42 1.02 1.17 1.14 1.03 1.19 1.17 1.16 1.02 1.14 1.16 1.00 0.42					2.3 2.3 0.8 -1.2 0.0 0.0 -1.5 -1.9 -0.8 -0.9 -0.3 0.7 1.5					0.43 0.92 1.16 1.23 1.16 1.06 1.16 1.23 1.16 0.92 0.43				
0.44 0.93 1.15 1.24 1.18 1.05 1.15 1.24 1.16 0.91 0.45					3.1 1.4 -1.2 0.7 1.2 -0.7 -1.2 0.4 -0.5 -0.5 3.4					0.43 1.00 1.08 1.23 1.05 1.23 1.03 1.00 0.43				
0.44 1.03 1.10 1.22 1.03 1.21 1.09 1.00 0.43					3.2 3.2 2.6 -0.1 -1.8 -0.9 0.6 0.1 0.0					0.42 0.97 1.10 1.12 1.10 0.97 0.42				
0.43 1.01 1.12 1.12 1.08 0.97 0.42					3.2 3.7 1.8 -0.4 -1.4 -0.2 1.1					STANDARD DEVIATION = 0.012				
0.44 0.60 0.44					0.46 0.82 0.44					AVERAGE PCT DIFFERENCE = 1.1				
4.3 2.0 -1.5														

MAP NO: S1-5-10

DATE: 7/13/78

POWER = 100%

CONTROL ROD POSITIONS:

$$F_{\Delta H}^N = 1.416$$

QPTR:

D BANK AT 221 STEPS

$$F_Q^T = 1.838$$

NW - 1.000

C BANK AT 228 STEPS

$$\bar{F}_z = 1.218$$

NE - 1.001

$$A.O. = -1.477$$

SW - 1.007

$$BURNUP = 150 \text{ MWD/MTU}$$

SE - 0.992

POWER COEFFICIENT MEASUREMENT

The power coefficient measurement was performed by reducing/increasing reactor thermal power using the turbine control system to establish a constant rampdown/rampup rate of one percent power per minute. Positive/negative reactivity changes were compensated for via control bank D insertion/withdrawal in order to keep the RCS temperature within 0.5°F of the programmed reference RCS temperature (T_{ref} vs. %power). The worth of control bank D for each individual D bank movement was determined from the reactivity computer output traces, taking into consideration the dampening effect on the indicated value of reactivity due to doppler feedback.

The power coefficient measurement was performed over approximately a 10% power change starting at 100% power. The measurement was repeated during the ramp back up. An estimate of the change in reactivity due to the changing concentration of xenon was made based on design calculations¹ and a small correction term was applied to the measured reactivity values. The power coefficient was determined by dividing the xenon corrected reactivity change by the percent reactor thermal power change as determined from calculations based on calorimetric, NIS, and reactor coolant system data.

The predicted and measured values of the coefficient are compared in Table 6-1. As can be seen from this table and the Startup Physics Test Results and Evaluation Sheets in the Appendix, the measured value of the power coefficient was within 0.1 pcm/%pwr of the design value which is well within the design tolerance of ± 3.2 pcm/%pwr.

In summary, this result was satisfactory.

Table 6-1

SURRY UNIT 1-CYCLE 5 BOL PHYSICS TESTPOWER COEFFICIENT SUMMARY

Power Level (%)	Bank D Position (steps)	Measured Rod Worth (pcm)	Xenon Correction (pcm)	Δ pcm	Δ % pwr	Power Coefficient (pcm/% pwr)		
						Measured	Predicted*	Difference (M-P)
100.0-90.1	220-187	+86	+5.8	+91.8	-9.9	-9.3	-10.6	+1.3
90.6-98.9	187-225	-101	+4.2	-96.8	+8.3	-11.7	-10.6	-1.1
Ave. $\partial \rho / \partial \rho = -10.5$							-10.6	+0.1

* Based on design values contained in WCAP-9322.⁵

REFERENCES

1. J. G. Miller, S. A. Ahmed, R. T. Robins, and H. H. Barker, "Surry Unit No. 1, Cycle 5, Predictions for Startup and Core Follow", VEP-FRD-NFE-74, May, 1978.
2. "Westinghouse Reactivity Measurements System for the Surry Unit 1 Nuclear Power Station Utilizing a PC-12 Reactivity Computer", NSD Plant Data Files, Shop Order VPA-810.
3. W. Leggett, and L. Eisenhart, "The INCORE Code", WCAP-7149, December, 1967.
4. Surry Power Station Technical Specifications, Section 3.12.
5. J. W. Miller and P. G. Isaac, "The Nuclear Design and Core Management of the Surry Unit 1 Nuclear Power Station Cycle 5", WCAP-9322, June, 1978.

APPENDIX

STARTUP PHYSICS TEST RESULTS
AND EVALUATION SHEETS

SURREY POWER STATION UNIT 1 CYCLE 1 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Reactivity Computer Checkout Procedure Number / Section: PT28.11/App. B Sequence Step Number: 5		
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: * P/L: 228 RCCA: NA		RCS Temperature (°F): 547±2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating *At the first critical position
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 217-222 CD: 89-94 P/L: 226 RCCA: N/A		RCS Temperature (°F): 544-548 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
IV Test Results	Date/Time Test 7/6/78 Performed: 1434-1504		
	Measured Parameter (description)	ρ_c = Measured Reactivity using ρ_c -computer ρ_t = Inferred Reactivity from reactor period	
	Measured Value	$\rho_c = 14.0$ 24.4 46.0 $\rho_t = 14.5$ 24.6 47.5 $\Delta \rho = -3.44$ -0.8 -3.15	
	Design Value (Actual Conditions)	$\left \frac{\rho_c - \rho_t}{\rho_c} \right < .04$	
	Design Value (Design Conditions)	$\left \frac{\rho_c - \rho_t}{\rho_c} \right < .04$	
V Acceptance Criteria	Reference	NA	
	Accident Analysis Value	NA	
VI Comments	Reference	NA	
	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input type="checkbox"/> YES <input type="checkbox"/> NO N/A Maximum Allowable Reactivity Range: ±46 pcm.		

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Approved: L. J. Cushman

3000 ENG 2125, SURREY POWER STATION

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NFO Startup Engineer

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SUNNY POWER STATION UNIT 1 CYCLE 1 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Boron Endpoint Measurement - ARO Procedure Number / Section: PT28.11/APP.C Sequence Step Number: 6	
II Test Conditions (Desir .)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228 ⁺⁰ ₋₁₅ P/L: 228 RCCA: N/A	RCS Temperature (°F): 547 ⁺² ₋₂ Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 214 P/L: 226 RCCA: N/A	RCS Temperature (°F): 547.3 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
	Date/Time Test 7/6/77 Performed: 1900-2012	
IV Test Results	Measured Parameter (description)	(C _B) ARO , Critical Boron Concentration - ARO
	Measured Value	C _B = 1304 ppm
	Design Value (Actual Conditions)	C _B = 1321 ± 50 ppm
	Design Value (Design Conditions)	C _B = 1321 ± 50 ppm (D/228, 547.0°F)
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	$\left(\frac{\delta p}{\delta C_B}\right) \times C_B \leq 15,115 \text{ pcm}$
	Reference	FSAR Section 14.2.5
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO $\frac{\delta p}{\delta C_B} = -8.94 \text{ pcm/ppm (MEASURED)}$	

Performed By L. J. Gurfman
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Recommended for Approval by D. W. Linnell
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Isothermal Temperature Coefficient - ARO Procedure Number / Section: PT28.11/APP D Sequence Step Number: 7	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228 ⁺⁰ ₋₁₅ P/L: 228 RCCA: NA	RCS Temperature (°F): 544 ± 1 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating Observe Precautions in PT28.11
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 222/223 P/L: 228 RCCA: N/A	RCS Temperature (°F): 543.4 - 544.8 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	Date/Time Test 7/6/78 Performed: 2000 - 2236	
IV	Measured Parameter (description)	$\left(\frac{\partial \rho}{\partial T}\right)_{\text{ARO}}^{\text{ISO}}$, Isothermal Temperature Coefficient - ARO
	Measured Value	$\left(\frac{\partial \rho}{\partial T}\right)^{\text{ISO}} = -2.7 \text{ pcm}/^{\circ}\text{F}$
Test Results	Design Value (Actual Conditions)	$\left(\frac{\partial \rho}{\partial T}\right)^{\text{ISO}} = -3.7 \pm 3 \text{ pcm}/^{\circ}\text{F}$ (CB = 1311 ppm)
	Design Value (Design Conditions)	$\left(\frac{\partial \rho}{\partial T}\right)^{\text{ISO}} = -3.6 \pm 3.0 \text{ pcm}/^{\circ}\text{F}$ (D/228, 1321 ppm, 547.0°F)
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	$\left(\frac{\partial \rho}{\partial T}\right)^{\text{ISO}} \leq 0.96 \frac{\text{pcm}}{^{\circ}\text{F}}$ ISO($\delta \rho / \delta T$) = MOD ($\delta \rho / \delta T$) + DOPPLER ($\delta \rho / \delta T$) DOPPLER ($\delta \rho / \delta T$) = -2.0 $\frac{\text{pcm}}{^{\circ}\text{F}}$
	Reference	TS 3.1, VEP-FRD-NFE 74
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By

L. J. Gurlman
Surrey Test Engineer

Evaluated By

T. J. Hammett
NFO Startup Engineer

Approved:

J. J. Jensen

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Recommended for

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D. W. Linn
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SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - HZP, ARO Procedure Number / Section: PT28.2, OP-57		S1-5-1 Sequence Step Number: 9		
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228+0.5 P/L: 228 RCCA: N/A		RCS Temperature (°F): 547+0 Power Level (% F.P.): 0 -4 Other (specify): Must have ≥ 40 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 218 P/L: 226 RCCA: N/A		RCS Temperature (°F): ~547 Power Level (% F.P.): 0 Other (specify): 40 THIMBLES		
IV Test Results	Date/Time Test 7/7/78 Performed: 0113-0229				
	Measured Parameter (description)	MAX. REL. ASSY PWR. % DIFF. $\left(\frac{M-P}{P}\right)$	F _{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F _{TQ} , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	% DIFF = 9.3 P _{L13} = 1.11	1.545 K-14 LM	2.400 K-14 LM	1.0143
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	±10% for P ₁ ≥ .9 ±15% for P ₁ < .9 (P ₁ = ASSY. PWR.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	F ₂₈ = 1.55(1+2(1-P))xT(20)	F _Q (2) = 3.88 x K(2)	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO F _{NH} / LOCA AND F _{NH} / ASSY WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS. THE DATA FOR THIS MAP WAS TAKEN USING A NEW FLUX MAPPING TECHNIQUE DESIGNED SPECIFICALLY FOR USE AT VERY LOW POWER LEVELS. ALTHOUGH THE RESULTS OF THIS MAP ARE ACCEPTABLE, THE USUAL QUALITY OF THIS MAP IS BELOW THE QUALITY USUALLY EXPERIENCED USING CONVENTIONAL MAPPING TECHNIQUES				

Performed By L. J. Curfman
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Evaluated By C. J. Smith
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Approved: J. H. [Signature]
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Recommended for Approval by D. W. [Signature]
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 2 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Rod Worth Measurement - D Bank		
	Procedure Number / Section: PT28.11/App. E		Sequence Step Number: 10
II Test Conditions (Design)	Bank Positions (steps)		RCS Temperature (°F): 547 ^{±2} Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: NA	
III Test Conditions (Actual)	Bank Positions (steps)		RCS Temperature (°F): ~547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: NA	
IV	Date/Time Test 7/7/78 Performed: 0500-0625		
	Measured Parameter (description)	I _D : Integral Worth of Control Bank - D Bank	
	Measured Value	1207 pcm	
Test Results	Design Value (Actual Conditions)	1148 ± 175 pcm	
	Design Value (Design Conditions)	1188 ± 178 pcm	
	Reference	VEP-FRD-NFE 74	
V Acceptance Criteria	Accident Analysis Value	If Design Acceptance Criterion is exceeded, then assure adequate shutdown margin and/or evaluate other accidents, as necessary.	
	Reference	Letter from C. M. Stallings (Vepco) to E. G. Case (NRC) dated May 11, 1978 (Serial No. 272)	
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		

Performed By L. J. Gorman
Surrey Test Engineer

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Surrey Eng. Supv. Surrey Power Station.

Evaluated By J. A. [Signature]
NFO Startup Engineer

Recommended for Approval by D. W. [Signature]
NFO Supervisor

SURRY POWER STATION UNIT 1 CYCLE & STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Boron Endpoint Measurement - D Bank In			Sequence Step Number: //
II Test Conditions (Design)	Bank Positions (steps)			RCS Temperature (OF): 547±2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	SDA: 228 CB : 228 P/L: 228	SDB: 228 CC : 228 +0 RCCA: N/A	CA: 228 CD: 0+15 -0	
III Test Conditions (Actual)	Bank Positions (steps)			RCS Temperature (OF): 547.0 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
	SDA: 228 CB: 228 P/L: 226	SDB: 228 CC: 222 RCCA: N/A	CA: 228 CD: 0	
IV Test Results	Date/Time Test 7/7/78 Performed: 0845-1015			
	Measured Parameter (description)	(C _B) _D , Critical Boron Concentration - D Bank In		
	Measured Value	C _B = 1184 ppm		
	Design Value (Actual Conditions)	C _B = 1165 ± 25 ppm		
	Design Value (Design Conditions)	$C_B = 1182 + [(C_B)_{ARO}^M - 1321] \pm [0.010 \times (C_D)_{D}^M + 118.8 / (\partial C_D / \partial C_B)]$		
	Reference	VEP-FRD-NFE 74		
V Acceptance Criteria	Accident Analysis Value	$\left(\frac{\delta P}{\delta C_B}\right) \times C_B \leq 15,115 \text{ pcm}$		
	Reference	FSAR Section 14.2.5		
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			
	$\frac{\delta P}{\delta C_B} = -8.94 \text{ pcm/ppm (MEASURED)}$			

Performed By

L. J. Surman
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Evaluated By

D. W. Lippard
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Approved:

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Recommended for

Approval by

C. J. Ennis
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SUNNY POWER STATION UNIT 1 CYCLE 3 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Isothermal Temperature Coefficient - D Bank In Procedure Number / Section: PT28.11/APP D Sequence Step Number: 12	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 +0 CD: 0 +15 P/L: 228 RCCA: NA -15 -0	RCS Temperature (°F): 544 ±1 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating Observe Precautions in PT28.11
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 222 CD: 0 P/L: 226 RCCA: N/A	RCS Temperature (°F): 544.2-546.2 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
Date/Time Test Performed: 7/7/78 1030-1110		
IV	Measured Parameter (description)	$\left(\frac{\partial \rho}{\partial T}\right)^{ISO}_D$, Isothermal Temperature Coefficient - D Bank In
Test Results	Measured Value	$\left(\frac{\partial \rho}{\partial T}\right)^{ISO} = -5.9 \text{ pcm}/^{\circ}\text{F}$
	Design Value (Actual Conditions)	$\left(\frac{\partial \rho}{\partial T}\right)^{ISO} = -6.9 \pm 3 \text{ pcm}/^{\circ}\text{F}$ (CB = 1173 ppm)
	Design Value (Design Conditions)	$\left(\frac{\partial \rho}{\partial T}\right)^{ISO} = -6.8 \pm 3.0 \text{ pcm}/^{\circ}\text{F}$ (D/O, C/228, 1182 ppm, 547.0°F)
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	$\left(\frac{\partial \rho}{\partial T}\right)^{ISO} \leq 0.96 \frac{\text{pcm}}{^{\circ}\text{F}} \left[\text{ISO}(\delta \rho / \delta T) \approx \text{MOD}(\delta \rho / \delta T) + \text{DOPPLER}(\delta \rho / \delta T) \right]$
	Reference	TS 3.1, VEP-FRD-NFE 74
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By L. J. Gurlman
Sunny Test Engineer

Approved: L. J. Gurlman
SUNNY ENG SVCS. SUNNY POWER STATION.

Evaluated By DW. Linnell
NFO Startup Engineer

Recommended for Approval by C. J. Sinner
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - H2P, D-Bank In 51-5-3 Procedure Number / Section: PT28.2, OF-57 Sequence Step Number: 13				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 ⁺¹⁵ CD: 0 ⁺¹⁵ P/L: 228 RCCA: N/A			RCS Temperature (°F): 547+0 Power Level (% F.P.): 0 -4 Other (specify): Must have ≥ 40 thimbles	
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 219 CD: 0 P/L: 226 RCCA: N/A			RCS Temperature (°F): 547 Power Level (% F.P.): 24 Other (specify): 43 THIMBLES	
Date/Time Test 7/7/78 Performed: 1904-1914					
IV Test Results	Measured Parameter (description)	MAX. REL. ASSY PWR. $\frac{(M-P)}{P}$ DIFF.	F _{CH} , NUCLEAR ENTHALPHY RISE HOT CHANNEL FACTOR	F _Q , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	7% DIFF = 4.8 P _{LT} = 1.22	1.684 M-5 (H2)	2.570 E-4 (S.H)	1.0129
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	±10% for P ₁ ≥ .9 ±15% for P ₁ < .9 (P ₁ = ASSY. PWR.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$P_{DA} = 1.55(1 + 2(1-P)) \times T(BC)$	$F_Q(2) = 3.85 \times R(2)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO F _{CH} / LOCA AND F _{CH} / LOCA F _Q / RED AND F _Q / ASSY WERE WITHIN THEIR TECHNICAL SPECIFICATION LIMITS.				

Performed By L. J. Gurlman
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Approved: J. J. Johnson
SUPERVISING SUREY POWER STATION.

Evaluated By JK Ross
NFO Startup Engineer

Recommended for Approval by [Signature]
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET
FINAL RESULTS

I Reference	Test Description: Rod Worth Measurement - C Bank Procedure Number / Section: PT28.11/App. E Sequence Step Number: 14	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CE: 228 CC: Moving CD: 0 P/L: 228 RCCA: NA	RCS Temperature (°F): 547±2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CE: 228 CC: MOVING CD: 0 P/L: 228 RCCA: N/A	RCS Temperature (°F): ~547 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
Date/Time Test 7/7/78 Performed: 2109-2240		
IV Test Results	Measured Parameter (description)	I _C ; Integral Worth of Control Bank - C Bank
	Measured Value	1032 pcm
	Design Value (Actual Conditions)	1056 ± 158 pcm
	Design Value (Design Conditions)	1056 ± 158 pcm
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	If Design Acceptance Criterion is exceeded, then assure adequate shutdown margin and/or evaluate other accidents, as necessary.
	Reference	Letter from C. M. Stallings (Vepco) to E. G. Case (NRC) dated May 11, 1978 (serial No. 272)
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By

L. J. Curkman
Surrey Test Engineer

Evaluated By

J. A. Vassilatos
NFO Startup Engineer

Approved:

J. A. Vassilatos
SURREY ENG SVCS. SURREY POWER STATION.

Recommended for
Approval by

D. W. Linnard
NFO Supervisor

SURRY POWER STATION UNIT 1 CYCLE & STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Boron Endpoint Measurement - D, C Banks In Procedure Number / Section: PT28.11/APP.C Sequence Step Number: 15		
II Test onditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 ⁺⁰ CC: 0 ⁺¹⁵ CD: 0 P/L: 228 ⁻¹⁵ RCCA: N/A		RCS Temperature (°F): 547 ⁺⁰ Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 216 CC: 0 CD: 0 P/L: 228 RCCA: N/A		RCS Temperature (°F): 546.5 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
IV Test Results	Date/Time Test Performed: 7/7/78 - 7/8/78 2317-0037		
	Measured Parameter (description)	(CB) _{DC} , Critical Boron Concentration - D, C Banks In	
	Measured Value	C _B = 1067 ppm	
	Design Value (Actual Conditions)	C _B = 1075 ± 22 ppm	
	Design Value (Design Conditions)	$C_B = 1073 + [(C_B)_D^M - 1182] \pm [0.010 \times (C_B)_{DC}^M + 105.6 / (\partial p / \partial C_B)]$	
	Reference	VEP-FRD-NFE 74	
V Acceptance Criteria	Accident Analysis Value $(\frac{\delta p}{\delta C_B}) \times C_B \leq 15,115 \text{ pcm}$		
	Reference	FSAR Section 14.2.5	
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	$\frac{\delta p}{\delta C_B} = -8.94 \text{ pcm/ppm (MEASURED)}$		

Performed By L. J. Gurlman
Surry Test Engineer

Evaluated By T. J. Hunsicker
NFO Startup Engineer

Approved: J. H. [Signature]
SURV ENG SVCS. SURRY POWER STATION.

Recommended for
Approval by DW [Signature]
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Isothermal Temperature Coefficient - D,C Banks In Procedure Number / Section: PT28.11/APP D Sequence Step Number: 16	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 +0 SDB: 228 +15 CA: 228 CB: 228 -15 CC: 0 +15 CD: 0 P/L: 228 -15 RCCA: NA -0	RCS Temperature (°F): 544 ±1 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating Observe Precautions in PT28.11
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 213 CC: 0 CD: 0 P/L: 226 RCCA: N/A	RCS Temperature (°F): 544.3 - 547.0 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
IV Test Results	Date/Time Test 7/8/78 Performed: 0210-0300	
	Measured Parameter (description)	$\left(\frac{\delta p}{\delta T}\right)^{ISO}_{DC}$, Isothermal Temperature Coefficient - D,C Banks In
	Measured Value	$\left(\frac{\delta p}{\delta T}\right)^{ISO} = -9.0 \text{ pcm}/^{\circ}\text{F}$
	Design Value (Actual Conditions)	$\left(\frac{\delta p}{\delta T}\right)^{ISO} = -10.4 \pm 3 \text{ pcm}/^{\circ}\text{F}$ (CB = 1052 ppm)
	Design Value (Design Conditions)	$\left(\frac{\delta p}{\delta T}\right)^{ISO} = -10.1 \pm 3.0 \text{ pcm}/^{\circ}\text{F}$ (D,C/O, B/228, 1073 ppm, 547.0°F)
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	$\left(\frac{\delta p}{\delta T}\right)^{ISO} \leq 0.96 \frac{\text{pcm}}{^{\circ}\text{F}}$ $\left[\begin{matrix} ISO(\delta p/\delta T) = MOD(\delta p/\delta T) + DOPPLER \\ (\delta p/\delta T) DOPPLER(\delta p/\delta T) = -2.04 \frac{\text{pcm}}{^{\circ}\text{F}} \end{matrix} \right]$
	Reference	TS 3.1, VEP-FRD-NFE 74
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By A.J. Curman
Surrey Test Engineer

Approved: A.J. Curman
SURREY ENG SVCS. SURREY POWER STATION.

Evaluated By T.A. Munro
NFO/Startup Engineer

Recommended for Approval by D.W. Lippard
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET
FINAL RESULTS

I Reference	Test Description: Rod Worth Measurement - B Bank Procedure Number / Section: PT28.11/App. E Sequence Step Number: 17	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: 0 CD: 0 P/L: 228 RCCA: NA	RCS Temperature (°F): 547.2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: 0 CD: 0 P/L: 228 RCCA: N/A	RCS Temperature (°F): 546.2 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
Date/Time Test 7/8/78 Performed: 1100 - 1450		
IV Test Results	Measured Parameter (description)	I _B : Integral Worth of Control Bank - B Bank
	Measured Value	1999 pcm
	Design Value (Actual Conditions)	2040 ± 306 pcm
	Design Value (Design Conditions)	2040 ± 306 pcm
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	If Design Acceptance Criterion is exceeded, then assure adequate shutdown margin and/or evaluate other accidents, as necessary.
	Reference	Letter from C. M. Stallings (Vepco) to E. G. Case (NRC) dated May 11, 1978 (Serial No. 272)
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By

S. J. Curpman
Surrey Test Engineer

Evaluated By

D. W. Linnard
NFO Startup Engineer

Approved:

J. A. Johnson
SURREY ENG SVCS. SURREY POWER STATION.

Recommended for

Approval by

C. J. Linnard
for NFO Supervisor

SUNNY POWER STATION UNIT 1 CYCLE & STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: boron Endpoint Measurement - D,C,B Banks In Procedure Number / Section: PT28.11/APP.C Sequence Step Number: 18	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 229 CA: 228 +0 CB: 0 +15 CC: 0 CD: 0 -15 P/L: 228 RCCA: N/A	RCS Temperature (°F): 547±2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 0 CD: 0 P/L: 226 RCCA: N/A	RCS Temperature (°F): 546.0 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
	Date/Time Test 7/8/78 Performed: 1445-1515	
IV Test Results	Measured Parameter (description)	(CB)DCB , Critical Boron Concentration - D,C,B Banks In
	Measured Value	C _B = 836 ppm
	Design Value (Actual Conditions)	C _B = 846 ± 31 ppm
	Design Value (Design Conditions)	$C_B = 852 + [(C_B)_{DC}^M - 1073] \pm [0.010 \times (C_B)_{DCB}^M + 204/(\partial p/\partial C_B)]$
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	$(\frac{\delta p}{\delta C_B}) \times C_B \leq 15,115 \text{ pcm}$
	Reference	FSAR Section 14.2.5
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	$\frac{\delta p}{\delta C_B} = -8.94 \text{ pcm/ppm (MEASURED)}$	

Performed By L. J. Gurfman
Sunny Test Engineer

Evaluated By D.W. Linnard
NFO Startup Engineer

Approved: J. A. Linnard
SUNNY ENG SVCS. SUNNY POWER STATION.

Recommended for
Approval by C. J. Linnard
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Rod Worth Measurement - A Bank		
	Procedure Number / Section: PT28.11/App. E		Sequence Step Number: 19
II Test Conditions (Design)	Bank Positions (steps)		RCS Temperature (°F): 547±2 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	SDA: 228 CB: 0 P/L: 228	SDB: 228 CC: 0 RCCA: NA	
III Test Conditions (Actual)	Bank Positions (steps)		RCS Temperature (°F): ~547 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
	SDA: 228 CB: 0 P/L: 228	SDB: 228 CC: 0 RCCA: N/A	
	Date/Time Test 7/8/78 Performed: 1530-1715		
IV	Measured Parameter (description)	I _A ; Integral Worth of Control Bank - A Bank	
	Measured Value	1304 pcm	
Test Results	Design Value (Actual Conditions)	1242 ± 186 pcm	
	Design Value (Design Conditions)	1242 ± 186 pcm	
	Reference	VEP-FRD-NFE 74	
V Acceptance Criteria	Accident Analysis Value	If Design Acceptance Criterion is exceeded, then assure adequate shutdown margin and/or evaluate other accidents, as necessary.	
	Reference	Letter from C. M. Stallings (Vepco) to E. G. Case (NRC) dated May 11, 1978 (Serial No. 272)	
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		

Performed By A. J. Gursman
Surrey Test Engineer

Approved: [Signature]
SUPERVISING ENG. SURREY POWER STATION

Evaluated By D.W. Lizzard
NFO Startup Engineer

Recommended for
Approval by C. J. Snow
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE & STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Boron Endpoint Measurement - D,C,B,A Banks In			Sequence Step Number: 20
II Test Conditions (Design)	Bank Positions (steps)			RCS Temperature (°F): 547.0 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
	SDA: 228 CB: 0 P/L: 228	SDB: 228 ⁺⁰ CC: 0 RCCA: N/A	CA: 0 ⁺¹⁵ CD: 0 ⁻⁰	
III Test Conditions (Actual)	Bank Positions (steps)			RCS Temperature (°F): 546.0 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
	SDA: 228 CB: 0 P/L: 226	SDB: 228 CC: 0 RCCA: N/A	CA: 0 CD: 0	
Date/Time Test 7/8/74 Performed: 1730 - 1900				
IV Test Results	Measured Parameter (description)		(C _B) _{DCBA} , Critical Boron Concentration - D,C,B,A Banks In	
	Measured Value		C _B = 693 ppm	
	Design Value (Actual Conditions)		C _B = 700 ± 21 ppm	
	Design Value (Design Conditions)		$C_B = 716 + [(C_B)_{DCB}^M - 852] \pm [0.010 \times (C_B)_{DCBA}^M + 124.2 / (\partial p / \partial C_B)]$	
	Reference		VEP-FRD-NFE 74	
V Acceptance Criteria	Accident Analysis Value		$(\frac{\partial p}{\partial C_B}) \times C_B \leq 15,115 \text{ pcm}$	
	Reference		FSAR Section 14.2.5	
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			
	$\frac{\partial p}{\partial C_B} = -8.94 \frac{\text{pcm}}{\text{ppm}} \text{ (MEASURED)}$			

Performed By L.J. Curkman
Surrey Test Engineer

Evaluated By D.W. Linnard
NFO Startup Engineer

Approved: L.J. Curkman
SURREY ENG SVCS. SURREY POWER STATION

Recommended for
Approval by C.J. Snow
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Rod Worth Measurement - D, C, B, A In Overlap Procedure Number / Section: PT28.11/App. E Sequence Step Number: 21	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: Moving CB: Moving CC: Moving CD: Moving P/L: 228 RCCA: NA	RCS Temperature (°F): 547 ⁺² Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: MOVING CB: MOVING CC: MOVING CD: MOVING P/L: 228 RCCA: N/A	RCS Temperature (°F): ~546 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
IV Test Results	Date/Time Test 7/8/78 - 7/9/78 Performed: 1915-0005	
	Measured Parameter (description)	I_{DCBA} ; Integral Worth of Control Bank - D,C,B,A In Overlap
	Measured Value	5577 pcm
	Design Value (Actual Conditions)	5526 ± 553 pcm
	Design Value (Design Conditions)	5526 ± 553 pcm (From A at 0 steps to D at 228 steps)
	Reference	VEP-FRD-NFE 74
V Acceptance Criteria	Accident Analysis Value	If Design Acceptance Criterion is exceeded, then assure adequate shutdown margin and/or evaluate other accidents, as necessary.
	Reference	Letter from C. M. Stallings (Vepco) to E. G. Case (NRC) dated May 11, 1978 (Serial No. 272)
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed By L. J. Curdman
Surrey Test Engineer

Approved: L. J. Curdman
SURREY ENG SVCS. SURREY POWER STATION.

Evaluated By [Signature]
NFO Startup Engineer

Recommended for Approval by [Signature]
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 1 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: HZP Boron Worth Coefficient		Sequence Step Number: NA
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: Moving CB: Moving CC: Moving CD: Moving P/L: 228 RCCA: NA		RCS Temperature (°F): 547 ⁺⁰ Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: MOVING CB: MOVING CC: MOVING CD: MOVING P/L: 228 RCCA: N/A		RCS Temperature (°F): ~547 Power Level (% F.P.): 0 Other (specify): BELOW NUCLEAR HEATING
Date/Time Test Performed: 7/6/78 - 7/8/78			
IV Test Results	Measured Parameter (description)	$(\frac{\delta \rho}{\delta C_B})$, Boron Worth Coefficient	
	Measured Value	$(\frac{\delta \rho}{\delta C_B}) = -8.94 \text{ pcm/ppm}$	
	Design Value (Actual Conditions)	$(\frac{\delta \rho}{\delta C_B}) = -9.19 \pm 0.42 \text{ pcm/ppm}$	
	Design Value (Design Conditions)	$(\frac{\delta \rho}{\delta C_B}) = -9.19 \pm 0.92 \frac{\text{pcm}}{\text{ppm}}$	
	Reference	VEP-FRD-NFE 74	
V Acceptance Criteria	Acceptance Analysis Value	$(\frac{\delta \rho}{\delta C_B}) \times C_B \leq 15,115 \text{ pcm}$	
	Reference	FSAR Section 14.2.5	
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		

Performed By L. J. Curzman
Surrey Test Engineer

Approved: J. A. Johnson
SURV ENG SVCS. SURREY POWER STATION.

Evaluated By L. J. Curzman
NFO/Startup Engineer

Recommended for Approval by D. W. L. Smith
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib., R Data Map 51-5-4 Procedure Number / Section: PT28.2, OP-57 Sequence Step Number: 24				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: Above P/L: 228 RCCA: N/A Insertion Limits			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): ~40 Other (specify): Must have ≥ 40 thimbles	
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 200 P/L: 226 RCCA: N/A			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): 50 Other (specify): 43 THIMBLES	
IV Test Results	Date/Time Test Performed: 7/9/78 1648-1903				
	Measured Parameter (description)	MAX. REL. ASSY PWR. % DIFF. $\left(\frac{M-P}{P}\right)$	F_{DH}^N , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_Q^N , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	% DIFF = -3.7 $P_{#1} = 0.77$	1.442 P-10 (ML)	1.494 P-10 ML	1.0022
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	$\pm 10\%$ for $P_1 \geq .9$ $\pm 15\%$ for $P_1 < .9$ $(P_1 = \text{Assy. Pwr.})$	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$F_{DH}^N = 1.35(1 + 2(1-P_1)) \times T(20)$	$F_Q^N(2) = \frac{1.94}{P} \times K(2)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO $F_{DH}^N /_{LOCA}$ AND $F_{DH}^N /_{ASSY}$ WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS				

Performed By L. J. Curzman
Surrey Test Engineer

Approved: J. A. [Signature]
SURREY ENG SVCS. SURREY POWER STATION.

Evaluated By 7 K [Signature]
NFO Startup Engineer

Recommended for Approval by D. W. [Signature]
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib., R Data Map 51-5-5 Procedure Number / Section: PT28.2, OP-57 Sequence Step Number: 25				
II Test Conditions (Design)	Bank Positions (steps)		RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): ~50 Other (specify): Must have ≥ 40 thimbles		
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: Above Insertion Limits		
III Test Conditions (Actual)	Bank Positions (steps)		RCS Temperature (°F): OPER. TEMP. Power Level (% F.P.): 50 Other (specify): 43 THIMBLES		
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: 185		
IV Test Results	Date/Time Test 7/9/78 Performed: 1920-2028				
	Measured Parameter (description)	MAX. REL. ASSY PWR. $\frac{M-P}{P}$ DIFF.	F_{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_Q , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	$\% DIFF = 3.2$ $P_{A9} = 0.45$	1.434 $P_{10}(ML)$	2.037 $P_{10}(ML)$	1.0043
	Design Value (Actual Conditions)	NA	NA	NA	< 1.02
	Design Value (Design Conditions)	±10% for $P_1 \geq .9$ ±15% for $P_1 < .9$ (P_1 = ASSY. PWR.)	NA	NA	< 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$F_{NH} = 1.55(1 + 2(1-P)) \times T(NU)$	$F_Q(Z) = \frac{1.94}{P} \times K(Z)$	< 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO $F_{NH}^{N} /_{R00}^{LCCA}$ AND $F_{NH}^{N} /_{ASSY}^{LCCA}$ WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS.				

Performed By L.J. Gureman
Surrey Test Engineer

Approved: [Signature]
SURREY ENG SVCS. SURREY POWER STATION.

Evaluated By C.J. Snow
NFO Startup Engineer

Recommended for Approval by D.W. Linnard
for NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib., R Data Map S1-5-6 Procedure Number / Section: FI28.2, OF-57 Sequence Step Number: 26				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: Above P/L: 228 RCCA: N/A Insertion Limits			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): ~60 Other (specify): Must have ≥ 40 thimbles	
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 161/162 P/L: 226 RCCA: N/A			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): 57 Other (specify): 43 Thimbles	
IV	Date/Time Test 7/10/78 Performed: 0129-0251				
Test Results	Measured Parameter (description)	MAX. REL. ASSY PWR. % DIFF. $\left(\frac{M-P}{P}\right)$	F_{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_{QH} , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	% diff = 4.9 $P_{AS} = 0.44$	1.465 K-14 (KL)	2.163 K-14 (LM)	1.0065
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	$\pm 10\%$ for $P_1 \geq .9$ $\pm 15\%$ for $P_1 < .9$ $(P_1 = \text{Assy. Pwr.})$	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$F_{AS}^H = 1.35(1 + 2(1-P)) \times T(80)$	$F_{Q(2)}^H = \frac{1.94}{P} \times K(2)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO F_{NH}^{LOCA} and F_{NH}^{LOCA} were within their Technical Specifications limits. 				

Performed By

L. J. Gurinman
Surrey Test Engineer

Evaluated By

TK Ross
NFO Startup Engineer

Approved:

J. J. [Signature]

Recommended for

Approval by

[Signature]
NFO Supervisor

SUPP ENG SVCS. SURREY POWER STATION.

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET
FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib., R Data Map 51-5-7 Procedure Number / Section: PT28.2, OP-57 Sequence Step Number: 27				
II Test Conditions (Design)	Bank Positions (steps)			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): ~70 Other (specify): Must have ≥ 40 thimbles	
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: Above Insertion Limits		
III Test Conditions (Actual)	Bank Positions (steps)			RCS Temperature (°F): OPER. TEMP. Power Level (% F.P.): 67% Other (specify): 40 THIMBLES	
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: 196		
IV Test Results	Date/Time Test Performed: 7/10/78 0940-1220				
	Measured Parameter (description)	MAX. REL. ASSY FWR. $\frac{M-P}{P}$ DIFF.	F_{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_{TQ} , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	7.2 DIFF $P_{25} = 0.45$	1.430 P-10 (LK)	1.901 P-10 (LK)	1.0043
	Design Value (Actual Conditions)	NA	NA	NA	< 1.02
	Design Value (Design Conditions)	±10% for $P_1 \geq .9$ ±15% for $P_1 < .9$ (P_1 = ASSY. FWR.)	NA	NA	< 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value		$F_{25} = 1.35(1 + 2(1-P)) \times T(NU)$		$F_{TQ(2)} = \frac{1.94}{T} \times K(2)$
	None				< 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO				
	F_{NH}^{LOCA} AND F_{NH}^{LOCA} WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS.				

Performed By L. J. Gurlman
Surrey Test Engineer

Approved: [Signature]
SURREY ENG SVCS. SURREY POWER STATION.

Evaluated By C. J. Shaw
NFO Startup Engineer

Recommended for Approval by [Signature]
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib., R Data Map 51-5-8 Procedure Number / Section: PT28.2, OP-57 Sequence Step Number: 29				
II Test Conditions (Design)	Bank Positions (steps)			RCS Temperature (°F): Oper. Temp. Power Level (% F.P.): ~80 Other (specify): Must have ≥ 40 thimbles	
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: Above Insertion Limits		
III Test Conditions (Actual)	Bank Positions (steps)			RCS Temperature (°F): OPER. TEMP. Power Level (% F.P.): 88 Other (specify): 41 THIMBLES	
	SDA: 228 CB: 228 P/L: 228	SDB: 228 CC: 228 RCCA: N/A	CA: 228 CD: 218		
IV Test Results	Date/Time Test 7/10/78 Performed: 1846-2108				
	Measured Parameter (description)	MAX. REL. ASSY PWR. $\frac{(M-P)}{P}$ DIFF.	F_{DH}^{N} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_Q^{T} , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	% DIFF = 3.6 $P_{A9} = 0.46$	1.408 P-10 (LK)	1.798 P-10 (LK)	1.0073
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	±10% for $P_1 \geq .9$ ±15% for $P_1 < .9$ (P_1 = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$P_{QA}^{N} = 1.55(1 + 2(1-P)) \times T(80)$	$F_Q^{T}(Z) = \frac{1.94}{P} \times K(Z)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO $F_{DH}^{N} / LOCA$ AND $F_{DH}^{N} / LOCA$ WERE WITHIN THEIR TECHNICAL SPECIFICATIONS RCD ASSY LIMITS. Preliminary $P_{THRESHOLD} = 98\%$				

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Recommended for Approval by SA Johnson
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - At Power, NI Calib, \bar{R} Data, P_{Thres} . Deter. Map Procedure Number / Section: PT28.2, OP-57 Sequence Step Number: 30				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: Above P/L: 228 RCCA: N/A Insertion Limits			RCS Temperature ($^{\circ}F$): Oper. Temp. Power Level (% F.P.): ~90 Other (specify): Must have ≥ 40 thimbles	
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 224 P/L: 228 RCCA: N/A			RCS Temperature ($^{\circ}F$): OPER. TEMP. Power Level (% F.P.): 98 Other (specify): 40 THIMBLES	
Date/Time Test 7/11/78. Performed: 0530-0747					
IV Test Results	Measured Parameter (description)	MAX. REL. ASSY PWR. $\frac{M-P}{P}$ DIFF.	F_{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_Q , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	$T_0 \text{ DIFF} = 47$ $P_{BS} = 0.43$	1.415 K-14 (KL)	1.841 K-14 (KL)	1.0068
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	$\leq 10\%$ for $P_1 \geq .9$ $\leq 15\%$ for $P_1 < .9$ $(P_1 = \text{Assy. Pwr.})$	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	NONE
V Acceptance Criteria	Accident Analysis Value	None	$P_{QA} = 1.55(1 + .2(1-P)) \times T(30)$	$F_Q^T(2) = \frac{1.95}{P} \times R(2)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO $F_{DN}^{N LOCA}$ AND $F_{DN}^{N LOCA}$ WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS $P_{THRESHOLD} = 98\%$				

Performed By L. J. Gorman
Surrey Test Engineer

Approved: H. Johnson
Surrey Power Sta

Evaluated By T. A. Dunlop
NFO Startup Engineer

Recommended for Approval by [Signature]
NFO Supervisor

SURREY POWER STATION UNIT 1 CYCLE 5 STARTUP
STARTUP PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: M/D Flux Map - HFP, ARO, Eq. Xe. Map Procedure Number / Section: FT28.2, OP-57 Sequence Step Number: 34				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: Above P/L: 228 RCCA: N/A Insertion Limits			RCS Temperature (OF): 566±2°F Power Level (% F.P.): 100 Other (specify): Equil. Xenon Must have ≥ 40 thimbles	
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 221 P/L: 226 RCCA: N/A			RCS Temperature (OF): OPER. TEMP. Power Level (% F.P.): 99.5 Other (specify): EQ. XENON 42 THIMBLES	
IV Test Results	Date/Time Test Performed: 7/13/78 0911-1121				
	Measured Parameter (description)	MAX. REL. ASSY PWR. DIFF. $\left(\frac{N-F}{P}\right)$	F_{NH} , NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F_Q , TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	% DIFF = 4.8 $P_{D3} = 0.45$	1.416 K-14 XL	1.835 K-14 KL	1.0065
	Design Value (Actual Conditions)	NA	NA	NA	≤ 1.02
	Design Value (Design Conditions)	$\leq 10\%$ for $F_1 \geq .9$ $\leq 15\%$ for $F_1 < .9$ $(F_1 = \text{Assy. Pwr.})$	NA	NA	≤ 1.02
	Reference	WCAP-7905 Rev. 1	NONE	NONE	
V Acceptance Criteria	Accident Analysis Value	None	$F_{NH} = 1.35(1 + 2(1-F)) \times (80)$	$F_Q(2) = \frac{1.92}{P} \times K(2)$	≤ 1.02
	Reference	None	TS 3.12	TS 3.12	TS 3.12
VI Comments	Design Tolerance is met : <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO F_{NH}^{LOCAL} AND F_Q^{LOCAL} ON ASSY WERE WITHIN THEIR TECHNICAL SPECIFICATIONS LIMITS.				

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Surrey Test Engineer

Approved [Signature]
Surrey Power Sta.

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NFO Startup Engineer

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NFO Supervisor

SUNNY POWER PLANT UNIT 1 CYCLE 1 STARTUP
STATUS PHYSICS TESTS RESULTS AND EVALUATION SHEET

FINAL RESULTS

I Reference	Test Description: Power Coefficient Measurement Procedure Number / Section: PY 28.12 Sequence Step Number: 32	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 278 CA: 228 CB: 228 CC: 228 CD: Moving P/L: 228 RCCA: NA	RCS Temperature (°F): Oper. Temp. Power Level (Z F.P.): ~95% Other (specify): Equil. Xenon Above Insertion Limits
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 187-225 P/L: 228 RCCA: NA	RCS Temperature (°F): Oper. Temp. Power Level (Z F.P.): 100.0-90.1 Other (specify): Burnup=1075 MWD/MTU
	Date/Time Test Performed: 6/10/78 2312-2352	
IV Test Results	Measured Parameter (description)	(b0/bP), Differential Power Coefficient
	Measured Value	$-10.5 \pm 3.2 \frac{\text{pcm}}{\text{ZP}}$
	Design Value (Actual Conditions)	$-10.6 \frac{\text{pcm}}{\text{ZP}}$ ($C_B = 805 \text{ ppm}$, $P=95\%$)
	Design Value (Design Conditions)	$-10.5 \frac{\text{pcm}}{\text{ZP}} \pm (.3 \times (b0/bP)^N)$ ($C_B=825 \text{ ppm}$, $P=95\%$)
	Reference	Letter from R. T. Meyer (Westinghouse) to D. E. Hostetler dated March 30, 1978 (FY-VY-573) and WCAP-9472.
V Acceptance Criteria	Accident Analysis Value	NA
	Reference	NA
VI Comments	Design Tolerance is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Acceptance Criteria is met: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	

Performed by

J. J. Carlson
Sunny Point Engineer

Evaluated by

TK Ross
Sunny Point Engineer

Recommended for

Approval by

E. J. [Signature]
Sunny Point Engineer

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