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NORTH ANNA UNIT 1, CYCLE 3
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 North Anna 1, Cycle 3 core could be operated safely, and to make an initial evaluation of the 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 techiques and methods of data analysis were used. The test data, results and evaluations, together with the detailed startup procedures, are on file at the North Anna Power Station; therefore, only a cursory discussion of these items is included in this report. The analyses presented include a brief summary of each test, a comparision of the test results with design predictions, and an evaluation of the results.

The North Anna 1, Cycle 3 Startup Physics Tests 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. The entries for the design values were based on the 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 facilitate the preliminary comparison between measured and predicted test results, thus enabling a quick identification of possible problems occuring during the tests. The Appendix to this report contains the final completed and approved version of the Startup Physics Tests Results and Evaluation Sheets.

Section 1

INTRODUCTION AND SUMMARY

On December 28, 1980, Unit No. 1 of the North Anna Power Station was shut down for its second refueling. During this shutdown, 64 of the 157 fuel assemblies in the core were replaced with fresh fuel assemblies. The cycle three core consists of four batches of fuel: two once burned batches (1A3 and 3A2), one twice burned batch (4), and one fresh batch (5). The core loading pattern and the design parameters for each batch are shown in Figure 1.1. Fuel assembly burnups are given in Figure 1.2. The incore instrumentation locations are identified in Figure 1.3. Figure 1.4 identifies the location and number of burnable poison rods and source assemblies for Cycle 3; and Figure 1.5 identifies the location and number of control rods in the Cycle 3 core.

On April 6, 1981, at 0140, the third 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 tests follows:

1. The drop time of each control and shutdown rod was confirmed to be within the 2.2 second limit of the North Anna Technical Specifications[2].
2. The reactor coolant system flow rate was confirmed to be greater than the minimum limit specified in the Technical Specifications[2].
3. Individual reactivity worths for all control and shutdown rod banks were measured using the rod swap technique[3] and were

found to be within 12.31% of the design predictions with the exception of Shutdown Bank A which showed a percent difference of 19.54% from design predictions. Except for Shutdown Bank A, these results are within the design tolerance of ±15% for individual bank worths (±10% for the rod swap reference bank worth). This deviation is discussed further in Section 4. The sum of the individual control and shutdown rod bank worths was measured to be within 4.78% of the design prediction which is within the design tolerance of ±10%.

4. Critical boron concentrations for two control bank configurations were measured to be within 26 ppm of the design predictions. These results were within the design tolerances and also met the accident analysis acceptance criterion.
5. The boron worth coefficient was measured to be within 4.7% of the design predication, which is within the design tolerance of ±10% and meets the accident analysis criterion.
6. Isothermal temperature coefficients for two control bank configurations were measured to be within 0.74 pcm/°F of design predictions. These results are within the design tolerance of ±3 pcm/°F and also met the accident analysis acceptance criterion.
7. Core power distributions for various HZP and at power conditions indicated measured assemblywise power values to be somewhat larger than the established design tolerance.

These higher-than-expected power values were accompanied by a quadrant power tilt ratio (QPTR), which at hot-zero-power, was measured to be approximately 4%. The QPTR decreased to 1.3% at full power. These deviations of power distribution had no adverse consequences since, for all flux maps, the hot channel factors were measured to be within the limits of the Technical Specifications. All measurement parameters met their respective accident analysis acceptance criteria.

In summary, all startup physics test results were acceptable. 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

NORTH ANNA 1 - BOL CYCLE 3 PHYSICS TESTS

CHRONOLOGY OF TESTS

Test	Date	Time	Power	Reference Procedure
Hot Rod Drop-Hot Full Flow	04/05/81	1205	HSD	1-PT-17.2
Reactivity Computer Checkout	04/07/81	0518	HZP	1-PT-94(B)
Boron Endpoint-ARO	04/07/81	1040	HZP	1-PT-94(C)
Temperature Coefficient-ARO	04/07/81	1113	HZP	1-PT-94(D)
Bank B Worth	04/07/81	1224	HZP	1-PT-94(E)
Boron Endpoint-B In	04/07/81	1840	HZP	1-PT-94(C)
Temperature Coefficient-B In	04/07/81	2300	HZP	1-PT-94(D)
Bank D Worth - Rod Swap	04/08/81	0026	HZP	1-PT-94(G)
Bank C Worth - Rod Swap	04/08/81	0138	HZP	1-PT-94(G)
Bank A Worth - Rod Swap	04/08/81	0244	HZP	1-PT-94(G)
Bank SB Worth - Rod Swap	04/08/81	0334	HZP	1-PT-94(G)
Bank SA Worth - Rod Swap	04/08/81	0421	HZP	1-PT-94(G)
Flux Map-ARO	04/08/81	2141	HZP	1-PT-21.1
Flux Map-Insertion Limits	04/09/81	0455	HZP	1-PT-21.1
Flux Map	04/11/81	0407	26.5	1-PT-21.1
Flux Map - APDMS	04/14/81	1623	49.7	1-PT-21.1
Flux Map - APDMS	04/14/81	2258	49.2	1-PT-21.1
Flux Map - APDMS	04/15/81	0445	60.6	1-PT-21.1
Flux Map - APDMS, I/E Calibration	04/15/81	1024	74.2	1-PT-21.1
Flux Map - APDMS, I/E Calibration	04/15/81	1410	79.4	1-PT-21.1
Flux Map - APDMS, I/E Calibration	04/16/81	0227	84.8	1-PT-21.1
RCS Flow Measurement	04/27/81	1018	99.9	1-PT-27
Flux Map - HZP, Eq. Xenon	04/27/81	1402	100.0	1-PT-21.1

FIGURE 1.1

NORTH ANNA UNIT 1 - CYCLE 3

CORE LOADING MAP

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						3A2 C33	5 E59	3A2 C46							1
				3A2 C11	5 E53	5 E21	4 D51	5 E41	5 E51	3A2 C29					2
			3A2 C17	5 E64	5 E18	4 D32	3A2 C05	4 D08	5 E06	5 E56	3A2 C45				3
		3A2 C08	4 D44	5 E04	4 D06	5 E29	4 D18	5 E61	4 D30	5 E14	4 D35	3A2 C19			4
	3A2 C24	5 E40	5 E13	4 D05	5 E19	3A2 C13	4 D34	3A2 C48	5 E50	4 D47	5 E02	5 E60	3A2 C37		5
	5 E08	5 E24	4 D17	5 E30	3A2 C32	4 D45	4 D03	4 D14	3A2 C28	5 E47	4 D02	5 E16	5 E57		6
3A2 C50	5 E01	4 D39	5 E54	3A2 C27	4 D22	4 D07	5 E45	4 D37	4 D20	3A2 C51	5 E39	4 D40	5 E07	3A2 C26	7
5 E33	4 D41	3A2 C43	4 D23	4 D09	4 D31	5 E15	1A3 A11	5 E35	4 D27	4 D15	4 D49	3A2 C49	4 D42	5 E20	8
3A2 C06	5 E44	4 D50	5 E17	3A2 C42	4 D10	4 D29	5 E10	4 D21	4 D48	3A2 C12	5 E52	4 D46	5 E27	3A2 C04	9
	5 E09	5 E63	4 D13	5 E46	3A2 C14	4 D26	4 D04	4 D25	3A2 C25	5 E22	4 D19	5 E31	5 E38		10
	3A2 C38	5 E32	5 E23	4 D11	5 E26	3A2 C44	4 D28	3A2 C10	5 E49	4 D33	5 E58	5 E36	3A2 C20		11
		3A2 C36	4 D16	5 E55	4 D12	5 E42	4 D38	5 E25	4 D43	5 E11	4 D52	3A2 C07			12
			3A2 C03	5 E12	5 E03	4 D01	3A2 C02	4 D24	5 E37	5 E05	3A2 C01				13
				3A2 C23	5 E34	5 E62	4 D36	5 E28	5 E48	3A2 C30					14
						3A2 C39	5 E43	3A2 C40							15

--> BATCH
--> ASSEMBLY I.D

FUEL ASSEMBLY DESIGN PARAMETERS

	Batch			
	1A3	3A2	4	5
Initial Enrichment (w/o U235)	2.11	3.10	3.21	3.40
Burnup At BOC-3 (MWD/MTU)	14,054	23,273	9,941	0.0
Assembly Type	17x17	17x17	17x17	17x17
Number of Assemblies	1	40	52	64
Fuel Rods per Assembly	264	264	264	264

FIGURE 1.2

NORTH ANNA UNIT 1 - CYCLE 3

BEGINNING OF CYCLE FUEL ASSEMBLY BURNUPS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							C33 26118	E59 0	C46 26398						
2					C11 22523	E53 0	E21 0	D51 8048	E41 0	E51 0	C29 22359				
3				C17 24765	E64 0	E18 0	D32 12413	C05 20744	D08 12520	E06 0	E56 0	C45 24672			
4			C08 24682	D44 7819	E04 0	D06 12424	E29 0	D18 8335	E61 0	D30 12579	E14 0	D35 7865	C19 24452		
5		C24 22531	E40 0	E13 0	D05 11155	E19 0	C13 21822	D34 8209	C48 21839	E50 0	D47 11107	E02 0	E60 0	C37 22545	
6		E08 0	E24 0	D17 12556	E30 0	C32 21486	D45 7926	D03 9644	D14 7939	C28 21234	E47 0	D02 12381	E16 0	E57 0	
7	C50 26734	E01 0	D39 12106	E54 0	C27 21497	D22 7772	D07 10703	E45 0	D37 11074	D20 7644	C51 22044	E39 0	D40 12668	E07 0	C26 26408
8	E33 0	D41 7627	C43 20988	D23 7989	D09 8223	D31 9177	E15 0	A11 14054	E35 0	D27 9676	D15 8062	D49 8209	C49 20798	D42 7948	E20 0
9	C06 26372	E44 0	D50 12483	E17 0	C42 21876	D10 7794	D29 10916	E10 0	D21 10710	D48 8005	C12 21694	E52 0	D46 12467	E27 0	C04 26311
10		E09 0	E63 0	D13 12512	E46 0	C14 21193	D26 7983	D04 9502	D25 7532	C25 21059	E22 0	D19 12674	E31 0	E38 0	
11		C38 22457	E32 0	E23 0	D11 11063	E26 0	C44 21728	D28 8021	C10 21620	E49 0	D33 10748	E58 0	E36 0	C20 22234	
12			C36 24824	D16 8227	E55 0	D12 12859	E42 0	D38 8089	E25 0	D43 12595	E11 0	D52 8005	C07 24626		
13				C03 24847	E12 0	E03 0	D01 12594	C02 20673	D24 12409	E37 0	E05 0	C21 24599			
14					C23 22470	E34 0	E62 0	D36 7935	E28 0	E48 0	C30 22374				
15							C39 26667	E43 0	C40 26679						

Legend: --> ASSEMBLY ID
-->ASSEMBLY BURNUP

FIGURE 1.3

NORTH ANNA UNIT 1 - CYCLE 3

INCORE INSTRUMENTATION LOCATIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1								MD	TC						
2							TC		TC	MD					
3				MD TC		TC	MD	MD TC		TC		MD TC			
4			TC		MD			MD		MD	TC				
5			MD		MD	TC	MD	TC		TC	MD	MD TC		MD TC	
6			TC		MD TC			MD	TC	MD					
7	TC	TC	MD				MD		MD		TC	MD		MD	
8	MD	TC	MD TC		MD TC	TC		TC	TC	MD	TC		MD TC	MD	TC
9				TC	MD			TC	MD	MD TC					MD
10			MD TC				MD TC				TC	MD		MD TC	
11				TC	MD	TC		MD TC		MD TC	MD				
12			MD		TC		MD TC				TC	MD	MD TC		
13								MD TC		MD TC					
14					MD TC				MD		TC				
15							MD	TC	TC						

MD - MOVABLE DETECTOR
TC - THERMOCOUPLE

FIGURE 1.4

NORTH ANNA UNIT 1 - CYCLE 3

BURNABLE POISON AND SOURCE ASSEMBLY LOCATIONS

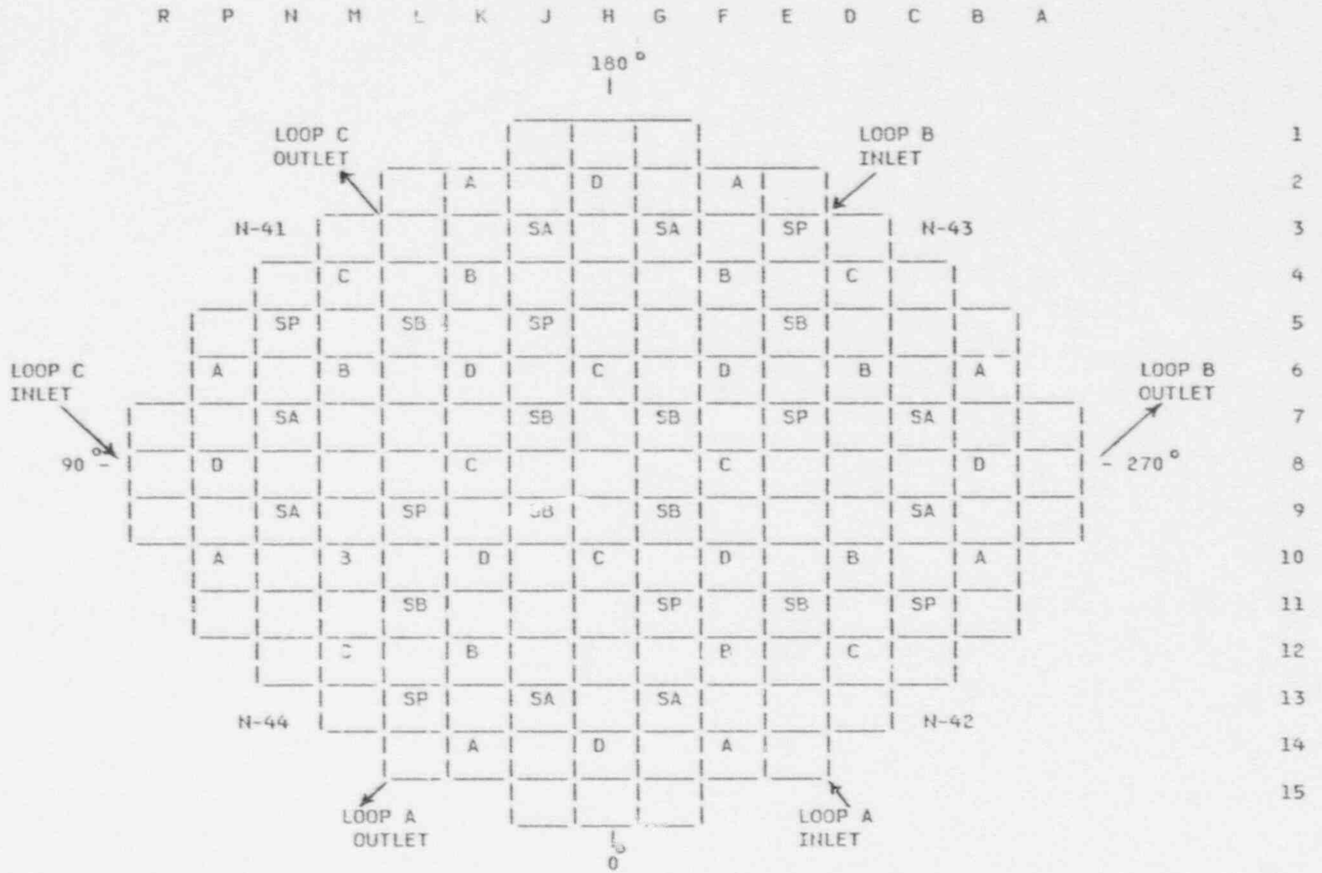
	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2							8		8						
3					4	20		SS		20	4				
4					20		20	8	20		20				
5			4	20		20		12		20		20	4		
6			20		20		12		12		20		20		
7		8		20		12		20		12		20		8	
8				8	12		20		20		12	8	SS		
9		8		20		12		20		12		20		8	
10			20		20		12		12		20		20		
11			4	20		20		12		20		20	4		
12					20		20	8	20		20				
13					4	20		SS		20	4				
14							8		8						
15															

992 FRESH BURNABLE POISON RODS
SS - SECONDARY SOURCE

FIGURE 1.5

NORTH ANNA UNIT 1 - CYCLE 3

CONTROL ROD LOCATIONS



ABSORBER MATERIAL
AG-IN-CD

FUNCTION	NUMBER OF CLUSTERS
CONTROL BANK D	8
CONTROL BANK C	8
CONTROL BANK B	8
CONTROL BANK A	8
CONTROL BANK SB	8
CONTROL BANK SA	8
SP (SPARE ROD LOCATIONS)	8

Section 2

CONTROL ROD DROP TIME MEASUREMENTS

The drop time of each control rod was measured at hot RCS conditions in order to confirm satisfactory operation and to verify that the rod drop times were less than the maximum allowed by the Technical Specifications. The control rod drop time measurements were run with the RCS at hot, full flow conditions (547 °F, 2235 psig) and are described below.

The rod drop time measurements were performed by first withdrawing a rod bank to its fully withdrawn position, and then removing the movable gripper coil fuse and stationary gripper coil fuse for the test rod. This allows the rod to drop into the core as it would in a normal plant trip. The data recorded during this test are the stationary gripper coil voltage, the LVDT (Linear Variable Differential Transformer) primary coil voltage and a 60Hz timing trace which are recorded via a visicorder. The rod drop time to the dashpot entry and to the bottom of the dashpot are determined from this data. Figure 2.1 provides an example of the data that is recorded during a rod drop time measurement.

As shown in Figure 2.1, the initiation of the rod drop is indicated by the decay of the stationary gripper coil voltage when the stationary coil fuse is removed. A voltage is then induced in the LVDT primary coil as the rod drops. The magnitude of this voltage is a function of the rod velocity. When the rod enters the dashpot section of its guide

tube, the velocity slows, causing a voltage decrease in the LVDT coil. The LVDT voltage then reaches a minimum as the rod reaches the bottom of the dashpot. Subsequent variations in the trace are caused by the rod bouncing. This procedure was repeated for each control rod.

The measured drop times for each control rod are recorded on Figure 2.2. The slowest, fastest, and average drop times are summarized in Table 2.1. Technical Specification 3.1.3.4 specifies a maximum rod drop time from loss of stationary gripper coil voltage to dashpot entry of 2.2 seconds with the RCS at hot, full flow conditions. All test results met this limit.

Table 2.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

HOT ROD DROP TIME SUMMARY

ROD DROP TIME TO DASHPOT ENTRY

SLOWEST ROD	FASTEST ROD	AVERAGE TIME
B-6, 1.77 sec.	C-9, 1.45 sec.	1.58 sec.

ROD DROP TIME TO BOTTOM OF DASHPOT

SLOWEST ROD	FASTEST ROD	AVERAGE TIME
B-6, 2.47 sec.	C-9, 2.10 sec.	2.25 sec.

Figure 2.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

TYPICAL ROD DROP TRACE

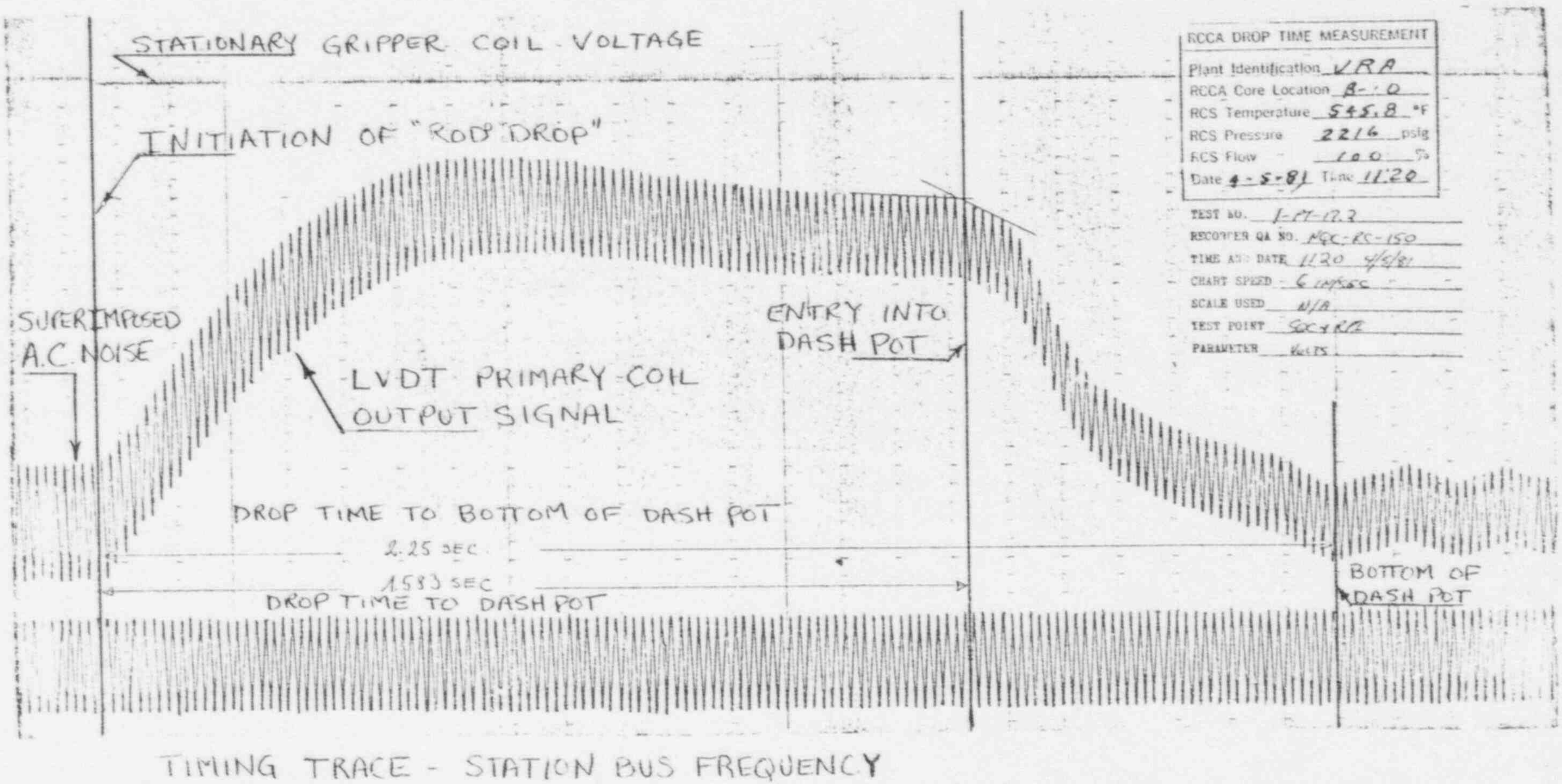


FIGURE 2.2

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ROD DROP TIME - HOT FULL FLOW CONDITIONS

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
															1
					1.57 2.18		1.48 2.12		1.55 2.22						2
						1.57 2.23		1.53 2.18							3
			1.60 2.28		1.55 2.22				1.60 2.27		1.58 2.25				4
				1.63 2.33						1.55 2.22					5
	1.52 2.15		1.58 2.32		1.57 2.27		1.57 2.25		1.62 2.30		1.62 2.30		1.77 2.47		6
		1.58 2.25				1.52 2.17		1.57 2.22				1.60 2.27			7
	1.58 2.28				1.58 2.25				1.60 2.26				1.68 2.42		8
		1.58 2.23				1.52 2.17		1.55 2.22				1.45 2.10			9
	1.55 2.22		1.58 2.25		1.55 2.22		1.58 2.25		1.63 2.32		1.57 2.22		1.58 2.25		10
				1.63 2.33						1.55 2.20					11
			1.55 2.23		1.63 2.33				1.55 2.20		1.58 2.27				12
						1.57 2.23		1.53 2.20							13
					1.72 2.38		1.58 2.27		1.62 2.27						14
															15

|-->ROD DROP TIME TO DASHPOT ENTRY(SEC.)

|-->ROD DROP TIME TO BOTTOM OF DASHPOT(SEC.)

Section 3

REACTOR COOLANT SYSTEM FLOW MEASUREMENT

The reactor coolant flow rate is measured in order to verify that the minimum flow rate requirement is satisfied. The RCS flow rate is determined using the calorimetric measurement technique. Precision calorimetric data (i.e., feedwater temperature, feedwater flow, steam flow, and steam pressure) are obtained in order to accurately determine the secondary-side heat rate. The primary-side enthalpy rise is determined from the RCS pressure and the temperature increase associated with each RCS loop. The flow for each RCS loop is determined by establishing a primary-side to secondary-side heat balance. Steam generator blowdown heat loss, system heat losses, and the power produced by the reactor coolant pumps are taken into account in the heat balance. A reactor coolant flow measurement was performed at 100% power. This data was analyzed using the RXFLOW[4] computer code, and manually adjusted to incorporate steam flow data. A summary of the results for this test is given in Table 3.1. As shown by this table, the results demonstrated that the RCS flow limit was met.

Table 3.1

NORTH ANNA 1 - CYCLE 3 BOL PHYSICS TEST

REACTOR COOLANT SYSTEM FLOW MEASUREMENT SUMMARY

Percent Power	Loop A Flow (gpm)	Loop B Flow (gpm)	Loop C Flow (gpm)	Total Flow (gpm)	Minimum Flow Limit* (gpm)
99.9%	99,385	102,053	101,347	302,785	278,400

* North Anna Unit 1 Technical Specification 3.2.5

Section 4

CONTROL ROD BANK WORTH MEASUREMENTS

Control rod bank worth measurements were obtained for all control and shutdown banks using the rod swap technique. The first step in the rod swap procedure was to dilute the most reactive control rod bank (hereafter referred to as the reference bank) into the core and measure its reactivity worth using conventional test techniques. The reactivity changes resulting from the reference bank movements were recorded continuously by the reactivity computer[5] and were used to determine the differential and integral worth of the reference bank (Control Bank B). At the completion of the reference bank reactivity worth measurement, the reactor coolant system temperature and boron concentration were stabilized such that the reactor was critical with the reference bank near full insertion. Initial statepoint data for the rod swap maneuver were obtained by moving the reference bank to its fully inserted position and recording the core reactivity and moderator temperature. At this point, a rod swap maneuver was performed by withdrawing the reference bank while one of the other control rod banks (i.e., a test bank) was inserted. The core was kept nominally critical throughout this rod swap and the maneuver was continued until the test bank was fully inserted and the reference bank was at the position at which the core was just critical. This measured critical position (MCP) of the reference bank with the test bank fully inserted is the major parameter of interest and was used to determine the integral reactivity worth of the test bank. Statepoint data (core reactivity, moderator temperature,

and the differential worth of the reference bank) were recorded with the reference bank at the MCP. The rod swap maneuver was then performed in reverse order such that the reference bank once again was near full insertion and the test bank was once again fully withdrawn from the core. The rod swap process was then repeated for all of the other control and shutdown rod banks.

A summary of the results for these tests is given in Table 4.1. As shown by this table and the Startup Physics Tests Results and Evaluation Sheets given in the Appendix, the individual measured bank worths for all of the control and shutdown banks were within the design tolerance (±10% for the reference bank and ±15% for the test banks), except for Shutdown Bank A. This deviation was reviewed with respect to the licensing bases. As a result of this review it was concluded[6-7] that the deviation did not exceed the bounds of the licensing bases nor did it represent an unreviewed safety issue. The sum of the individual rod bank worths was measured to be within 4.78% of the design prediction. This is well within the design tolerance of ±10% for the sum of the individual control rod bank worths.

The integral and differential reactivity worths of the reference bank (Control Bank B) are shown in Figures 4.1 and 4.2, respectively. The design predictions and the measured data are plotted together in order to illustrate their agreement. In summary, all measured rod worth values were acceptable.

Table 4.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

CONTROL ROD BANK WORTH SUMMARY

BANK	MEASURED WORTH (PCM)	PREDICTED WORTH (PCM)	PERCENT DIFFERENCE (M-P)/P X 100
B-Reference Bank	1419	1311	+8.26
D	1089	1038	+4.83
C	777	850	-8.59
A	722	643	+12.31
SB	919	1005	-8.54
SA	1238	1036	+19.54
Total Worth	6164	5883	+4.78

FIGURE 4.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST
ROD SWAP REFERENCE BANK
BANK B INTEGRAL ROD WORTH - HZP

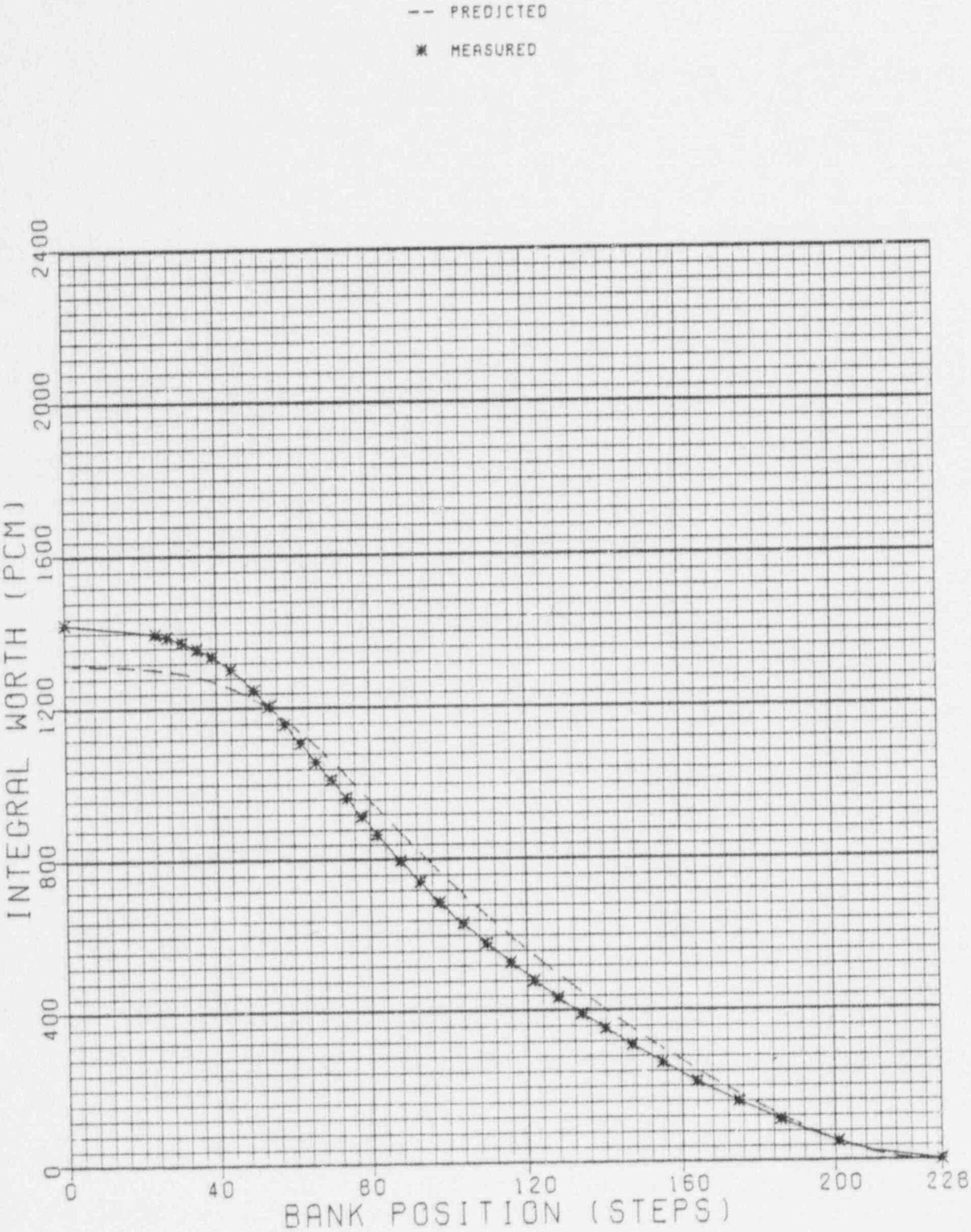
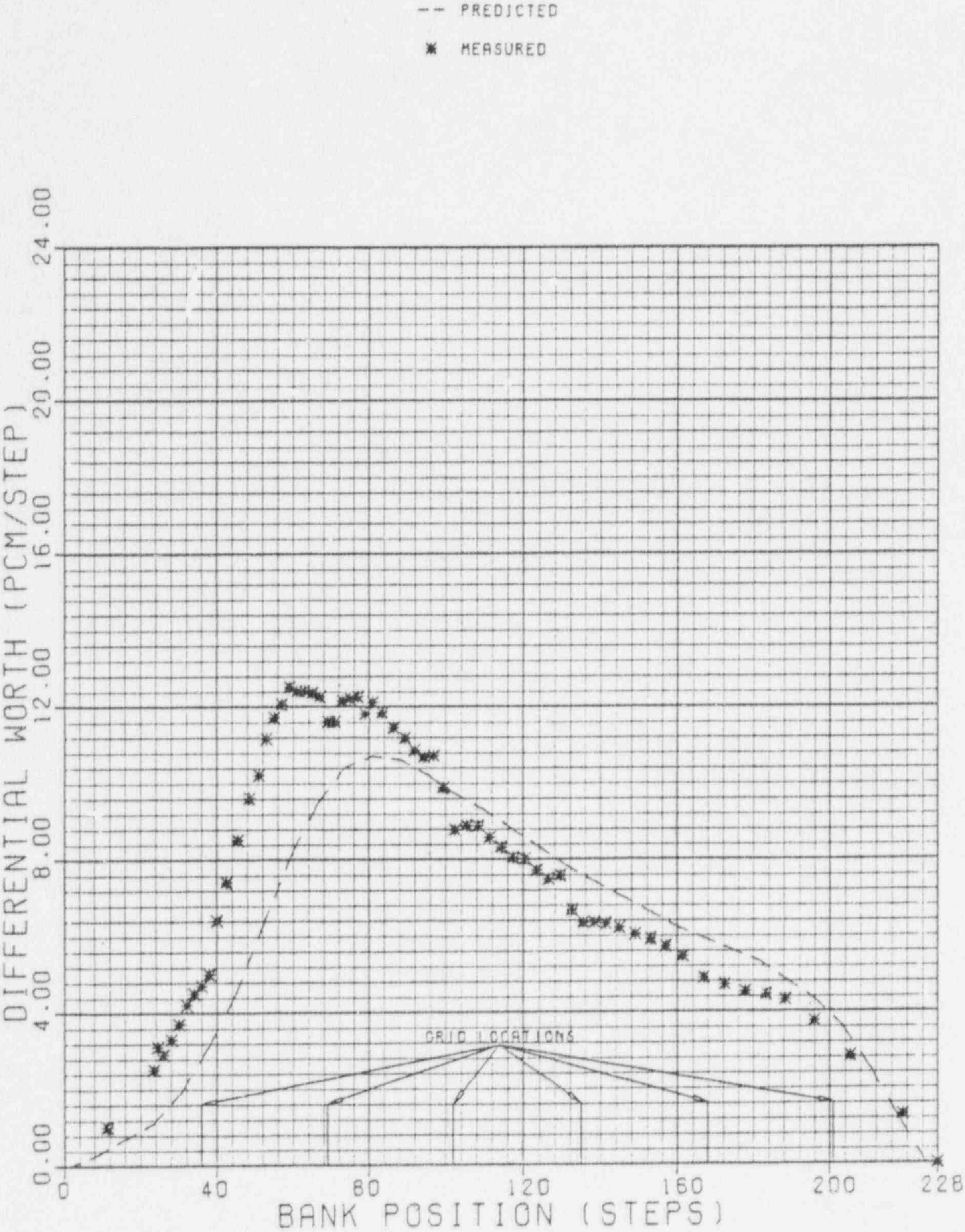


FIGURE 4.2

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST
ROD SWAP REFERENCE BANK
BANK B DIFFERENTIAL ROD WORTH - HZP



Section 5

BORON ENDPOINT AND WORTH MEASUREMENTS

Boron Endpoint

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 banks 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 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 5.1. 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 their respective design tolerances. All measured values met the accident analysis acceptance criterion. In summary, all results were satisfactory.

Boron Worth Coefficient

The measured boron endpoint values provide stable statepoint data from which the boron worth coefficient was determined. A plot of the boron concentration as a function of integrated reactivity can be constructed by relating each endpoint concentration to the integrated

rod worth present in the core at the time of the endpoint measurement. The value of the boron coefficient, over the range of boron endpoint concentrations, is obtained directly from this plot.

The boron worth plot is shown in Figure 5.1. As indicated in this figure and in the Appendix, the boron worth coefficient of reactivity was measured to be -8.54 pcm/ppm. The measured boron worth coefficient is within 4.7% of the predicted value of -8.16 pcm/ppm and is well within the design tolerance of ±10%. The measurement result also met the accident analysis acceptance criterion. In summary, this result was satisfactory.

Table 5.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

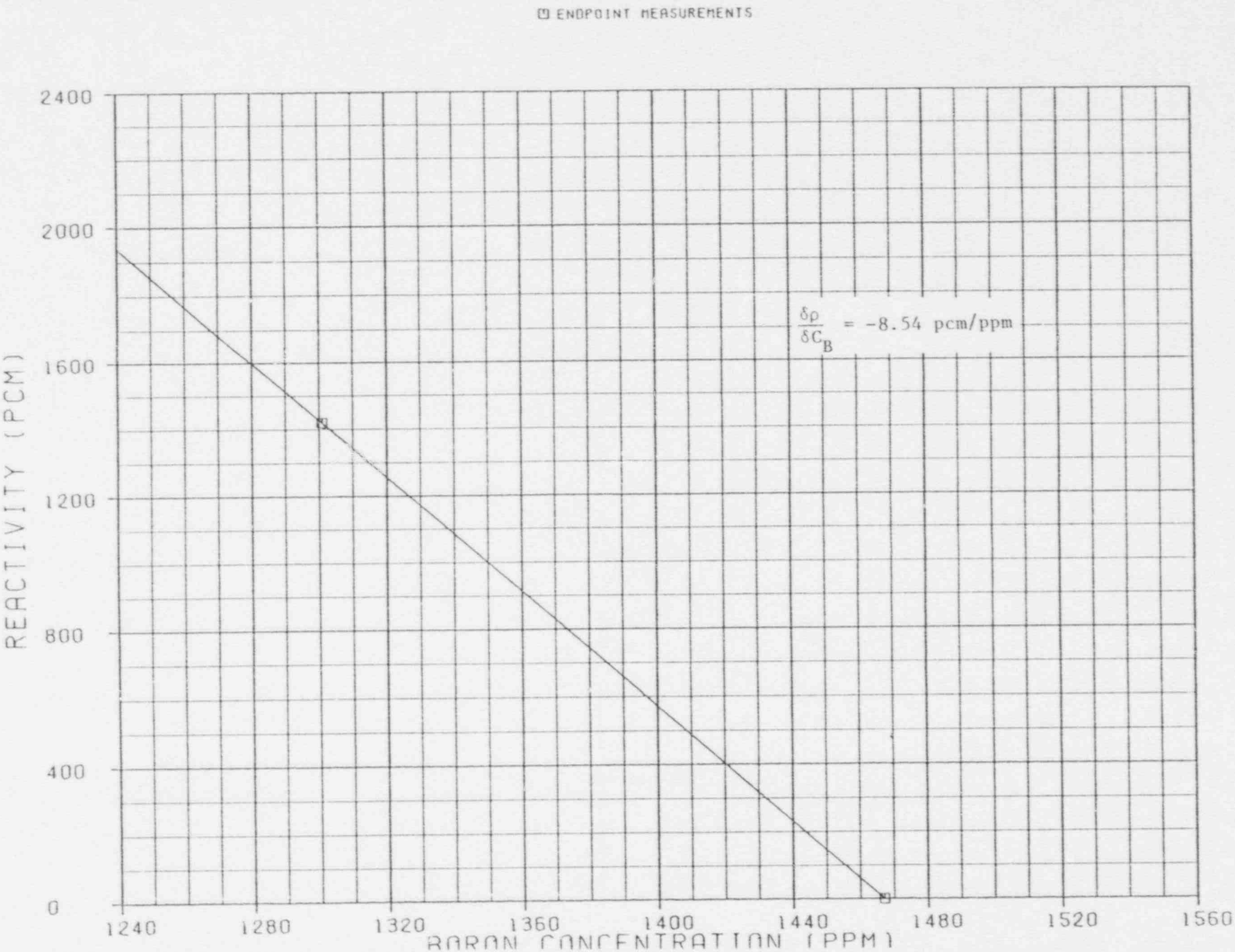
BORON ENDPOINTS SUMMARY

Control Rod Configuration	Measured Endpoint (ppm)	Predicted Endpoint (ppm)	Difference M-P (ppm)
ARO	1466.7	1492	-25.3
B Bank In	1300.7	1304*	-3.3

* The predicted endpoint for the B Bank in configuration has been adjusted for the difference between the measured and predicted values of the endpoint taken at the ARO configuration as shown in the boron endpoint Startup Physics Test Results and Evaluation Sheets in the Appendix.

FIGURE 5.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST
BORON WORTH COEFFICIENT



Section 6

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 and/or steam generator blowdown, 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 543 - 549 °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 6°F. Reactivity was determined using the reactivity computer and was plotted against the RCS temperature on an x-y recorder. The isothermal temperature coefficient was then determined from the slope of the plotted lines. The x-y recorder plots of reactivity changes versus RCS temperature for each measurement are shown in Figures 6.1 and 6.2.

The predicted and measured isothermal temperature coefficient values are compared in Table 6.1. As can be seen from this summary and from the Startup Physics Test Results and Evaluation Sheets given in the

Appendix, all measured isothermal temperature coefficient values were within the design tolerance of ±3 pcm/°F and met the accident analysis acceptance criterion. In summary, all measured results were satisfactory.

Table 6.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TESTS

ISOTHERMAL TEMPERATURE COEFFICIENT SUMMARY

BANK POSITION (steps)		TEMPERATURE RANGE (°F)	BORON CONCENTRATION (PPM)	ISOTHERMAL TEMPERATURE COEFFICIENT (PCM/°F)				
B	D			HEATUP	COOL DOWN	AVER.	PRED.	DIFFER. (M-P)
228	228	542.9-548.5	1487	-4.52	-4.20	-4.36	-3.99	-0.37
9	228	543.1-546.2	1311	-7.30	-7.50	-7.40	-6.66	-0.74

Figure 6.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TESTS

ISOTHERMAL TEMPERATURE COEFFICIENT

HZP, ARO

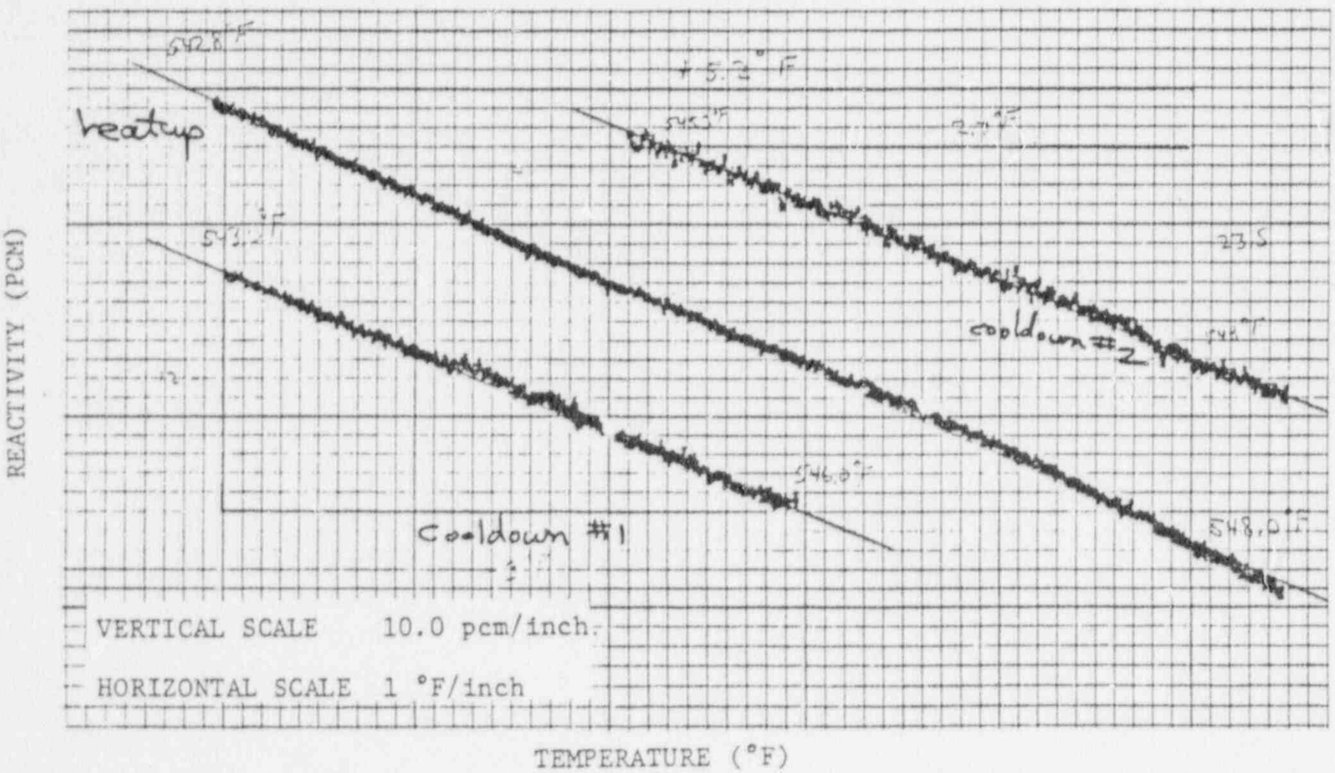
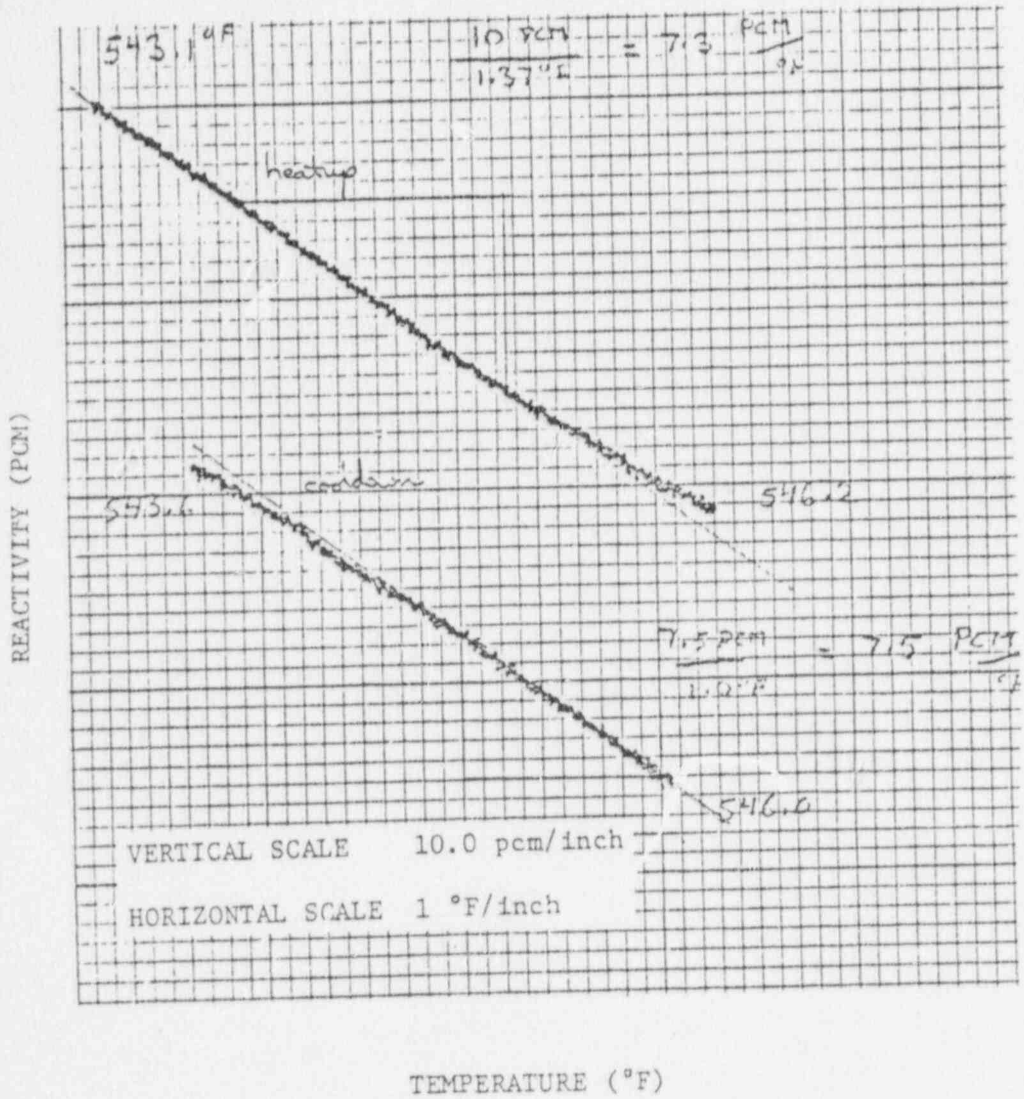


Figure 6.2

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TESTS

ISOTHERMAL TEMPERATURE COEFFICIENT

HZP, E-BANK IN



Section 7

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 1.3). 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[8]. 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 7.1. The measured power distribution parameter values are compared with their Technical Specifications limits in Table 7.2. Flux Maps 2 and 3 were taken at zero power (Map 1 was aborted due to low incore detector signals). These flux maps serve as base case design checks. Figures 7.1 and 7.2 show the resulting radial power distributions associated with these flux maps. These maps indicated the presence of a significant quadrant power tilt (~4%) and some assemblywise relative power values in excess of the design tolerances, but all measured hot channel factor values were within the Technical Specifications limits.

Flux maps 4 through 14 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 7.3 through 7.11. These figures show that the measured relative assembly power values are generally within 8% of the predicted values. Some relative assembly power values were in excess of design tolerances, but all measured hot channel factor values were acceptable. These figures also show that the value of the quadrant power tilt ratio decreased significantly during power ascension.

In conclusion, all power distribution measurement results were considered to be acceptable with respect to the accident analysis acceptance criteria and the Technical Specifications limits. It is therefore anticipated that the core will continue to operate safely throughout Cycle 3.

TABLE 7.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TESTS

INCORE FLUX MAP SUMMARY

MAP DESCRIPTION	MAP NO.	DATE	BURNUP MWD/MTU	PWR (%)	BANK D STEPS	F-Q(T) HOT CHANNEL FACTOR [1] ASSY	PIN	AXIAL POINT	F-Q(T)	F-DH(N) HOT CHNL.FACTOR [2] ASSY	PIN	F-DH(N)	CORE F(Z) MAX AXIAL POINT	F(Z)	F(XY) MAX [3]	QPTR [4] MAX	LOC	AXIAL OFF SET (%)	NO. OF THIMBLES
ARO [5]	2	4- 8-81	0	4	220	J14	JL	21	2.520	J14	JL	1.678	21	1.449	1.796	1.044	SW	16.96	46
D AT 2,C AT 130	3	4- 9-81	0	4	2	L13	OK	38	3.114	L13	OK	1.843	38	1.619	1.960	1.029	SE	-26.50	45
FLUX MAP	4	4-10-81	0	27	58	L13	OK	47	2.824	L13	OK	1.673	48	1.687	1.846	1.013	SE	-34.56	45
FLUX MAP	5	4-11-81	10	27	138	J14	JL	37	2.444	K14	MO	1.570	37	1.483	1.731	1.015	SW	-18.60	45
[6] APDMS FLUX MAP	8	4-14-81	53	50	200	K14	MO	36	2.116	K14	MO	1.544	37	1.307	1.631	1.018	SW	-6.80	45
APDMS FLUX MAP	9	4-15-81	63	49	206	K14	MO	36	2.064	K14	MO	1.545	30	1.278	1.629	1.015	SW	-1.81	46
APDMS FLUX MAP	10	4-15-81	67	61	205	K14	MO	36	2.040	K14	MO	1.528	30	1.276	1.606	1.014	SW	-2.84	46
APDMS, I/E CAL.	11	4-15-81	73	74	190	K14	MN	36	2.124	K14	MN	1.509	38	1.343	1.591	1.016	SW	-12.15	46
APDMS, I/E CAL.	12	4-15-81	78	79	180	K14	MN	38	2.200	K14	MN	1.505	39	1.397	1.629	1.015	SW	-18.95	46
APDMS, I/E CAL.	13	4-16-81	88	85	210	K14	MN	28	1.983	K14	MN	1.498	28	1.275	1.574	1.013	SW	2.88	46
HFP, EQ.XENON	14	4-27-81	487	100	224	K14	MN	37	1.953	K14	MN	1.474	38	1.264	1.553	1.013	SW	-7.88	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 "Y" COORDINATE WITH THE SEVENTEEN ROWS OF FUEL RODS LETTERED A THROUGH Q 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.

1. F-Q(T) INCLUDES A TOTAL UNCERTAINTY OF 1.05 X 1.03

2. F-DH(N) INCLUDES A MEASUREMENT UNCERTAINTY OF 1.04

3. F(XY) MAX. INCLUDES A TOTAL UNCERTAINTY OF 1.05 X 1.03.

4. QPTR - QUADRANT POWER TILT RATIO.

5. MAP 1 WAS ABORTED DUE TO LOW DETECTOR SIGNAL.

6. MAPS 6 AND 7 WERE QUARTER CORE M/D FLUX MAPS.

Table 7.2

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TESTS

COMPARISION OF MEASURED POWER DISTRIBUTION PARAMETERS

WITH THEIR TECHNICAL SPECIFICATIONS LIMITS

MAP NO.	F-Q(T) HOT CHANNEL FACTOR[1]			F-DH(N) HOT CHANNEL FACTOR[2]			F(XY) MAX[3]			
	MEAS	LIMIT	MARGIN (%)	MEAS	LIMIT	MARGIN (%)	MEAS	AXIAL POINT	LIMIT	MARGIN (%)
4	2.82	4.20	+32.8	1.67	1.78	+6.2	1.85	10	1.96	+5.8
5	2.44	4.20	+41.8	1.57	1.78	+11.8	1.73	22	1.96	+11.7
8	2.12	4.20	+49.6	1.54	1.71	+9.9	1.63	44	1.73	+5.6
9	2.06	4.20	+50.9	1.55	1.71	+9.4	1.63	44	1.73	+5.8
10	2.04	3.47	+41.2	1.53	1.67	+8.4	1.61	44	1.69	+5.2
11	2.12	2.83	+25.0	1.51	1.63	+7.4	1.59	36	1.65	+3.6
12	2.20	2.65	+16.8	1.51	1.61	+6.2	1.63	10	1.78	+8.4
13	1.98	2.46	+19.3	1.50	1.60	+6.3	1.57	44	1.62	+3.1
14	1.95	2.10	+6.8	1.47	1.55	+5.2	1.55	35	1.57	+1.3

1 The Technical Specifications limit for the heat flux hot channel factor, F-Q(T) is a function of core height. The value for F-Q(T) listed above is the maximum 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 differences between the measured values of F-Q(T) and the Technical Specifications limit for each map. All measured F-Q(T) hot channel factors include 5% measurement uncertainty and 3% engineering uncertainty.

2 The measured values for the enthalpy rise hot channel factor, F-dH(N), includes 4% measurement uncertainty.

3 All measured F(XY) MAX values include 5% measurement uncertainty and 3% engineering uncertainty.

Figure 7.1

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

HZP, ARO

Legend (each location): PREDICTED / MEASURED / PCT DIFFERENCE

Row		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	Predicted							0.36	0.71	0.36						
	Measured							0.36	0.70	0.36						
	Pct Difference							-1.4	-1.4	-1.7						
2	Predicted					0.39	0.98	1.18	1.16	1.18	0.98	0.39				
	Measured					0.39	0.93	1.13	1.11	1.14	0.96	0.39				
	Pct Difference					0.2	-5.3	-4.1	-4.1	-2.9	-2.0	-0.3				
3	Predicted				0.38	1.11	1.23	1.23	1.03	1.23	1.23	1.11	0.38			
	Measured				0.37	1.08	1.17	1.15	0.97	1.16	1.18	1.08	0.39			
	Pct Difference				-1.9	-2.1	-4.9	-6.2	-6.3	-5.4	-3.9	-2.0	1.6			
4	Predicted			0.38	0.94	1.21	1.25	1.21	1.13	1.21	1.25	1.21	0.94	0.38		
	Measured			0.38	0.92	1.17	1.18	1.13	1.05	1.14	1.19	1.18	0.92	0.38		
	Pct Difference			0.5	-2.3	-3.4	-5.7	-6.6	-6.7	-6.5	-5.0	-3.1	-2.1	0.5		
5	Predicted		0.39	1.11	1.21	1.28	1.21	0.94	1.02	0.94	1.21	1.28	1.21	1.11	0.39	
	Measured		0.40	1.12	1.17	1.22	1.14	0.86	0.93	0.87	1.14	1.22	1.16	1.10	0.41	
	Pct Difference		0.8	0.8	-3.3	-4.7	-5.4	-8.5	-8.6	-7.4	-5.2	-4.8	-4.0	-0.1	3.8	
6	Predicted		0.98	1.23	1.25	1.21	0.94	1.02	1.15	1.02	0.94	1.21	1.25	1.23	0.98	
	Measured		1.01	1.26	1.24	1.15	0.88	0.94	1.06	0.94	0.88	1.15	1.20	1.21	1.00	
	Pct Difference		2.7	2.7	-1.1	-4.7	-5.7	-7.8	-7.9	-7.8	-5.8	-4.5	-4.1	-1.3	1.5	
7	Predicted	0.36	1.18	1.23	1.21	0.94	1.02	1.13	1.14	1.13	1.02	0.94	1.21	1.23	1.18	0.36
	Measured	0.38	1.23	1.29	1.20	0.90	0.97	1.04	1.05	1.05	0.96	0.89	1.19	1.21	1.17	0.36
	Pct Difference	4.6	4.6	4.6	-1.3	-4.4	-4.9	-7.8	-7.9	-7.4	-6.5	-5.2	-2.4	-1.7	-0.6	-0.8
8	Predicted	0.71	1.16	1.03	1.13	1.02	1.15	1.14	0.84	1.14	1.15	1.02	1.13	1.03	1.16	0.71
	Measured	0.74	1.21	1.08	1.13	0.99	1.11	1.07	0.80	1.08	1.09	0.97	1.10	1.01	1.19	0.75
	Pct Difference	4.6	4.6	4.6	-0.4	-2.9	-3.8	-5.9	-5.1	-5.1	-5.1	-5.0	-2.2	-1.6	3.2	5.3
9	Predicted	0.36	1.18	1.23	1.21	0.94	1.02	1.13	1.14	1.13	1.02	0.94	1.21	1.23	1.18	0.36
	Measured	0.37	1.20	1.25	1.20	0.92	1.00	1.12	1.13	1.08	0.98	0.90	1.21	1.24	1.23	0.39
	Pct Difference	1.8	1.8	1.8	-1.2	-2.5	-2.0	-0.7	-1.3	-4.1	-4.3	-4.0	-0.6	0.8	5.0	7.8
10	Predicted		0.98	1.23	1.25	1.21	0.94	1.02	1.15	1.02	0.94	1.21	1.25	1.23	0.98	
	Measured		1.00	1.25	1.25	1.20	0.93	1.03	1.15	1.02	0.93	1.20	1.24	1.25	1.05	
	Pct Difference		1.8	1.8	0.4	-0.4	-0.5	0.2	-0.3	-0.8	-1.1	-0.9	-0.4	1.4	7.0	
11	Predicted		0.39	1.11	1.21	1.28	1.21	0.94	1.02	0.94	1.21	1.28	1.21	1.11	0.39	
	Measured		0.41	1.15	1.24	1.28	1.23	0.97	1.05	0.96	1.22	1.28	1.23	1.14	0.41	
	Pct Difference		3.9	3.9	2.5	-0.3	2.0	2.6	2.5	1.7	1.2	0.5	1.6	2.9	4.7	
12	Predicted			0.38	0.94	1.21	1.25	1.21	1.13	1.21	1.25	1.21	0.94	0.38		
	Measured			0.40	0.97	1.21	1.29	1.30	1.21	1.29	1.29	1.26	0.97	0.40		
	Pct Difference			6.0	3.0	-0.3	3.5	7.1	7.1	6.1	3.6	3.5	3.1	5.7		
13	Predicted				0.38	1.11	1.23	1.23	1.03	1.23	1.23	1.11	0.38			
	Measured				0.42	1.27	1.36	1.35	1.14	1.36	1.35	1.20	0.40			
	Pct Difference				10.3	14.6	10.9	9.9	10.7	11.0	10.0	8.3	5.7			
14	Predicted					0.39	0.98	1.18	1.16	1.16	0.98	0.39				
	Measured					0.45	1.15	1.36	1.32	1.31	1.08	0.43				
	Pct Difference					14.7	16.7	15.8	14.3	11.1	10.2	8.3				
15	Predicted							0.36	0.71	0.36						
	Measured							0.43	0.82	0.41						
	Pct Difference							18.8	15.5	12.1						

STANDARD DEVIATION =3.711

AVERAGE PCT DIFFERENCE = 4.5

MAP NO: N1-3- 2 DATE: 4/ 8/81 POWER: 4%

CONTROL ROD POSITIONS: F-Q(T) = 2.520 QPTR:

D BANK AT 220 STEPS F-DH(N) = 1.678

NW 0.967	NE 0.960
SW 1.044	SE 1.029

F(Z) = 1.449

F(XY) = 1.796

BURNUP = 0 MWD/MTU A.O = 16.96(%)

Figure 7.2

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

HZP, D - BANK AT 2 STEPS

C - BANK AT 130 STEPS

PREDICTED / MEASURED / PCT DIFFERENCE

Row		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	Predicted							0.29	0.47	0.29						
	Measured							0.30	0.48	0.30						
	Pct Difference							3.5	3.5	3.1						
2	Predicted					0.46	1.08	1.03	0.55	1.03	1.08	0.46				
	Measured					0.48	1.04	1.02	0.54	1.04	1.10	0.49				
	Pct Difference					2.4	-3.0	-1.4	-1.3	0.6	2.7	4.5				
3	Predicted				0.44	1.31	1.40	1.27	0.96	1.27	1.40	1.31	0.44			
	Measured				0.43	1.29	1.35	1.21	0.91	1.24	1.41	1.34	0.47			
	Pct Difference				-0.7	-1.1	-3.7	-4.3	-4.4	-2.4	0.4	2.5	6.4			
4	Predicted			0.44	0.98	1.38	1.41	1.32	1.21	1.32	1.41	1.38	0.98	0.44		
	Measured			0.44	0.97	1.35	1.35	1.26	1.15	1.27	1.40	1.39	1.00	0.46		
	Pct Difference			1.0	-1.8	-2.6	-4.6	-4.7	-4.8	-4.0	-1.0	0.6	1.7	4.3		
5	Predicted		0.46	1.31	1.38	1.38	1.20	0.95	1.03	0.95	1.20	1.38	1.38	1.31	0.46	
	Measured		0.46	1.30	1.33	1.31	1.13	0.88	0.96	0.90	1.18	1.36	1.37	1.35	0.50	
	Pct Difference		-0.4	-0.4	-3.8	-5.0	-5.3	-7.3	-7.5	-5.2	-1.5	-1.6	-1.0	3.1	8.0	
6	Predicted		1.08	1.40	1.41	1.20	0.53	0.89	1.01	0.89	0.53	1.20	1.41	1.40	1.08	
	Measured		1.08	1.41	1.38	1.13	0.50	0.82	0.91	0.82	0.51	1.18	1.40	1.42	1.13	
	Pct Difference		0.8	0.8	-2.3	-5.3	-5.7	-8.1	-9.1	-7.4	-3.3	-1.5	-1.1	1.7	5.0	
7	Predicted	0.29	1.03	1.27	1.32	0.95	0.89	1.03	1.06	1.03	0.89	0.95	1.32	1.27	1.03	0.29
	Measured	0.29	1.05	1.29	1.28	0.89	0.83	0.93	0.97	0.95	0.83	0.91	1.32	1.27	1.05	0.29
	Pct Difference	1.9	1.9	1.9	-3.2	-6.1	-6.4	-9.1	-9.0	-7.8	-6.4	-3.7	-0.4	0.4	1.2	1.8
8	Predicted	0.47	0.55	0.96	1.21	1.03	1.01	1.06	0.81	1.06	1.01	1.03	1.21	0.96	0.55	0.47
	Measured	0.48	0.56	0.98	1.18	0.99	0.95	0.99	0.76	0.99	0.93	0.98	1.20	0.96	0.58	0.50
	Pct Difference	1.9	1.9	1.9	-2.1	-4.4	-5.8	-7.5	-6.1	-6.6	-7.5	-5.0	-0.3	0.4	5.0	7.6
9	Predicted	0.29	1.03	1.27	1.32	0.95	0.89	1.03	1.06	1.03	0.89	0.95	1.32	1.27	1.03	0.29
	Measured	0.29	1.04	1.27	1.29	0.91	0.85	0.95	1.03	0.97	0.84	0.90	1.32	1.28	1.10	0.31
	Pct Difference	0.3	0.3	0.4	-2.4	-3.9	-4.2	-7.2	-3.0	-5.8	-5.7	-4.5	0.0	1.3	6.0	9.1
10	Predicted		1.08	1.40	1.41	1.20	0.53	0.89	1.01	0.89	0.53	1.20	1.41	1.40	1.08	
	Measured		1.08	1.41	1.40	1.18	0.52	0.88	0.98	0.87	0.52	1.18	1.41	1.43	1.16	
	Pct Difference		0.4	0.5	-0.7	-1.4	-1.5	-0.5	-2.6	-2.3	-1.5	-1.1	0.3	1.9	8.2	
11	Predicted		0.46	1.31	1.38	1.38	1.20	0.95	1.03	0.95	1.20	1.38	1.38	1.31	0.46	
	Measured		0.48	1.36	1.41	1.36	1.21	0.96	1.05	0.95	1.21	1.39	1.42	1.36	0.49	
	Pct Difference		3.5	3.6	2.0	[illegible]	1.0	1.7	1.5	0.2	0.8	0.5	3.0	4.1	6.1	
12	Predicted			0.44	0.98	1.38	1.41	1.32	1.21	1.32	1.41	1.38	0.98	0.44		
	Measured			0.47	1.01	1.37	1.43	1.37	1.25	1.38	1.45	1.42	1.03	0.47		
	Pct Difference			6.4	2.7	-1.2	1.1	3.8	3.9	4.0	3.0	3.0	5.2	8.1		
13	Predicted				0.44	1.31	1.40	1.27	0.96	1.27	1.40	1.31	0.44			
	Measured				0.47	1.44	1.49	1.34	1.02	1.37	1.51	1.40	0.47			
	Pct Difference				8.3	9.8	6.4	5.5	6.8	8.0	8.0	7.3	8.1			
14	Predicted					0.46	1.08	1.03	0.55	1.03	1.08	0.46				
	Measured					0.51	1.21	1.16	0.61	1.12	1.16	0.50				
	Pct Difference					9.7	12.9	12.[illegible]	10.9	8.0	8.0	7.2				
15	Predicted							0.29	0.47	0.29						
	Measured							0.33	0.53	0.31						
	Pct Difference							16.4	12.7	8.9						

STANDARD DEVIATION =3.147

AVERAGE PCT DIFFERENCE = 4.0

MAP NO: N1-3- 3

DATE: 4/ 9/81

POWER: 4%

CONTROL ROD POSITIONS:

D BANK AT 2 STEPS

C BANK AT 130 STEPS

F-Q(T) = 3.114

F-DH(N) = 1.843

F(Z) = 1.619

F(XY) = 1.960

BURNUP = 0 MWD/MTU

A.O = -26.50(%)

QPTR:

NW 0.963	NE 0.988
SW 1.020	SE 1.029

Figure 7.3

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

PRELIM I/E CAL FLUX MAP

PREDICTED
MEASURED
PCT DIFFERENCE

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.31	0.55	0.31							1
						0.33	0.57	0.33							
						5.1	4.6	5.5							
				0.43	0.97	1.03	0.78	1.03	0.97	0.43					2
				0.45	0.99	1.06	0.79	1.07	1.03	0.46					
				5.1	1.4	2.3	1.4	3.9	5.7	6.8					
			0.43	1.17	1.25	1.20	0.97	1.20	1.25	1.17	0.43				3
			0.44	1.20	1.25	1.19	0.96	1.21	1.30	1.23	0.47				
			2.2	1.9	0.2	-0.8	-0.9	0.8	3.6	5.1	7.9				
		0.43	1.03	1.28	1.30	1.25	1.17	1.25	1.30	1.28	1.03	0.43			4
		0.45	1.04	1.28	1.28	1.22	1.15	1.23	1.32	1.32	1.07	0.46			
		3.9	0.8	-0.1	-1.8	-1.7	-1.8	-0.9	1.5	3.0	3.6	6.7			
	0.43	1.17	1.28	1.32	1.19	0.99	1.09	0.99	1.19	1.32	1.28	1.17	0.43		5
	0.44	1.21	1.26	1.28	1.15	0.92	1.01	0.94	1.19	1.32	1.30	1.25	0.48		
	2.9	2.9	-1.7	-3.2	-3.3	-7.0	-7.3	-5.0	-0.2	0.3	1.3	6.2	11.0		
	0.97	1.25	1.30	1.19	0.74	1.04	1.23	1.04	0.74	1.19	1.30	1.25	0.97		6
	1.00	1.29	1.30	1.14	0.70	0.95	1.12	0.95	0.71	1.19	1.32	1.30	1.05		
	3.1	3.1	-0.6	-4.3	-5.1	-8.6	-9.3	-9.0	-4.0	-0.2	1.0	4.2	7.5		
0.31	1.03	1.20	1.25	0.99	1.04	1.20	1.23	1.20	1.04	0.99	1.25	1.20	1.03	0.31	7
0.32	1.06	1.24	1.21	0.93	0.96	1.07	1.10	1.09	0.96	0.95	1.26	1.23	1.06	0.32	
3.0	3.1	3.2	-3.2	-6.6	-7.3	-10.8	-10.8	-9.3	-7.8	-4.3	1.0	2.0	2.7	3.1	
0.55	0.78	0.97	1.17	1.09	1.23	1.23	0.94	1.23	1.23	1.09	1.17	0.97	0.78	0.55	8
0.57	0.80	1.00	1.13	1.02	1.14	1.12	0.86	1.12	1.12	1.02	1.18	0.99	0.82	0.60	
2.8	2.5	3.1	-3.2	-6.5	-7.1	-8.6	-8.5	-9.1	-9.2	-6.5	1.1	1.9	5.2	8.4	
0.31	1.03	1.20	1.25	0.99	1.04	1.20	1.23	1.20	1.04	0.99	1.25	1.20	1.03	0.31	9
0.32	1.05	1.22	1.20	0.93	0.97	1.10	1.15	1.10	0.95	0.93	1.26	1.24	1.11	0.35	
1.9	1.8	1.8	-3.7	-6.2	-6.2	-8.6	-6.6	-8.6	-8.7	-6.2	1.5	3.2	7.9	11.0	
	0.97	1.25	1.30	1.19	0.74	1.04	1.23	1.04	0.74	1.19	1.30	1.25	0.97		10
	0.99	1.27	1.29	1.16	0.72	0.97	1.15	0.98	0.71	1.16	1.31	1.30	1.08		
	1.8	1.8	-1.3	-2.8	-2.6	-6.1	-6.3	-6.1	-4.4	-2.6	0.4	4.0	10.6		
	0.43	1.17	1.28	1.32	1.19	0.99	1.09	0.99	1.19	1.32	1.28	1.17	0.43		11
	0.44	1.21	1.30	1.30	1.19	0.96	1.06	0.95	1.18	1.31	1.31	1.23	0.46		
	2.9	2.8	1.4	-1.4	-0.5	-2.9	-3.2	-3.9	-1.1	-0.4	2.4	5.0	6.8		
		0.43	1.03	1.28	1.30	1.25	1.17	1.25	1.30	1.28	1.03	0.43			12
		0.45	1.04	1.26	1.30	1.25	1.17	1.26	1.32	1.30	1.06	0.46			
		3.8	1.3	-1.4	-0.5	0.1	0.1	1.1	1.4	1.3	3.2	6.8			
			0.43	1.17	1.25	1.20	0.97	1.20	1.25	1.17	0.43				13
			0.47	1.33	1.34	1.24	1.02	1.28	1.34	1.25	0.46				
			8.4	13.0	6.7	3.1	4.7	6.6	7.0	6.3	6.8				
				0.43	0.97	1.03	0.78	1.03	0.97	0.43					14
				0.48	1.11	1.14	0.84	1.10	1.04	0.46					
				13.0	14.0	10.2	8.1	6.5	7.0	6.3					
						0.31	0.55	0.31							15
						0.36	0.61	0.34							
						14.1	10.5	7.4							

STANDARD DEVIATION =3.253

AVERAGE PCT DIFFERENCE = 4.6

MAP NO: N1-3- 4 DATE: 4/10/81 POWER: 27%

CONTROL ROD POSITIONS: F-Q(T) = 2.824 QPTR:

D BANK AT 58 STEPS F-DH(N) = 1.673

NW 0.982	NE 1.007
SW 0.999	SE 1.013

F(Z) = 1.687

F(XY) = 1.846

BURNUP = 0 MWD/MTU A.O = -34.56(%)

Figure 7.4

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

PRELIM I/E CAL FLUX MAP

PREDICTED / MEASURED / PCT DIFFERENCE

Row		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	Predicted							0.34	0.64	0.34						
	Measured							0.34	0.63	0.36						
	Pct Difference							-0.4	-1.1	3.6						
2	Predicted					0.41	0.96	1.10	0.99	1.10	0.96	0.41				
	Measured					0.42	0.96	1.09	0.98	1.11	1.00	0.43				
	Pct Difference					2.6	-0.3	-0.7	-0.9	1.3	3.3	5.2				
3	Predicted				0.41	1.12	1.22	1.21	1.01	1.21	1.22	1.12	0.41			
	Measured				0.41	1.13	1.21	1.18	0.99	1.20	1.23	1.15	0.44			
	Pct Difference				0.9	0.7	-0.6	-1.9	-2.1	-0.9	1.2	3.3	7.3			
4	Predicted			0.41	0.97	1.22	1.26	1.22	1.15	1.22	1.26	1.22	0.97	0.41		
	Measured			0.42	0.98	1.22	1.24	1.19	1.12	1.19	1.26	1.24	0.99	0.43		
	Pct Difference			3.2	0.6	-0.5	-2.2	-2.8	-2.9	-2.3	-0.6	1.4	2.3	4.8		
5	Predicted		0.41	1.12	1.22	1.29	1.20	0.98	1.07	0.98	1.20	1.29	1.22	1.12	0.41	
	Measured		0.43	1.16	1.21	1.26	1.16	0.92	1.00	0.93	1.18	1.27	1.22	1.16	0.44	
	Pct Difference		3.8	3.8	-0.8	-2.4	-3.0	-6.5	-6.6	-5.0	-1.8	-1.3	-0.3	3.6	7.6	
6	Predicted		0.96	1.22	1.26	1.20	0.87	1.06	1.21	1.06	0.87	1.20	1.26	1.22	0.96	
	Measured		1.00	1.27	1.27	1.16	0.84	0.98	1.12	0.98	0.83	1.18	1.25	1.24	1.01	
	Pct Difference		4.1	4.1	0.4	-3.7	-4.4	-7.1	-7.5	-7.5	-4.7	-1.9	-1.1	1.9	5.3	
7	Predicted	0.34	1.10	1.21	1.22	0.98	1.06	1.19	1.21	1.19	1.06	0.98	1.22	1.21	1.10	0.34
	Measured	0.36	1.14	1.26	1.20	0.93	1.00	1.09	1.11	1.10	0.98	0.94	1.20	1.21	1.11	0.36
	Pct Difference	4.2	4.3	4.3	-1.9	-5.2	-5.7	-8.0	-8.1	-7.4	-6.7	-4.7	-1.4	0.1	1.6	3.0
8	Predicted	0.64	0.99	1.01	1.15	1.07	1.21	1.21	0.92	1.21	1.21	1.07	1.15	1.01	0.99	0.64
	Measured	0.67	1.03	1.05	1.14	1.03	1.15	1.13	0.86	1.13	1.13	1.01	1.14	1.01	1.04	0.69
	Pct Difference	4.2	4.2	4.3	-1.3	-4.2	-4.9	-6.5	-6.0	-6.6	-6.7	-5.9	-1.3	0.1	5.2	8.4
9	Predicted	0.34	1.10	1.21	1.22	0.98	1.06	1.19	1.21	1.19	1.06	0.98	1.22	1.21	1.10	0.34
	Measured	0.35	1.12	1.23	1.20	0.95	1.01	1.13	1.15	1.12	0.99	0.93	1.21	1.22	1.17	0.38
	Pct Difference	2.2	2.2	2.1	-1.9	-3.8	-4.4	-5.4	-4.5	-6.1	-6.4	-5.7	-1.0	1.0	6.4	9.9
10	Predicted		0.96	1.22	1.26	1.20	0.87	1.06	1.21	1.06	0.87	1.20	1.26	1.22	0.96	
	Measured		0.98	1.24	1.26	1.18	0.85	1.00	1.16	1.01	0.84	1.16	1.25	1.23	1.05	
	Pct Difference		2.1	2.1	-0.4	-1.6	-3.1	-4.9	-4.4	-4.4	-3.7	-3.0	-1.4	1.5	9.0	
11	Predicted		0.41	1.12	1.22	1.29	1.20	0.98	1.07	0.98	1.20	1.29	1.22	1.12	0.41	
	Measured		0.43	1.16	1.24	1.26	1.18	0.96	1.05	0.95	1.18	1.27	1.24	1.15	0.44	
	Pct Difference		3.8	3.8	1.7	-2.2	-1.5	-2.2	-2.3	-2.9	-1.2	-1.4	1.3	3.3	5.8	
12	Predicted			0.41	0.97	1.22	1.26	1.22	1.15	1.22	1.26	1.22	0.97	0.41		
	Measured			0.43	0.99	1.20	1.27	1.25	1.18	1.24	1.27	1.23	1.00	0.43		
	Pct Difference			5.5	1.7	-2.2	0.5	2.2	2.1	1.6	0.7	0.6	3.1	6.8		
13	Predicted				0.41	1.12	1.22	1.21	1.01	1.21	1.22	1.12	0.41			
	Measured				0.44	1.23	1.30	1.27	1.08	1.29	1.30	1.17	0.43			
	Pct Difference				7.9	10.4	6.8	5.3	6.7	7.1	6.7	4.5	6.8			
14	Predicted					0.41	0.96	1.10	0.99	1.10	0.96	0.41				
	Measured					0.45	1.09	1.22	1.09	1.18	1.03	0.43				
	Pct Difference					10.5	13.1	11.6	10.4	7.4	7.0	4.5				
15	Predicted							0.34	0.64	0.34						
	Measured							0.40	0.72	0.38						
	Pct Difference							15.4	12.4	9.4						

STANDARD DEVIATION =2.927

AVERAGE PCT DIFFERENCE = 4.0

MAP NO: N1-3- 5 DATE: 4/11/81 POWER: 27%

CONTROL ROD POSITIONS: F-Q(T) = 2.444 QPTR:

D BANK AT 138 STEPS F-DH(N) = 1.570

NW 0.984	NE 0.989
SW 1.015	SE 1.013

F(Z) = 1.483

F(XY) = 1.731

BURNUP = 10 MWD/MTU A.O = -13.60(%)

Figure 7.5

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

APDMS - FLUX MAP

PREDICTED / MEASURED / PCT DIFFERENCE

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.36 0.39 8.5	0.68 0.73 8.3	0.36 0.38 6.8						
2					0.40 0.42 5.4	0.94 0.93 -0.2	1.12 1.14 2.5	1.10 1.12 2.3	1.12 1.16 4.2	0.94 0.98 4.7	0.40 0.42 5.7				
3				0.39 0.40 2.2	1.07 1.09 1.8	1.18 1.17 -0.9	1.21 1.18 -2.1	1.03 1.01 -2.3	1.21 1.19 -1.0	1.18 1.20 1.3	1.07 1.10 3.2	0.39 0.41 6.8			
4			0.39 0.40 4.1	0.93 0.94 0.9	1.18 1.18 -0.1	1.24 1.21 -2.6	1.21 1.17 -3.1	1.15 1.11 -3.2	1.21 1.18 -3.0	1.24 1.21 -2.3	1.18 1.19 0.3	0.93 0.94 1.3	0.39 0.41 5.4		
5		0.40 0.41 3.0	1.07 -1.10 3.0	1.18 1.16 -1.5	1.27 1.23 -3.1	1.21 1.17 -3.6	0.99 0.93 -6.8	1.08 1.00 -7.0	0.99 0.94 -5.6	1.21 1.17 -3.0	1.27 1.24 -2.4	1.18 1.16 -1.5	1.07 1.12 4.6	0.40 0.43 9.8	
6		0.94 0.97 3.5	1.18 1.22 3.5	1.24 1.24 -0.2	1.21 1.16 -3.8	0.97 0.93 -5.0	1.09 1.01 -7.2	1.23 1.14 -7.3	1.09 1.01 -7.1	0.97 0.93 -4.7	1.21 1.18 -2.8	1.24 1.21 -2.3	1.18 1.21 2.3	0.94 1.00 6.8	
7	0.36 0.37 3.8	1.12 1.16 3.9	1.21 1.25 3.9	1.21 1.18 -2.3	0.99 0.94 -5.6	1.09 1.02 -6.0	1.21 1.12 -8.0	1.22 1.12 -7.8	1.21 1.13 -7.2	1.09 1.02 -6.4	0.99 0.94 -5.2	1.21 1.19 -2.0	1.21 1.21 0.1	1.12 1.14 2.2	0.36 0.37 3.7
8	0.68 0.70 3.8	1.10 1.14 3.8	1.03 1.07 3.9	1.15 1.13 -2.0	1.08 1.02 -4.9	1.23 1.16 -5.4	1.22 1.14 -6.6	0.93 0.87 -6.1	1.22 1.14 -6.8	1.23 1.14 -6.9	1.08 1.01 -6.4	1.15 1.13 -1.7	1.03 1.03 0.1	1.10 1.16 5.9	0.68 0.74 9.3
9	0.36 0.37 2.7	1.12 1.14 2.6	1.21 1.24 2.5	1.21 1.18 -2.3	0.99 0.95 -4.6	1.09 1.04 -4.7	1.21 1.13 -6.6	1.22 1.16 -4.8	1.21 1.13 -6.6	1.09 1.01 -6.9	0.99 0.93 -6.1	1.21 1.20 -1.3	1.21 1.22 1.4	1.12 1.20 7.5	0.36 0.40 11.3
10		0.94 0.96 2.5	1.18 1.21 2.5	1.24 1.23 -0.7	1.21 1.18 -2.4	0.97 0.95 -2.3	1.09 1.04 -4.4	1.23 1.17 -4.6	1.09 1.04 -4.9	0.97 0.93 -4.1	1.21 1.17 -3.4	1.24 1.22 -1.8	1.18 1.21 2.0	0.94 1.03 10.5	
11		0.40 0.41 4.8	1.07 1.12 4.8	1.18 1.21 2.3	1.27 1.24 -2.3	1.21 1.20 -0.6	0.99 0.98 -1.6	1.08 1.06 -1.9	0.99 0.96 -3.4	1.21 1.19 -1.5	1.27 1.25 -1.8	1.18 1.20 1.2	1.07 1.11 3.8	0.40 0.42 7.0	
12			0.39 0.42 7.1	0.93 0.96 2.5	1.18 1.15 -2.3	1.24 1.23 -0.6	1.21 1.22 1.0	1.15 1.16 1.0	1.21 1.22 1.0	1.24 1.25 0.5	1.18 1.19 0.5	0.93 0.96 3.5	0.39 0.42 7.2		
13				0.39 0.43 9.7	1.07 1.20 12.2	1.18 1.26 6.6	1.21 1.25 3.6	1.03 1.09 5.4	1.21 1.28 6.5	1.18 1.26 6.4	1.07 1.11 4.5	0.39 0.42 7.2			
14					0.40 0.44 12.2	0.94 1.07 14.2	1.12 1.24 11.3	1.10 1.21 10.0	1.12 1.19 6.6	0.94 1.00 6.6	0.40 0.41 4.5				
15							0.36 0.42 16.1	0.68 0.76 12.5	0.36 0.39 8.6						

PREDICTED / MEASURED / PCT DIFFERENCE

STANDARD DEVIATION =3.033

AVERAGE PCT DIFFERENCE 4.4

MAP NO: N1-3- 8 DATE: 4/14/81 POWER: 50%

CONTROL ROD POSITIONS: F-Q(T) = 2.126 QPTR:

D BANK AT 200 STEPS F-DH(N) = 1.544

NW 0.983	NE 0.991
SW 1.018	SE 1.008

F(Z) = 1.307

F(XY) = 1.631

BURNUP = 53 MWD/MTU A.O = -6.80(%)

Figure 7.6

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

APDMS - FLUX MAP

PREDICTED
MEASURED
PCT DIFFERENCE

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.36 0.39 8.3	0.68 0.74 8.2	0.36 0.39 7.4						
2					0.39 0.41 4.2	0.94 0.93 -0.4	1.12 1.15 2.5	1.11 1.13 2.4	1.12 1.17 4.9	0.94 1.00 6.4	0.39 0.42 7.2				
3				0.39 0.39 1.0	1.06 1.07 0.7	1.18 1.16 -1.6	1.21 1.19 -1.5	1.03 1.02 -1.6	1.21 1.21 0.0	1.18 1.21 2.3	1.06 1.11 4.4	0.39 0.42 8.2			
4			0.39 0.40 3.5	0.93 0.93 0.2	1.18 1.17 -0.9	1.24 1.20 -2.9	1.21 1.18 -2.5	1.15 1.12 -2.6	1.21 1.19 -2.1	1.24 1.21 -1.9	1.18 1.19 1.1	0.93 0.95 2.2	0.39 0.41 5.7		
5		0.39 0.41 3.0	1.06 1.10 3.0	1.18 1.16 -1.8	1.27 1.23 -3.5	1.21 1.16 -3.9	0.99 0.93 -6.5	1.08 1.01 -6.6	0.99 0.94 -5.5	1.21 1.17 -3.1	1.27 1.24 -2.2	1.18 1.17 -0.8	1.06 1.11 4.5	0.39 0.43 8.7	
6		0.94 0.97 3.8	1.18 1.23 3.8	1.24 1.24 -0.1	1.21 1.17 -3.8	0.98 0.93 -4.8	1.09 1.01 -7.5	1.23 1.13 -7.7	1.09 1.00 -7.9	0.98 0.93 -5.2	1.21 1.18 -2.9	1.24 1.21 -2.1	1,18 1.21 2.4	0.94 1.00 6.8	
7	0.36 0.38 4.5	1.12 1.17 4.5	1.21 1.26 4.5	1.21 1.19 -2.0	0.99 0.94 -5.5	1.09 1.03 -5.9	1.21 1.11 -8.4	1.22 1.12 -8.3	1.21 1.12 -8.0	1.09 1.01 -7.2	0.99 0.93 -6.0	1.21 1.18 -2.3	1.21 1.21 0.3	1.12 1.15 2.8	0.36 0.38 4.9
8	0.68 0.71 4.4	1.11 1.15 4.4	1.03 1.08 4.5	1.15 1.13 -1.7	1.08 1.02 -4.8	1.23 1.16 -5.4	1.22 1.13 -6.8	0.93 0.87 -6.5	1.22 1.13 -7.1	1.23 1.14 -7.2	1.08 1.00 -6.8	1.15 1.13 -2.0	1.03 1.04 0.3	1.11 1.18 6.7	0.68 0.75 10.5
9	0.36 0.37 1.9	1.12 1.14 1.9	1.21 1.23 1.9	1.21 1.18 -2.5	0.99 0.95 -4.4	1.09 1.04 -5.0	1.21 1.14 -6.0	1.22 1.15 -5.5	1.21 1.13 -6.8	1.09 1.01 -7.0	0.99 0.93 -6.3	1.21 1.19 -1.4	1.21 1.22 1.1	1.12 1.20 7.5	0.36 0.40 11.5
10		0.94 0.95 1.9	1.18 1.20 1.8	1.24 1.22 -1.1	1.21 1.18 -2.6	0.98 0.94 -3.9	1.09 1.04 -4.7	1.23 1.17 -4.7	1.09 1.04 -4.6	0.98 0.94 -4.1	1.21 1.17 -3.4	1.24 1.21 -2.1	1.18 1.20 1.4	0.94 1.03 10.4	
11		0.39 0.41 4.1	1.06 1.11 4.1	1.18 1.20 1.7	1.27 1.23 -2.8	1.21 1.18 -2.3	0.99 0.97 -2.4	1.08 1.05 -2.4	0.99 0.97 -2.8	1.21 1.19 -1.8	1.27 1.24 -2.1	1.18 1.19 1.0	1.06 1.10 3.5	0.39 0.42 6.6	
12			0.39 0.41 6.3	0.93 0.95 1.9	1.18 1.15 -2.8	1.24 1.23 -0.4	1.21 1.23 1.6	1.15 1.17 1.6	1.21 1.22 1.0	1.24 1.24 0.1	1.18 1.18 0.0	0.93 0.96 3.3	0.39 0.42 7.5		
13				0.39 0.42 8.9	1.06 1.19 11.5	1.18 1.26 6.7	1.21 1.25 3.9	1.03 1.09 5.8	1.21 1.28 6.4	1.18 1.26 6.3	1.06 1.10 3.6	0.39 0.42 7.5			
14					0.39 0.44 11.5	0.94 1.07 14.3	1.12 1.25 11.6	1.11 1.22 10.4	1.12 1.19 6.6	0.94 1.00 6.6	0.39 0.41 3.6				
15							0.36 0.42 16.9	0.68 0.77 13.2	0.36 0.39 9.5						

STANDARD DEVIATION =3.122

AVERAGE PCT DIFFERENCE = 4.5

MAP NO: N1-3- 9 DATE: 4/15/81 POWER: 49%

CONTROL ROD POSITIONS: F-Q(T) = 2.064 QPTR:

D BANK AT 206 STEPS F-DH(N) = 1.545

NW 0.982	NE 0.994
SW 1.015	SE 1.010

F(Z) = 1.278

F(XY) = 1.629

BURNUP = 63 MWD/MTU A.O = -1.81(%)

Figure 7.7

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

APDMS - FLUX MAP

PREDICTED / MEASURED / PCT DIFFERENCE

Row	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.36	0.69	0.36						
							0.39	0.73	0.38						
							6.0	5.8	5.0						
2					0.40	0.94	1.12	1.11	1.12	0.94	0.40				
					0.42	0.94	1.14	1.13	1.16	0.98	0.42				
					4.4	-0.2	1.8	1.7	3.2	3.9	5.2				
3				0.39	1.06	1.18	1.20	1.04	1.20	1.18	1.06	0.39			
				0.40	1.08	1.17	1.18	1.02	1.20	1.19	1.10	0.42			
				1.8	1.5	-0.7	-1.8	-1.9	-0.7	1.3	3.1	6.6			
4			0.39	0.93	1.17	1.23	1.21	1.15	1.21	1.23	1.17	0.93	0.39		
			0.40	0.94	1.17	1.20	1.17	1.12	1.18	1.21	1.18	0.95	0.41		
			3.6	0.7	-0.2	-2.3	-2.6	-2.7	-2.3	-1.6	0.8	1.7	5.0		
5		0.40	1.06	1.17	1.26	1.21	0.99	1.08	0.99	1.21	1.26	1.17	1.06	0.40	
		0.41	1.09	1.16	1.23	1.17	0.93	1.01	0.95	1.18	1.24	1.16	1.11	0.43	
		2.9	2.9	-1.2	-2.7	-3.2	-6.2	-6.3	-4.9	-2.5	-1.8	-0.8	4.2	8.3	
6		0.94	1.18	1.23	1.21	0.98	1.09	1.23	1.09	0.98	1.21	1.23	1.18	0.94	
		0.97	1.21	1.23	1.17	0.94	1.02	1.15	1.02	0.94	1.18	1.21	1.20	0.99	
		3.2	3.1	-0.1	-3.3	-4.3	-6.6	-6.6	-6.5	-4.3	-2.2	-1.5	2.2	5.7	
7	0.36	1.12	1.20	1.21	0.99	1.09	1.21	1.22	1.21	1.09	0.99	1.21	1.20	1.12	0.36
	0.38	1.16	1.24	1.18	0.94	1.03	1.12	1.13	1.13	1.03	0.95	1.18	1.20	1.13	0.38
	3.3	3.3	3.3	-2.2	-5.1	-5.4	-7.3	-7.1	-6.5	-5.7	-4.5	-1.9	-0.2	1.3	3.0
8	0.69	1.11	1.04	1.15	1.08	1.23	1.22	0.93	1.22	1.23	1.08	1.15	1.04	1.11	0.69
	0.71	1.15	1.07	1.12	1.02	1.17	1.14	0.88	1.14	1.15	1.02	1.13	1.03	1.16	0.75
	3.3	3.3	3.3	-2.1	-4.8	-5.1	-6.0	-5.6	-6.1	-6.2	-5.5	-1.8	-0.3	4.8	8.3
9	0.36	1.12	1.20	1.21	0.99	1.09	1.21	1.22	1.21	1.09	0.99	1.21	1.20	1.12	0.36
	0.38	1.16	1.24	1.18	0.95	1.04	1.16	1.16	1.14	1.02	0.94	1.18	1.21	1.19	0.40
	3.2	3.2	3.1	-2.1	-4.4	-4.5	-4.5	-4.5	-6.0	-6.2	-5.5	-1.8	0.6	6.2	9.9
10		0.94	1.18	1.23	1.21	0.98	1.09	1.23	1.09	0.98	1.21	1.23	1.18	0.94	
		0.97	1.21	1.23	1.18	0.95	1.04	1.17	1.04	0.95	1.17	1.21	1.19	1.02	
		3.0	3.0	-0.5	-2.4	-3.2	-4.3	-4.3	-4.5	-3.6	-3.0	-1.6	1.3	9.1	
11		0.40	1.06	1.17	1.26	1.21	0.99	1.08	0.99	1.21	1.26	1.17	1.06	0.40	
		0.42	1.11	1.20	1.23	1.18	0.97	1.05	0.96	1.19	1.24	1.19	1.10	0.42	
		4.3	4.3	2.0	-2.5	-1.9	-2.4	-2.5	-3.0	-1.1	-1.5	1.0	3.0	5.7	
12			0.39	0.93	1.17	1.23	1.21	1.15	1.21	1.23	1.17	0.93	0.39		
			0.41	0.95	1.15	1.23	1.22	1.16	1.22	1.24	1.18	0.96	0.41		
			5.6	1.7	-2.5	-0.5	0.8	0.8	0.8	0.7	0.7	3.1	6.1		
13				0.39	1.06	1.18	1.20	1.04	1.20	1.18	1.06	0.39			
				0.42	1.19	1.25	1.24	1.09	1.27	1.25	1.11	0.41			
				8.5	11.4	6.4	3.2	4.8	5.8	6.0	4.1	6.1			
14					0.40	0.94	1.12	1.11	1.12	0.94	0.40				
					0.44	1.06	1.23	1.21	1.19	1.00	0.41				
					11.4	13.2	10.0	9.0	6.0	6.2	4.1				
15							0.36	0.69	0.36						
							0.42	0.77	0.39						
							16.6	11.4	8.2						

STANDARD DEVIATION =2.696

AVERAGE PCT DIFFERENCE = 4.0

MAP NO: N1-3-10 DATE: 4/15/81 POWER: 61%

CONTROL ROD POSITIONS: D BANK AT 205 STEPS

F-Q(T) = 2.040

F-DH(N) = 1.528

F(Z) = 1.276

F(XY) = 1.606

BURNUP = 67 MWD/MTU A.O = -2.84(%)

QPTR:

NW 0.990	NE 0.989
SW 1.014	SE 1.007

Figure 7.8

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

APDMS, I/E CALIBRATION - FLUX MAP

Key: PREDICTED / MEASURED / PCT DIFFERENCE

Row		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	Predicted							0.37	0.70	0.37						
	Measured							0.39	0.73	0.38						
	Pct difference							4.3	4.2	4.0						
2	Predicted					0.40	0.94	1.12	1.10	1.12	0.94	0.40				
	Measured					0.42	0.93	1.13	1.11	1.14	0.98	0.42				
	Pct difference					4.8	-1.0	0.6	0.6	2.2	3.5	4.6				
3	Predicted				0.40	1.07	1.17	1.20	1.04	1.20	1.17	1.07	0.40			
	Measured				0.41	1.09	1.16	1.17	1.01	1.19	1.18	1.09	0.42			
	Pct difference				2.3	2.0	-0.9	-2.5	-2.6	-1.3	0.8	2.5	5.9			
4	Predicted			0.40	0.94	1.17	1.23	1.20	1.15	1.20	1.23	1.17	0.94	0.40		
	Measured			0.41	0.94	1.17	1.20	1.17	1.11	1.17	1.21	1.18	0.95	0.42		
	Pct difference			3.7	1.0	0.2	-2.1	-3.0	-3.0	-2.9	-1.6	0.6	1.6	4.8		
5	Predicted		0.40	1.07	1.17	1.26	1.20	1.00	1.08	1.00	1.20	1.26	1.17	1.07	0.40	
	Measured		0.42	1.10	1.16	1.23	1.17	0.94	1.01	0.95	1.17	1.24	1.16	1.11	0.44	
	Pct difference		2.8	2.8	-1.0	-2.4	-2.7	-5.8	-6.0	-4.9	-2.2	-1.6	-0.5	4.3	8.4	
6	Predicted		0.94	1.17	1.23	1.20	0.98	1.09	1.23	1.09	0.98	1.20	1.23	1.17	0.94	
	Measured		0.97	1.21	1.23	1.16	0.94	1.03	1.15	1.02	0.94	1.18	1.21	1.20	0.99	
	Pct difference		3.2	3.2	-0.0	-3.2	-3.9	-5.9	-6.0	-6.1	-3.8	-1.8	-1.2	2.1	5.3	
7	Predicted	0.37	1.12	1.20	1.20	1.00	1.09	1.21	1.22	1.21	1.09	1.00	1.20	1.20	1.12	0.37
	Measured	0.38	1.16	1.25	1.28	0.95	1.04	1.13	1.14	1.14	1.03	0.96	1.18	1.20	1.13	0.38
	Pct difference	3.6	3.6	3.6	-1.5	-4.2	-4.6	-6.8	-6.6	-6.0	-5.2	-4.0	-1.6	-0.3	0.9	2.2
8	Predicted	0.70	1.10	1.04	1.15	1.08	1.23	1.22	0.94	1.22	1.23	1.08	1.15	1.04	1.10	0.70
	Measured	0.72	1.14	1.08	1.13	1.04	1.18	1.15	0.89	1.15	1.16	1.03	1.13	1.04	1.15	0.74
	Pct difference	3.6	3.6	3.6	-1.1	-3.5	-4.0	-5.3	-4.8	-5.3	-5.4	-4.9	-1.5	-0.3	3.8	6.4
9	Predicted	0.37	1.12	1.20	1.20	1.00	1.09	1.21	1.22	1.21	1.09	1.00	1.20	1.20	1.12	0.37
	Measured	0.38	1.15	1.24	1.19	0.96	1.05	1.16	1.17	1.15	1.03	0.95	1.19	1.21	1.18	0.40
	Pct difference	2.9	2.9	2.8	-1.3	-3.2	-3.6	-4.1	-5.7	-5.1	-8.3	-4.8	-1.3	0.9	5.3	8.3
10	Predicted		0.94	1.17	1.23	1.20	0.98	1.09	1.23	1.09	0.98	1.20	1.23	1.17	0.94	
	Measured		0.97	1.21	1.23	1.18	0.95	1.04	1.18	1.05	0.94	1.17	1.21	1.19	1.02	
	Pct difference		2.8	2.8	-0.2	-1.8	-2.8	-4.4	-4.0	-4.0	-3.2	-2.7	-1.7	1.7	7.7	
11	Predicted		0.40	1.07	1.17	1.26	1.20	1.00	1.08	1.00	1.20	1.26	1.17	1.07	0.40	
	Measured		0.42	1.11	1.19	1.23	1.10	0.97	1.05	0.96	1.18	1.24	1.18	1.10	0.43	
	Pct difference		4.1	4.1	1.9	-2.2	-1.4	-2.2	-2.3	-3.2	-1.4	-1.6	1.1	3.5	6.1	
12	Predicted			0.40	0.94	1.17	1.23	1.20	1.15	1.20	1.23	1.17	0.94	0.40		
	Measured			0.42	0.95	1.14	1.23	1.21	1.15	1.21	1.23	1.17	0.96	0.42		
	Pct difference			5.3	1.7	-2.2	0.1	0.8	0.7	0.5	0.4	0.3	3.0	6.9		
13	Predicted				0.40	1.07	1.17	1.20	1.04	1.20	1.17	1.07	0.40			
	Measured				0.43	1.18	1.25	1.24	1.08	1.26	1.23	1.11	0.42			
	Pct difference				7.9	10.5	6.3	3.3	4.4	5.0	5.1	3.9	6.9			
14	Predicted					0.40	0.94	1.12	1.10	1.12	0.94	0.40				
	Measured					0.45	1.05	1.22	1.19	1.18	0.99	0.42				
	Pct difference					10.5	11.9	8.9	7.7	5.1	5.2	3.9				
15	Predicted							0.37	0.70	0.37						
	Measured							0.42	0.77	0.39						
	Pct difference							13.0	9.8	6.5						

STANDARD DEVIATION =2.411

AVERAGE PCT DIFFERENCE = 3.6

MAP NO: N1-3-11 DATE: 4/15/81 POWER: 74%

CONTROL ROD POSITIONS: D BANK AT 190 STEPS

F-Q(T) = 2.124

F-DH(N) = 1.509

F(Z) = 1.343

F(XY) = 1.591

BURNUP = 73 MWD/MTU A.O = -12.15(%)

QPTR:

NW 0.989	NE 0.990
SW 1.016	SE 1.004

Figure 7.9

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

AFDMS, I/E CALIBRATION - FLUX MAP

PREDICTED
MEASURED
PCT DIFFERENCE

Row		R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	Predicted							0.37	0.69	0.37						
	Measured							0.39	0.72	0.38						
	Pct Difference							4.5	4.4	4.0						
2	Predicted					0.41	0.95	1.11	1.09	1.11	0.95	0.41				
	Measured					0.42	0.94	1.12	1.09	1.14	0.97	0.43				
	Pct Difference					3.7	-0.8	0.8	0.7	2.2	3.2	4.6				
3	Predicted				0.40	1.07	1.18	1.20	1.04	1.20	1.18	1.07	0.40			
	Measured				0.41	1.09	1.17	1.17	1.01	1.19	1.18	1.10	0.43			
	Pct Difference				2.0	1.8	-0.5	-2.3	-2.3	-1.2	0.8	2.6	6.2			
4	Predicted			0.40	0.94	1.17	1.23	1.20	1.15	1.20	1.23	1.17	0.94	0.40		
	Measured			0.42	0.95	1.17	1.20	1.17	1.11	1.17	1.21	1.18	0.96	0.42		
	Pct Difference			3.6	1.0	0.1	-2.0	-2.9	-3.0	-2.7	-1.3	0.9	1.8	4.8		
5	Predicted		0.41	1.07	1.17	1.26	1.20	1.00	1.06	1.00	1.20	1.26	1.17	1.07	0.41	
	Measured		0.42	1.11	1.17	1.23	1.17	0.94	1.01	0.95	1.17	1.24	1.17	1.12	0.44	
	Pct Difference		3.6	3.6	-0.6	-2.0	-2.6	-6.0	-6.1	-4.6	-1.9	-1.3	-0.4	4.1	7.9	
6	Predicted		0.95	1.18	1.23	1.20	0.96	1.09	1.23	1.09	0.96	1.20	1.23	1.18	0.95	
	Measured		0.98	1.22	1.23	1.16	0.92	1.02	1.15	1.02	0.93	1.18	1.22	1.20	0.99	
	Pct Difference		3.6	3.5	0.3	-2.8	-3.8	-6.2	-6.3	-6.1	-3.7	-1.6	-1.1	1.9	5.0	
7	Predicted	0.37	1.11	1.20	1.20	1.00	1.09	1.21	1.22	1.21	1.09	1.00	1.20	1.20	1.11	0.37
	Measured	0.38	1.15	1.24	1.18	0.95	1.04	1.13	1.14	1.14	1.03	0.96	1.18	1.20	1.12	0.38
	Pct Difference	3.4	3.4	3.4	-1.6	-4.3	-4.6	-6.8	-6.7	-6.0	-5.1	-3.8	-1.8	-0.5	0.8	2.1
8	Predicted	0.69	1.09	1.04	1.15	1.08	1.23	1.22	0.94	1.22	1.23	1.08	1.15	1.04	1.09	0.69
	Measured	0.72	1.12	1.07	1.13	1.04	1.18	1.16	0.90	1.15	1.16	1.03	1.13	1.03	1.13	0.74
	Pct Difference	3.4	3.4	3.4	-1.4	-3.9	-4.2	-5.1	-4.8	-5.4	-5.5	-5.0	-1.7	-0.5	3.9	6.8
9	Predicted	0.37	1.11	1.20	1.20	1.00	1.09	1.21	1.22	1.21	1.09	1.00	1.20	1.20	1.11	0.37
	Measured	0.38	1.15	1.23	1.18	0.96	1.05	1.16	1.17	1.15	1.03	0.95	1.18	1.21	1.17	0.40
	Pct Difference	2.8	2.8	2.8	-1.6	-3.6	-3.9	-4.4	-3.8	-5.1	-5.4	-5.1	-1.8	0.4	5.3	8.5
10	Predicted		0.95	1.18	1.23	1.20	0.96	1.09	1.23	1.09	0.96	1.20	1.23	1.18	0.95	
	Measured		0.97	1.21	1.23	1.17	0.93	1.04	1.18	1.05	0.93	1.16	1.21	1.19	1.02	
	Pct Difference		2.7	2.7	-0.3	-1.9	-2.9	-4.3	-3.9	-3.9	-3.2	-2.8	-1.8	1.1	7.8	
11	Predicted		0.41	1.07	1.17	1.26	1.20	1.00	1.08	1.00	1.20	1.26	1.17	1.07	0.41	
	Measured		0.42	1.11	1.19	1.23	1.18	0.98	1.06	0.97	1.18	1.24	1.19	1.10	0.43	
	Pct Difference		3.9	3.9	1.7	-2.3	-1.5	-2.1	-2.2	-2.7	-1.0	-1.5	1.1	3.2	5.8	
12	Predicted			0.40	0.94	1.17	1.23	1.20	1.15	1.20	1.23	1.17	0.94	0.40		
	Measured			0.42	0.96	1.15	1.23	1.22	1.16	1.21	1.24	1.18	0.97	0.43		
	Pct Difference			5.1	1.5	-2.3	0.0	1.1	1.0	0.7	0.5	0.4	3.2	6.9		
13	Predicted				0.40	1.07	1.18	1.20	1.04	1.20	1.18	1.07	0.40			
	Measured				0.43	1.18	1.25	1.24	1.08	1.26	1.23	1.11	0.43			
	Pct Difference				7.6	10.2	6.3	3.5	4.6	5.1	5.0	3.4	6.9			
14	Predicted					0.41	0.95	1.11	1.09	1.11	0.95	0.41				
	Measured					0.45	1.05	1.21	1.17	1.17	0.99	0.42				
	Pct Difference					10.2	11.5	8.8	7.9	5.2	5.2	3.4				
15	Predicted							0.37	0.69	0.37						
	Measured							0.42	0.76	0.39						
	Pct Difference							12.6	9.8	6.9						

STANDARD DEVIATION =2.401

AVERAGE PCT DIFFERENCE = 3.6

MAP NO: N1-3-12   DATE: 4/15/81   POWER: 79%

CONTROL ROD POSITIONS:

D BANK AT 180 STEPS

F-Q(T) = 2.200

F-DH(N) = 1.505

F(Z) = 1.397

F(XY) = 1.629

BURNUP = 78 MWD/MTU   A.O = -18.93(%)

QPTR:

NW 0.987	NE 0.991
SW 1.015	SE 1.007

Figure 7.10

NORTH ANNA UNIT 2 - CYCLE 5 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

APDMS, I/E CALIBRATION - FLUX MAP

Row	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
			PREDICTED				0.38	0.71	0.38				PREDICTED		
1			MEASURED				0.40	0.75	0.39				MEASURED		
			PCT DIFFERENCE				5.1	5.0	4.4				PCT DIFFERENCE		
					0.41	0.94	1.13	1.12	1.13	0.94	0.41				
2					0.42	0.94	1.14	1.14	1.16	0.98	0.43				
					3.9	-0.6	1.2	1.0	2.7	3.7	4.8				
				0.40	1.06	1.17	1.20	1.04	1.20	1.17	1.06	0.40			
3				0.40	1.08	1.16	1.18	1.02	1.19	1.18	1.09	0.42			
				1.6	1.3	-0.9	-1.9	-2.0	-0.9	1.1	2.8	5.9			
			0.40	0.93	1.16	1.22	1.20	1.14	1.20	1.22	1.16	0.93	0.40		
4			0.41	0.94	1.16	1.20	1.17	1.11	1.17	1.20	1.17	0.95	0.42		
			2.9	0.5	-0.2	-2.1	-2.5	-2.6	-2.4	-1.4	0.8	1.7	4.6		
		0.41	1.06'	1.16	1.25	1.20	1.00	1.08	1.00	1.20	1.25	1.16	1.06	0.41	
5		0.41	1.08	1.15	1.22	1.16	0.94	1.02	0.95	1.17	1.24	1.16	1.10	0.44	
		2.0	2.0	-1.2	-2.2	-2.6	-5.4	-5.5	-4.2	-1.8	-1.2	-0.4	4.0	7.8	
		0.94	1.17	1.22	1.20	0.99	1.09	1.23	1.09	0.99	1.20	1.22	1.17	0.94	
6		0.97	1.20	1.22	1.16	0.95	1.03	1.16	1.03	0.95	1.18	1.21	1.19	0.99	
		2.6	2.5	-0.1	-2.7	-3.6	-5.6	-5.8	-5.5	-3.4	-1.4	-1.0	2.0	5.0	
	0.38	1.13	1.20	1.20	1.00	1.09	1.21	1.21	1.21	1.09	1.00	1.20	1.20	1.13	0.38
7	0.39	1.16	1.24	1.18	0.96	1.04	1.14	1.14	1.15	1.04	0.96	1.18	1.20	1.14	0.39
	3.1	3.1	3.1	-1.5	-4.0	-4.4	-6.4	-6.3	-5.6	-4.8	-3.5	-1.1	0.1	1.3	2.3
	0.71	1.12	1.04	1.14	1.08	1.23	1.21	0.94	1.21	1.23	1.08	1.14	1.04	1.12	0.71
8	0.73	1.16	1.08	1.13	1.04	1.18	1.15	0.90	1.15	1.16	1.03	1.13	1.04	1.17	0.76
	3.1	3.2	3.1	-1.4	-3.6	-4.1	-5.1	-4.7	-5.1	-5.2	-4.6	-1.0	0.1	4.4	7.0
	0.38	1.13	1.20	1.20	1.00	1.09	1.21	1.21	1.21	1.09	1.00	1.20	1.20	1.13	0.38
9	0.38	1.15	1.23	1.18	0.96	1.05	1.16	1.17	1.15	1.04	0.95	1.19	1.21	1.19	0.41
	2.2	2.1	2.0	-1.7	-3.3	-3.6	-4.0	-3.5	-4.8	-5.0	-4.5	-0.9	0.9	5.6	8.6
		0.94	1.17	1.22	1.20	0.99	1.09	1.23	1.09	0.99	1.20	1.22	1.17	0.94	
10		0.96	1.19	1.21	1.17	0.96	1.05	1.18	1.05	0.96	1.17	1.20	1.18	1.02	
		2.0	2.0	-0.6	-1.9	-2.7	-4.1	-3.7	-3.6	-2.9	-2.5	-1.6	1.4	7.9	
		0.41	1.06	1.16	1.25	1.20	1.00	1.08	1.00	1.20	1.25	1.16	1.06	0.41	
11		0.42	1.10	1.18	1.22	1.18	0.97	1.05	0.97	1.18	1.23	1.17	1.09	0.43	
		3.4	3.4	1.4	-2.2	-1.6	-2.2	-2.3	-2.6	-1.2	-1.4	0.7	2.8	5.1	
			0.40	0.93	1.16	1.22	1.20	1.14	1.20	1.22	1.16	0.93	0.40		
12			0.42	0.95	1.14	1.22	1.21	1.15	1.21	1.23	1.17	0.95	0.42		
			4.8	1.4	-2.2	-0.3	0.6	0.7	0.8	0.5	0.4	2.3	5.5		
				0.40	1.06	1.17	1.20	1.04	1.20	1.17	1.06	0.40			
13				0.43	1.16	1.23	1.24	[illegible]	1.26	1.22	1.10	0.42			
				7.1	9.3	5.4	3.1	4.1	4.9	4.9	3.6	5.5			
					0.41	0.94	1.17	1.12	1.13	0.94	0.41				
14					0.44	1.05	1.23	1.21	1.18	0.99	0.42				
					9.4	11.1	8.9	7.7	5.0	5.0	3.6				
			STANDARD				0.38	0.71	0.38				AVERAGE		
15			DEVIATION				0.42	0.78	0.40				PCT DIFFERENCE		
			=2.321				12.8	9.6	6.4				= 3.4		

MAP NO: N1-3-13 DATE: 4/16/81 POWER: 85%

CONTROL ROD POSITIONS: F-Q(T) = 1.983 QPT(I)

D BANK AT 210 STEPS F-DH(N) = 1.498

NW 0.991	NE 0.990
SW 1.013	SE 1.007

F(Z) = 1.275

F(XY) = 1.574

BURNUP = 88 MWD/MTU A.O = 2.88(%)

Figure 7.11

NORTH ANNA UNIT 1 - CYCLE 3 BOL PHYSICS TEST

ASSEMBLYWISE POWER DISTRIBUTION

HFP, EQ. XENON - FLUX MAP

PREDICTED
MEASURED
PCT DIFFERENCE

Row	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.38	0.72	0.38						
							0.40	0.75	0.39						
							3.5	3.5	2.9						
2					0.41	0.94	1.12	1.13	1.12	0.94	0.41				
					0.41	0.93	1.13	1.14	1.14	0.96	0.43				
					-1.0	-0.5	0.7	0.7	1.6	2.2	4.3				
3				0.40	1.05	1.16	1.19	1.04	1.19	1.16	1.05	0.40			
				0.40	1.04	1.15	1.17	1.02	1.18	1.16	1.08	0.43			
				-1.0	-1.0	-0.8	-1.9	-2.0	-1.1	0.5	2.6	6.6			
4			0.40	0.93	1.15	1.21	1.19	1.14	1.19	1.21	1.15	0.93	0.40		
			0.41	0.93	1.14	1.19	1.17	1.11	1.17	1.20	1.17	0.95	0.42		
			1.5	-0.6	-1.6	-1.8	-2.4	-2.5	-2.3	-1.1	1.1	2.1	3.6		
5		0.41	1.05	1.15	1.24	1.20	1.00	1.08	1.00	1.20	1.24	1.15	1.05	0.41	
		0.42	1.07	1.14	1.22	1.17	0.95	1.03	0.97	1.18	1.23	1.15	1.06	0.41	
		1.5	1.5	-1.1	-2.0	-2.3	-4.9	-5.0	-3.7	-1.4	-0.9	-0.2	0.6	1.2	
6		0.94	1.16	1.21	1.20	1.01	1.10	1.23	1.10	1.01	1.20	1.21	1.16	0.94	
		0.96	1.18	1.21	1.17	0.98	1.05	1.17	1.05	0.99	1.18	1.20	1.16	0.95	
		2.0	2.0	-0.2	-2.4	-3.1	-4.8	-5.0	-4.5	-1.6	-1.1	-0.8	-0.0	1.2	
7	0.38	1.12	1.19	1.19	1.00	1.10	1.22	1.22	1.22	1.10	1.00	1.19	1.19	1.12	0.38
	0.39	1.15	1.22	1.17	0.96	1.06	1.15	1.15	1.16	1.06	0.97	1.18	1.19	1.13	0.39
	2.6	2.6	2.6	-1.8	-4.2	-4.1	-5.3	-5.5	-4.7	-3.5	-3.0	-1.3	-0.4	0.5	1.2
8	0.72	1.13	1.04	1.14	1.08	1.23	1.22	0.95	1.22	1.23	1.08	1.14	1.04	1.13	0.72
	0.74	1.16	1.07	1.13	1.04	1.19	1.17	0.92	1.17	1.18	1.04	1.13	1.04	1.18	0.77
	2.6	2.6	2.6	-1.4	-3.5	-3.5	-4.0	-3.1	-4.2	-4.3	-4.1	-1.2	-0.4	3.9	6.4
9	0.38	1.12	1.19	1.19	1.00	1.10	1.22	1.22	1.22	1.10	1.00	1.19	1.19	1.12	0.38
	0.39	1.14	1.21	1.17	0.97	1.07	1.17	1.18	1.17	1.06	0.96	1.18	1.18	1.19	0.43
	1.3	1.3	1.3	-1.8	-3.1	-3.5	-3.9	-3.0	-4.1	-4.3	-4.2	-1.3	-1.3	5.6	11.3
10		0.94	1.16	1.21	1.20	1.01	1.10	1.23	1.10	1.01	1.20	1.21	1.16	0.94	
		0.95	1.17	1.20	1.18	0.98	1.06	1.19	1.07	0.98	1.17	1.19	1.13	1.04	
		1.3	1.3	-0.5	-1.4	-2.3	-3.8	-3.3	-3.1	-2.3	-2.2	-1.4	-2.1	11.3	
11		0.41	1.05	1.15	1.24	1.20	1.00	1.08	1.00	1.20	1.24	1.15	1.05	0.41	
		0.43	1.09	1.18	1.22	1.18	0.98	1.06	0.98	1.19	1.23	1.17	1.08	0.44	
		3.9	3.9	1.9	-1.9	-1.7	-2.3	-2.4	-2.4	-0.8	-1.2	1.2	2.3	6.5	
12			0.40	0.93	1.15	1.21	1.19	1.14	1.19	1.21	1.15	0.93	0.40		
			0.43	0.95	1.13	1.20	1.20	1.14	1.20	1.21	1.16	0.96	0.43		
			6.5	2.4	-1.9	-0.5	0.2	0.1	0.3	0.4	0.4	3.1	6.5		
13				0.40	1.05	1.16	1.19	1.04	1.19	1.16	1.05	0.40			
				0.44	1.16	1.22	1.22	1.07	1.23	1.20	1.08	0.43			
				8.1	9.8	5.3	2.0	3.0	3.6	3.6	2.7	6.5			
14					0.41	0.94	1.12	1.13	1.12	0.94	0.41				
					0.45	1.04	1.21	1.21	1.16	0.97	0.42				
					9.8	10.8	7.7	6.5	3.7	3.7	2.7				
15							0.38	0.72	0.38						
							0.43	0.78	0.40						
							11.9	8.5	4.8						

STANDARD DEVIATION =2.363

AVERAGE PCT DIFFERENCE = 2.9

MAP NO: N1-3-14 DATE: 4/27/81 POWER: 100%

CONTROL ROD POSITIONS: F-Q(T) = 1.953 QPTR:

D BANK AT 224 STEPS F-DH(N) = 1.474

NW 0.987	NE 0.993
SW 1.013	SE 1.007

F(Z) = 1.264

F(XY) = 1.553

BURNUP = 487 MWD/MTU A.O = -7.88(%)

Section 8

REFERENCES

1. S. A. Ahmed, M. C. Cheok, T. W. Schleicher, "North Anna Unit 1, Cycle 3, Design Report," NFE Technical Report No. 161, Vepco, December, 1980.

2. North Anna Unit 1 Technical Specifications.

3. T. K. Ross, W. C. Beck, "Control Rod Reactivity Worth Determination By The Rod Swap Technique," VEP-FRD-36A, December, 1980.

4. T. J. Kunsitis, "RXFLOW, A Computer Program to Calculate Reactor Flow and Thermal Output," NFO-CCR-8, Vepco, December, 1979.

5. "Technical Manual for Westinghouse Solid State Reactivity Computer," Westinghouse Electric Corporation.

6. Memorandum from R. M. Berryman to E. J. Lozito, " Evaluation of North Anna 1 Cycle 3 Rod Swap Test Deviation," April 8, 1981.

7. Memorandum from R. M. Berryman to E. J. Lozito, " Evaluation of North Anna 1 Cycle 3 Rod Swap Test Deviation," April 10, 1981.

8. W. Leggett and L. Eisenhart, "The INCORE Code," WCAP-7149, December, 1967.

APPENDIX

STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEETS

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

<table>
<tr><td>I
Reference</td><td colspan="3">Test Description: Reactivity Computer Checkout
Procedure Number/Section: 1-PT-94/App. B Sequence Step Number: 6</td></tr>
<tr><td>II
Test Conditions (Design)</td><td colspan="2">Bank Positions (steps)
SDA: 228 SDB: 228 CA: 228
CB: 228 CC: 228 CD: *
RCCA: NA</td><td>RCS Temperature (°F): 547 +0 -5
Power Level (%F.P.): 0
Other (specify):
Below Nuclear Heating
*At the just critical position</td></tr>
<tr><td>III
Test Conditions (Actual)</td><td colspan="2">Bank Positions (steps)
SDA: 228 SDB: 228 CA: 228
CB: 97 CC: 228 CD: 228
RCCA: NA</td><td>RCS Temperature (°F): 544.2°F
Power Level (%F.P.): 0%
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td rowspan="6">IV

Test Results</td><td colspan="2">Date/Time Test Performed: 4/7/81 0518</td><td></td></tr>
<tr><td>Measured Parameter (description)</td><td colspan="2">$\Delta\rho_c$ = Measured reactivity using the reactivity computer
$\Delta\rho_r$ = Inferred reactivity from reactor period</td></tr>
<tr><td>Measured Value</td><td colspan="2">$\left|\frac{\Delta\rho_c - \Delta\rho_r}{\Delta\rho_r}\right| = 0.0251$</td></tr>
<tr><td>Design Value (Actual Conditions)</td><td colspan="2">$\left|\frac{\Delta\rho_c - \Delta\rho_r}{\Delta\rho_r}\right| \leq 0.04$</td></tr>
<tr><td>Design Value (Design Conditions)</td><td colspan="2">$\left|\frac{\Delta\rho_c - \Delta\rho_r}{\Delta\rho_r}\right| \leq 0.04$</td></tr>
<tr><td>Reference</td><td colspan="2">WCAP-7905, Rev. 1, Table 3.6</td></tr>
<tr><td rowspan="2">V
Acceptance Criteria</td><td>FSAR/Tech Spec</td><td colspan="2">NA</td></tr>
<tr><td>Reference</td><td colspan="2">NA</td></tr>
<tr><td>VI
Comments</td><td colspan="3">The reliability of the reactivity computer has been tested to be within ±40 pcm. Acceptance criteria was met.</td></tr>
</table>

Completed By J. P. Smith
Test Engineer

Evaluated By Jay H. Lebrastein

Recommended For Approval By C. T. Snow
NFO Engineer

A.2

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Critical Boron Concentration - ARO Procedure Number/Section: 1-PT-94/App. C Sequence Step Number: 7	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 547 +0 −5 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: 228 RCCA: NA	RCS Temperature (°F): 544.2°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/7/81 1040	
	Measured Parameter (description)	$(C_B)^M_{ARO}$; Critical Boron Concentration - ARO
	Measured Value	C_B = 1466.7 ppm
	Design Value (Actual Conditions)	C_B = 1492 ± 50 ppm
	Design Value (Design Conditions)	C_B = 1492 ± 50 ppm
	Reference	Vepco NFE Technical Report No. 161, December 1980; Memorandum from T.S. Rotella to C.T. Snow, dated January 20, 1981.
V Acceptance Criteria	FSAR/Tech Spec	$\left(\frac{\partial \rho}{\partial C_B}\right) \times C_B \leq 24{,}000$ pcm
	Reference	FSAR Section 15.2.4
VI Comments	Use $\frac{\partial \rho}{\partial C_B}$ = -8.16 pcm/ppm for preliminary analysis $\frac{\partial \rho}{\partial C_B}$ = -8.54 pcm/ppm used for final analysis. Acceptance criteria met; Design tolerance met.	

Completed By J.P. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C.T. Snow
NFO Engineer

A.3

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Isothermal Temperature Coefficient - ARO Sequence Step Number: 8 Procedure Number/Section: 1-PT-94/APP.D	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 547^{+3}_{-5} 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: 228 RCCA: NA	RCS Temperature (°F): 542.9-548.5 Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/7/81 1113	
	Measured Parameter (description)	$\left(\frac{\partial\rho}{\partial T}\right)^{ISO}_{ARO}$; Isothermal Temperature Coefficient-ARO
	Measured Value	$\left(\frac{\partial\rho}{\partial T}\right)^{ISO}_{ARO}$ = -4.36 pcm/°F
	Design Value (Actual Conditions)	$\left(\frac{\partial\rho}{\partial T}\right)^{ISO}_{ARO}$ = -3.99 ± 3.0 pcm/°F (C_B=1467 ppm)
	Design Value (Design Conditions)	$\left(\frac{\partial\rho}{\partial T}\right)^{ISO}_{ARO}$ = -3.66 ± 3.0 pcm/°F (D/228, 1492ppm, 547.0°F)
	Reference	Vepco NFE Technical Report No. 161, December 1980; Memorandum from T.S. Rotello to C.T. Snow, dated January 20, 1981.
V Acceptance Criteria	FSAR/Tech Spec	$\left(\frac{\partial\rho}{\partial T}\right)^{ISO}$ < -2.00 pcm/°F [Doppler $\left(\frac{\partial\rho}{\partial T}\right)$ = -2.00pcm/°F]
	Reference	FSAR Table 4.3-2, Vepco NFE Technical Report No.161
VI Comments	Acceptance criteria met. Design tolerance met.	

Completed By J.P. Smith
Test Engineer

Evaluated By Jay H. Liberstein

Recommended For Approval By C. T. Snow
NFO Engineer

A.4

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Control Bank B Worth Measurement, All Other Rods Out Procedure Number/Section: 1-PT-94/APP.E		Sequence Step Number: 10
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: 228 CD: 228 RCCA: NA		RCS Temperature (°F): 547^{+0}_{-5} 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: 228 CD: 228 RCCA: NA		RCS Temperature (°F): 544.7°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/7/81 1224		
	Measured Parameter (description)	I_B; Integral Worth of Control Bank B, All Other Rods Out	
	Measured Value	I_B = 1419.3 pcm	
	Design Value (Actual Conditions)	I_B = 1311 ± 131 pcm	
	Design Value (Design Conditions)	I_B = 1311±131pcm	
	Reference	Vepco NFE Technical Report No. 161, December, 1980	
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.	
	Reference	VEP-FRD-36A	
VI Comments	Acceptance criteria were met. Design tolerance met		

Completed By J. C. Smith
Test Engineer

Evaluated By Jay H. Leberstien

Recommended For Approval By C. T. Snow
NFO Engineer

A.5

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Boron Worth Measurement Procedure Number/Section: 1-PT-94/App. E		Sequence Step Number: 10
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: 228 CD: 228 RCCA: NA		RCS Temperature (°F): 547^{+0}_{-5} 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: 228 CD: 228 RCCA: NA		RCS Temperature (°F): 544.7 °F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/7/81 1224		
	Measured Parameter (description)	$\left(\frac{\partial\rho}{\partial C_B}\right)$, Differential Boron Worth	
	Measured Value	$\left(\frac{\partial\rho}{\partial C_B}\right) = -8.54$ pcm/ppm	
	Design Value (Actual Conditions)	$\left(\frac{\partial\rho}{\partial C_B}\right) = -8.16 \pm 0.82$ pcm/ppm	
	Design Value (Design Conditions)	$\left(\frac{\partial\rho}{\partial C_B}\right) = -8.16 \pm 0.82$ pcm/ppm	
	Reference	Vepco NFE Technical Report No. 161, December, 1980	
V Acceptance Criteria	FSAR/Tech Spec	$\left(\frac{\partial\rho}{\partial C_B}\right) \times C_B \leq 24{,}000$ pcm	
	Reference	FSAR Section 15.2.4	
VI Comments	Acceptance criteria were met. Design tolerance met		

Completed By J.P. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C.T. Snow
NFO Engineer

A.6

North Anna Power Station Unit 1 Cycle 2

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Critical Boron Concentration - Bank B IN Procedure Number/Section: 1-PT-94/APP.C Sequence Step Number: 11	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 547^{+0}_{-5} Power Level (%F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 23 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 544.1°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/7/81 1840	
	Measured Parameter (description)	$(C_B)^M_B$; Critical Boron Concentration - Bank B In
	Measured Value	C_B = 1300.7 ppm
	Design Value (Actual Conditions)	C_B = 1304 ± 25.4 ppm
	Design Value (Design Conditions)	$C_B = 1329 + \left[(C_B)^M_{ARO} - 1492\right] \pm \left[10 + 131.1/\left(\frac{\partial\rho}{\partial C_B}\right)\right]$
	Reference	Vepco NFE Technical Report No. 161, December 1980; Memorandum from T.S. Rotella to C.T. Snow, dated January 20, 1981.
V Acceptance Criteria	FSAR/Tech Spec	$\left(\frac{\partial\rho}{\partial C_B}\right) \times C_B \leq 24{,}000$ pcm
	Reference	FSAR Section 15.2.4
VI Comments	Use $\frac{\partial\rho}{\partial C_B}$ = -8.16 pcm/ppm for preliminary analysis $\frac{\partial\rho}{\partial C_B}$ = -8.54 used for final analysis. Acceptance criteria met; Design tolerance met.	

Completed By J.P. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C. T. Snow
NFO Engineer

A.7

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Isothermal Temperature Coefficient - Bank B In Procedure Number/Section: 1-PT-94/App. D Sequence Step Number: 12	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 547 +3 -5 Power Level (%F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 23 CC: 228 CD: 228 RCCA: NA	RCS Temperature (°F): 543.1-546.2 Power Level (%F.P.): 0% Other (specify): BELOW NUCLEAR HEATING
IV Test Results	Date/Time Test Performed: 4/7/81 2300	
	Measured Parameter (description)	$\left(\frac{\partial \alpha}{\partial T}\right)_B^{ISO}$; Isothermal Temperature Coefficient Bank B In
	Measured Value	$\left(\frac{\partial \alpha}{\partial T}\right)_B^{ISO}$ = -7.40 pcm/°F
	Design Value (Actual Conditions)	$\left(\frac{\partial \alpha}{\partial T}\right)_B^{ISO}$ = -6.66 ± 3.0 pcm/°F (C_B = 1311 ppm)
	Design Value (Design Conditions)	$\left(\frac{\partial \alpha}{\partial T}\right)_B^{ISO}$ = - 6.42 ± 3.0 pcm/°F (B/0, C/228, D/228 1329 ppm, 547.0°F)
	Reference	Vepco NFE Technical Report No. 161, December 1980; Memorandum from T.S. Rotella to C.T. Snow, dated January 20, 1981.
V Acceptance Criteria	FSAR/Tech Spec	$\left(\frac{\partial \alpha}{\partial T}\right)^{ISO}$ < -2.00 pcm/°F [Doppler $\left(\frac{\partial \alpha}{\partial T}\right)$ = -2.00pcm/°F]
	Reference	FSAR Table 4.3-2, Vepco NFE Technical Report No. 161.
VI Comments	ACCEPTANCE CRITERIA WERE MET. DESIGN TOLERANCE MET	

Completed By J.C. Smith
Test Engineer

Evaluated By David M. Kapuschinsky

Recommended For Approval By C. T. Snow
NFO Engineer

A.8

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Control Bank D Worth Measurement- Rod Swap Procedure Number/Section: 1-PT-94/APP.G Sequence Step Number: 14	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: 228 CD: Moving RCCA: NA	RCS Temperature (°F): 547 +0/-5 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: 228 CD: Moving RCCA: NA	RCS Temperature (°F): 544°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
	Date/Time Test Performed: 4/8/81 / 0026	
IV Test Results	Measured Parameter (description)	I_D; Integral Worth of Control Bank D - Rod Swap
	Measured Value	I_D = 1089 pcm (Critical Reference Bank Position = 143 steps)
	Design Value (Actual Conditions)	I_D = 1038 ± 156 pcm (Critical Reference Bank Position = 143 steps)
	Design Value (Design Conditions)	I_D = 1028±154 pcm (Critical Reference Bank Position = 157 steps)
	Reference	Vepco NFE Technical Report No. 161; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from J.R. Ju to C.T. Snow, dated December 4, 1980.
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Acceptance criteria was met. Design tolerance met	

Completed By J. C. Smith
Test Engineer

Evaluated By T. S. Rotella

Recommended For Approval By T.K. Ross
NFO Engineer

A.9

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Control Bank C Worth Measurement - Rod Swap Procedure Number/Section: 1-PT-94/APP.C Sequence Step Number: 15	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: Moving CC: Moving CD: 228 RCCA: N/A	RCS Temperature (°F): 547 +0 -5 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: Moving CD: 228 RCCA: N/A	RCS Temperature (°F): 544°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed:	4/8/81 / 0138
	Measured Parameter (description)	I_C ; Integral Worth of Control Bank C-Rod Swap
	Measured Value	I_C = 777 pcm (Critical Reference Bank Position = 103 steps)
	Design Value (Actual Conditions)	I_C = 850 ± 128 pcm (Critical Reference Bank Position = 103 steps)
	Design Value (Design Conditions)	I_C=843±126pcm (Critical Reference Bank Position = 131 steps)
	Reference	Vepco NFE Technical Report No. 161; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from J.R. Ju to C.T. Snow, dated December 4, 1980.
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Acceptance criteria was met. Design tolerance met	

Completed By J.C. Smith
Test Engineer

Evaluated By J. S. Rotella

Recommended For Approval By T K Ross
NFO Engineer

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Control Bank A Worth Measurement-Rod Swap Procedure Number/Section: 1-PT-94/APP.C	Sequence Step Number: 16
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: Moving CB: Moving CC: 228 CD: 228 RCCA: N/A	RCS Temperature (°F): 547^{+0}_{-5} 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: 228 CD: 228 RCCA: N/A	RCS Temperature (°F): 544°F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed:	4/8/81 / 0244
	Measured Parameter (description)	I_A; Integral Worth of Control Bank A
	Measured Value	I_A = 722 pcm (Critical Reference Bank Position = 97 steps)
	Design Value (Actual Conditions)	I_A = 643 ± 96 pcm (Critical Reference Bank Position = 97 steps)
	Design Value (Design Conditions)	I_A = 645±97 pcm (Critical Reference Bank Position = 108 steps)
	Reference	Vepco NFE Technical Report No. 161; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from M.L. Smith to C.T. Snow, dated March 18, 1981; Memorandum from T.S. Rotella to C.T. Snow, dated March 20, 1981.
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Acceptance criteria was met. Design tolerance met	

Completed By J.P. Smith
Test Engineer

Evaluated By T.S. Rotella

Recommended For Approval By T K Ross
NFO Engineer

A.11

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Shutdown Bank B Worth Measurement - Rod Swap Procedure Number/Section: 1-PT-94/APP.G Sequence Step Number: 17		
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: Moving CA: 228 CB: Moving CC: 228 CD: 228 RCCA: N/A		RCS Temperature (°F): 547^{+0}_{-5} Power Level (%F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: Moving CA: 228 CB: Moving CC: 228 CD: 228 RCCA: N/A		RCS Temperature (°F): 544 °F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 4/8/81/0334		
	Measured Parameter (description)	I_{SDB} ; Integral Worth of Shutdown Bank B-Rod Swap	
	Measured Value	I_{SDB} = 919 pcm (Critical Reference Bank Position = 119 steps)	
	Design Value (Actual Conditions)	I_{SDB} = 1005 ± 151 pcm (Critical Reference Bank Position = 119 steps)	
	Design Value (Design Conditions)	I_{SDB} = 1022 ± 153 pcm (Critical Reference Bank Position = 156 steps)	
	Reference	Vepco NFE Technical Report No. 161; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from J.R. Ju to C.T. Snow, dated December 4, 1980.	
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.	
	Reference	VEP-FRD-36A	
VI Comments	Acceptance criteria was met. Design tolerance met		

Completed By J.C. Smith
Test Engineer

Evaluated By J. S. Rotilla

Recommended For Approval By T.K. Ross
NFO Engineer

A.12

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Shutdown Bank A Worth Measurement-Rod Swap Procedure Number/Section: 1-PT-94/APP. G Sequence Step Number: 18	
II Test Conditions (Design)	Bank Positions (steps) SDA: Moving SDB: 228 CA: 228 CB: Moving CC: 228 CD: 228 RCCA: N/A	RCS Temperature (°F): 547^{+0}_{-5} Power Level (%F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: Moving SDB: 228 CA: 228 CB: Moving CC: 228 CD: 228 RCCA: N/A	RCS Temperature (°F): 544 °F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
	Date/Time Test Performed: 4/8/81 / 0421	
IV Test Results	Measured Parameter (description)	I_{SDA} ; Integral Worth of Shutdown Bank A - Rod Swap
	Measured Value	I_{SDA} = 1238 pcm. (Critical Reference Bank Position = 170 steps)
	Design Value (Actual Conditions)	I_{SDA} = 1036 ± 155 pcm (Critical Reference Bank Position = 170 steps)
	Design Value (Design Conditions)	I_{SDA} = 1034±155 pcm (Critical Reference Bank Position = 158 steps)
	Reference	Vepco NFE Technical Report No. 161; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from J.R. Ju to C.T. Snow, dated December 4, 1980.
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, the SNSOC shall evaluate the impact of the test result on the safety analyses. The SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design tolerance was exceeded. Acceptance criteria was met. The test result is acceptable per References: 1. Memorandum from R.M. Berryman to E.J. Lozito,	

Completed By J.P. Smith
Test Engineer

Evaluated By J. S. Rotella

Recommended For Approval By TK Ross
NFO Engineer

April 8, 1981.
2. Memorandum from R.M. Berryman to E.J. Lozito, April 10, 1981.
3. North Anna Power Station Deviation Report No. 81-244.

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: Total Rod Worth-Rod Swap Procedure Number/Section: 1-PT-94/APP.C	Sequence Step Number: 19
II Test Conditions (Design)	Bank Positions (steps) SDA: Moving SDB: Moving CA: Moving CB: Moving CC: Moving CD: Moving RCCA: NA	RCS Temperature (°F): 547^{+0}_{-5} Power Level (%F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (steps) SDA: Moving SDB: Moving CA: Moving CB: Moving CC: Moving CD: Moving RCCA: NA	RCS Temperature (°F): 544 °F Power Level (%F.P.): 0% Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed:	4/8/81 / 0026-0421
	Measured Parameter (description)	I_{Total}, Integral Worth of All Banks-Rod Swap
	Measured Value	I_{Total} = 6164 pcm
	Design Value (Actual Conditions)	I_{Total} = 5883 ± 588 pcm
	Design Value (Design Conditions)	I_{Total} = 5883 ± 588 pcm
	Reference	Vepco NFE Technical Report No. 1-1; Vepco Rod Swap Topical Report VEP-FRD-36A; Memorandum from M.L. Smith to C.T. Snow, dated March 18, 1981; Memorandum from T.S. Rotella to C.T. Snow, dated March 20, 1981; Memorandum from C.T. Snow to E.J. Lozito, March 24, 1981.
V Acceptance Criteria	FSAR/Tech Spec	If the Design Tolerance is exceeded, assure adequate shutdown margin by measuring the reactivity worth of control banks D through A (and also the remainder of the rod banks to the N-1 configuration, if required) by successive rod insertion using the boron dilution/addition technique.
	Reference	VEP-FRD-36A
VI Comments	Acceptance criteria was met. Design tolerance met	

Completed By J.C. Smith
Test Engineer

Evaluated By T. S. Rotella

Recommended For Approval By TK Ross
NFO Engineer

A.14

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP- ARO Procedure Number/Section: 1-PT-21.1		Sequence Step Number: 43.1		
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228 RCCA: NA		RCS Temperature (°F): Tref ± 1 Power Level (%F.P.): ~1 Other (specify): Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 220 RCCA: NA		RCS Temperature (°F): 547.0°F Power Level (%F.P.): ~4% Other (specify): 46 Thimbles		
IV Test Results	Date/Time Test Performed: 4/8/81 2141				
	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. (M-P)/P	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	+16.7%* P_{K14}=1.15 +18.8%* P_{J15}=0.43	1.678	2.520	1.0437*
	Design Value (Actual Conditions)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9	≤ 1.848	≤ 4.096	≤ 1.02
	Design Value (Design Conditions)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	NA	NA	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	*Design tolerances not met, but test results are acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-245.				

Completed By J. C. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C. T. Snow
NFO Engineer

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: H/D FLUX MAP- Control Banks At The Insertion Limits For Zero Power Testing Procedure Number/Section: 1-PT-21.1 Sequence Step Number: 43.2				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: AR CD: AR RCCA: NA		RCS Temperature (°F): T_{ref} ±1 Power Level (%F.P.): 3-5 Other (specify): Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 130 CD: 2 RCCA: NA		RCS Temperature (°F): 547.0°F Power Level (%F.P.): ~4% Other (specify): 45 Thimbles		
	Date/Time Test Performed: 4/9/81 0455				
IV	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	+12.9%* P_{K14}=1.21 +16.4%* P_{J15}=0.33	1.843	3.114	1.0294*
Test Results	Design Value (Actual Conditions)	±10% for P_i ≥ 0.9 ±15% for P_i < 0.9	≤ 1.848	≤ 4.200	≤ 1.02
	Design Value (Design Conditions)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	NA	NA	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	*Design tolerances not met, but test results are acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-245.				

Completed By J. C. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C. T. Snow
NFO Engineer

A.16

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: H/D FLUX MAP- At Power, $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2		Sequence Step Number: 45		
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA		RCS Temperature (°F): $T_{ref} \pm 1$ Power Level (%F.P.): ~30 [illegible] Other (specify): Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 138 RCCA: NA		RCS Temperature (°F): 554.0°F Power Level (%F.P.): ~26.5% Other (specify): 45 Thimbles.		
IV Test Results	Date/Time Test Performed: 4/11/81 0407				
	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (MTR)
	Measured Value	13.1%* for P_{K14}=1.09 15.4%* for P_{J15}=0.40	1.570	2.444	1.0149
	Design Value (Actual Conditions)	±10% for $P_i \ge 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for $P_i \ge 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	None	None	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \le 1.55 \times [1+.2(1-P)] \times [1-RBP(BU)]$,	$F^T_Q \le$ [illegible] x K(Z)/P; P>0.5 $F^T_Q \le$ [illegible] x K(Z); P ≤ 0.5	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	* Design tolerances not met, but test results are acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-252 Acceptance criteria met.				

Completed By J.C. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C. T. Snow
NFO Engineer

The measured value for F_{xy} exceeds the Technical Specifications limits for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained within 24 hours after reaching a power level which is 20% higher than the level at which the F_{xy}^{RTP} limit was exceeded.

A.17

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP - At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 46
II Test Conditions (Design)	Bank Positions (steps): SDA: 228, SDB: 228, CA: 228, CB: 228, CC: 228, CD: AR, RCCA: NA RCS Temperature (°F): $T_{ref} \pm 1$ Power Level (%F.P.): ~50 Other (specify): Must have ≥ 38 Thimbles
III Test Conditions (Actual)	Bank Positions (steps): SDA: 228, SDB: 228, CA: 228, CB: 228, CC: 228, CD: 200, RCCA: NA RCS Temperature (°F): 562 °F Power Level (%F.P.): ~50% Other (specify): 45 Thimbles
IV Test Results	Date/Time Test Performed: 4/14/81 / 1623 – 1808

MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. (M-P)/P	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
Measured Value	14.2%* for $P_{K-14} = 1.07$ 16.1%* for $P_{J-15} = 0.42$	1.544	2.116	1.0182
Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria: FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1 + .2(1-P)] \times [1 - RDP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P$; $P > 0.5$ $F^T_Q \leq 4.20 \times K(Z)$; $P \leq 0.5$	NA
V Acceptance Criteria: Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments: * Design tolerances not met, but test results are acceptable per Reference:
1. North Anna Power Station Deviation Report No. 81-257.
The measured value for F_{xy} exceeds the Technical Specifications limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded. Acceptance criteria met.

Completed By J P Smith, Test Engineer

Evaluated By T. S. Rotella

Recommended For Approval By T K Ross

A.18

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP- At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 46				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA		RCS Temperature (°F): $T_{ref} \pm 1$ Power Level (%F.P.): ≈50 Other (specify): Must have ≥ 38 Thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 205/206 RCCA:		RCS Temperature (°F): 562 °F Power Level (%F.P.): 49.2 % Other (specify): 46 Thimbles		
IV Test Results	Date/Time Test Performed: 4/14/81 – 4/15/81 2258 – 0027				
	MEASURED PARAMETER (Description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	14.3* for $P_{K-14} = 1.07$ 11.9* for $P_{J-15} = 0.42$	1.545	2.064	1.0145
	Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤1.02
	Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	± 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1 + .2(1-P)] \times [1 - RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P;\ P > 0.5$ $F^T_Q \leq 4.20 \times K(Z);\ P \leq 0.5$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	* Design tolerances not met, but test results are acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-257. Acceptance criteria met.				

Completed By J.P. Smith
Test Engineer

Evaluated By J.S.? Rotella

Recommended For Approval By T K Ross
NSS Engineer

The measured value for F_{xy} exceeds the Technical Specifications limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded.

A.19

North Anna Power Station Unit 1 Cycle 1 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP- At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 47				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA		RCS Temperature (°F): Tref ± 1 Power Level (%F.P.): ~60 Other (specify): Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 204/205 RCCA: NA		RCS Temperature (°F): 567.5°F Power Level (%F.P.): ~60.6% Other (specify): 46 Thimbles		
IV	Date/Time Test Performed: 4/15/81 0445				
	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	13.2%* for P_{K14}=1.06 14.6% for P_{J15}=0.42	1.528	2.040	1.0141
Test Results	Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1+.2(1-P)] \times [1-RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	* Design tolerance not met, but test result is acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-257. The measured value for F_{xy} exceeds the Technical Specifications				

Completed By J.C. Smith
Test Engineer

Evaluated By Jay H. Leberstein

Recommended For Approval By C. T. Snow
NFO Engineer

limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded. Acceptance criteria met.

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP- At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 48				
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA		RCS Temperature (°F): Tref ± 1 Power Level (%F.P.): ~70 Other (specify): Must have > 38 thimbles		
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 190 RCCA: NA		RCS Temperature (°F): 571.3°F Power Level (%F.P.): ~74.2% Other (specify): 46 Thimbles		
IV Test Results	Date/Time Test Performed: 4/15/81 1024				
	MEASURED PARAMETER (Description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	11.9%* for P_{K14} = 1.05 13.0% for P_{J15} = 0.42	1.509	2.124	1.0164
	Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1+.2(1-P)] \times [1-RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	* Design tolerance not met, but test result is acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-257. The measured value for F_{xy} exceeds the Technical Specifications				

Completed By J.P. Smith
Test Engineer

Evaluated By Jay H. Goldstein

Recommended For Approval By C. T. Snow
SRO Engineer

limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded. Acceptance criteria met.

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

Section		
I Reference	Test Description: M/D FLUX MAP- At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 49	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA	RCS Temperature (°F): Tref ± 1 Power Level (%F.P.): ≈80 Other (specify): Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 180 RCCA: NA	RCS Temperature (°F): 573°F Power Level (%F.P.): ~79.4% Other (specify):
	Date/Time Test Performed: 4/15/81 1410 - 1554	46 Thimbles

IV Test Results	MEASURED PARAMETER (Description)	[illegible]	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
	Measured Value	11.5% for P_{K-14} = 1.05 12.6% for P_{J-15} = 0.42	1.505	2.200	1.0154
	Design Value (Actual Conditions)	±10% for P_i ≥ 0.9 ±15% for P_i < 0.9	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1 + .2(1-P)] \times [1-RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	* Design tolerance not met, but test result is acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-257.				

Completed By J.C. Smith
Test Engineer

Evaluated By T. S. Rotella

Recommended For Approval By T K Ross
SNS Engineer

The measured value for F_{xy} exceeds the Technical Specifications limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded.
Acceptance criteria met.

A.22

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: H/D FLUX MAP- At Power, NI Calib., $\bar{R}$ Data Map Procedure Number/Section: 1-PT-22.2 Sequence Step Number: 50	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA	RCS Temperature (°F): Tref ± 1 Power Level (%F.P.): ~90 Other (specify): Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 210 RCCA: NA	RCS Temperature (°F): 574.2 °F Power Level (%F.P.): 84.8% Other (specify): 46 Thimbles
	Date/Time Test Performed: 4/16/81 0227-0350	

	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
IV Test Results	Measured Value	11.1%* for $P_{K-14} = 1.05$ 12.8% for $P_{J-15} = 0.42$	1.498	1.983	1.0127
	Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1 + .2(1-P)] \times [1 - RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments: * Design value tolerance not met, but test result is acceptable per Reference:
1. North Anna Power Station Deviation Report No. 81-257.
The measured value for F_{xy} exceeded the Technical Specifications

Completed By J. C. Smith, Test Engineer

Evaluated By T. S. Rotella

Recommended For Approval By T K Ross, SPO Engineer

limit for F_{xy}^{RTP}. In accordance with Technical Specification 4.2.2.2.d, an additional full-core flux map was obtained at a power level within 20% of the power level at which the F_{xy}^{RTP} limit was exceeded. Acceptance criteria met.

North Anna Power Station Unit 1 Cycle 3 Startup

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: M/D FLUX MAP- HFP, ARO, Eq. Xe Procedure Number/Section: 1-PT-21.1 Sequence Step Number: 51	
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA: NA	RCS Temperature (°F): $T_{ref} \pm 1$ Power Level (%F.P.): 95 ± 5 Other (specify): Equilibrium xenon Must Have ≥38 Thimbles
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 224 RCCA: NA	RCS Temperature (°F): 578°F Power Level (%F.P.): 100% Other (specify): 42 Thimbles
IV	Date/Time Test Performed: 4/27/81 1403	

	MEASURED PARAMETER (description)	MAX. REL. ASSY. PWR. % Diff. $\frac{(M-P)}{P}$	$F^N_{\Delta H}$, NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR	F^T_Q, TOTAL HEAT FLUX HOT CHANNEL FACTOR	QUADRANT POWER TILT RATIO (QPTR)
IV Test Results	Measured Value	11.3%* for P_{B10} = 1.04 11.9% for P_{J15} = 0.43	1.474	1.953	1.0134
	Design Value (Actual Conditions)	±10% for $P_i \geq 0.9$ ±15% for $P_i < 0.9$	NA	NA	≤ 1.02
	Design Value (Design Conditions)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy pwr)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	None	None	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NA	$F^N_{\Delta H} \leq 1.55 \times [1+.2(1-P)] \times [1-RBP(BU)]$	$F^T_Q \leq 2.10 \times K(Z)/P$	NA
	Reference	NA	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	* Design tolerance not met, but test result is acceptable per Reference: 1. North Anna Power Station Deviation Report No. 81-325 Acceptance criteria met.

Completed By [signature]
Test Engineer

Evaluated By [signature]

Recommended For Approval By C. T. Snow
NSS Engineer

A.24

North Anna Power Station Unit 1 Cycle 3

Startup Physics Tests Results and Evaluation Sheet

I Reference	Test Description: RCS Flow Measurement Procedure Number/Section: 1-PT-27	Sequence Step Number: 52
II Test Conditions (Design)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: AR RCCA:	RCS Temperature (°F): $T_{Ref} \pm 1$ Power Level (%F.P.): 95^{+5}_{-0} Other (specify):
III Test Conditions (Actual)	Bank Positions (steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 224 RCCA:	RCS Temperature (°F): 579°F Power Level (%F.P.): 100% Other (specify):
IV Test Results	Date/Time Test Performed: 4/28/81 1018 - 1058	
	Measured Parameter (description)	F_{RCS}^{TOTAL}, Total RCS Flow Rate
	Measured Value	F_{RCS}^{TOTAL} = 302,764 gpm.
	Design Value (Actual Conditions)	Not Applicable
	Design Value (Design Conditions)	Not Applicable
	Reference	Not Applicable
V Acceptance Criteria	FSAR/Tech Spec	F_{RCS}^{TOTAL} /1.02(measurement uncertainty) ≥278,400 gpm
	Reference	Technical Specification 3.2.5
VI Comments	Acceptance Criteria Met	

Completed By J C Smith
Test Engineer

Evaluated By J. S. Rotella

Recommended For Approval By C. J. Snow
NFO Engineer