VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

December 27, 1994

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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 1
CYCLE 11 STARTUP PHYSICS TESTS REPORT

As required by North Anna Technical Specification 6.9.1, enclosed are five copies of the Virginia Electric and Power Company Technical Report NE-1000, "North Anna Unit 1, Cycle 11 Startup Physics Tests Report." This report summarizes the results of the physics testing program performed after initial criticality of Cycle 11 on October 8, 1994. The results of the physics tests were within required design tolerances and applicable Technical Specification limits.

Very truly yours,

ML Bowling

M. L. Bowling, Manager
Nuclear Licensing and Programs

Enclosures

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North Ann[illegible]
Unit 1 Cycle 11
Startup Physics
Tests Report

Nuclear Analysis and Fuel
Nuclear Engineering Services

December, 1994

VIRGINIA POWER

North Anna
Unit 1 Cycle 11
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VIRGINIA POWER

TECHNICAL REPORT NE-1000 - REV. 0

NORTH ANNA UNIT 1, CYCLE 11

STARTUP PHYSICS TESTS REPORT

NUCLEAR ANALYSIS AND FUEL
NUCLEAR ENGINEERING SERVICES
VIRGINIA POWER
DECEMBER 1994

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

This report presents the analysis and evaluation of the physics tests which were performed to verify that the North Anna 1, Cycle 11 core could be operated safely, and makes 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 testing techniques and methods of data analysis were used. The test data, results and evaluations, together with the detailed startup procedures, are on file at the 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 comparison of the test results with design predictions, and an evaluation of the results.

The North Anna 1, Cycle 11 startup physics tests results and evaluation sheets are 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 (at design conditions) of the measured parameters were completed prior to the startup physics testing. The entries for the design values were based on the calculations performed by Virginia Electric and Power Company's Nuclear Analysis and Fuel 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.

SECTION 1

INTRODUCTION AND SUMMARY

On September 9, 1994 Unit No. 1 of the North Anna Power Station shutdown for its tenth refueling. During this shutdown, 81 of the 157 fuel assemblies in the core were replaced with 64 fresh fuel assemblies, 1 once-burned fuel assembly, and 16 twice-burned fuel assemblies. The eleventh cycle core consists of 10 sub-batches of fuel: four once-burned batches, three from Cycle 10 (batches N2/11A, 12A, and 12B) and one from North Anna 2 Cycle 8 (batch N2/10B); four twice-burned batches, one from Cycles 7 and 8 (batch 9A), two from Cycles 8 and 9 (batches N2/9B and 10B), and one from Cycles 9 and 10 (batch 11A); and two fresh batches (batches 13A and 13B). Batches N1/11, N1/12, N2/10, and N2/11 have top and bottom grids of Inconel-718 while the inner six grids are made of Zircaloy-4. Batch N1/13 has top and bottom grids of Inconel-718, six inner grids made of ZIRLO (ZIRLO provides improved corrosion resistance and dimensional stability under irradiation relative to Zircaloy-4 components), and one Inconel-718 protective grid placed below the fuel and above the bottom nozzle for debris resistance. All other batches are composed of 8 Inconel-718 grids.

Cycle 11, similar to Cycle 10, incorporated the burnable poison rod design made of B_4C in Alumina, which is available in various enrichments of B_4C. There are no thimble plugging devices inserted in N1C11. Twenty-four peripheral assemblies have baffle clips mounted on them to help protect against baffle jetting degradation. Reference 1 provides a more detailed description of the Cycle 11 core.

The core loading pattern and the design parameters for each sub-batch are shown in Figure 1.1. Fuel assembly burnups are given in Figure 1.2. The available incore moveable detector locations used for the BOC flux map analyses are identified in Figure 1.3. Figure 1.4 identifies the location and number of burnable poison rods and source assemblies for Cycle 11, and Figure 1.5 identifies the location and number of control rods in the Cycle 11 core.

On October 8, 1994 at 2225, the Cycle 11 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 measured drop time of each control rod was within the 2.7 second limit of Technical Specification 3.1.3.4.

2. Individual control rod bank worths were measured using the rod swap technique[2,5] and the results were within 4.6% of the design predictions. The sum of the individual measured control rod bank worths was within 1.9% of the design prediction. These results are within the design tolerance of ±15% for individual bank worths (±10% for the rod swap reference bank worth) and the design tolerance of ±10% for the sum of the individual control rod bank worths.

3. Measured critical boron concentrations for two control bank configurations were within 7 ppm of the design predictions. These

results were within the design tolerances and also met the Technical Specification 4.1.1.1.2 criterion that the overall core reactivity balance shall be within ±1% Δk/k of the design prediction.

4. The boron worth coefficient measurement was within 1.0% of the design prediction, which is within the design tolerance of ±10%.

5. The measured isothermal temperature coefficient (ITC) for the all-rods-out (ARO) configuration was within 0.74 pcm/°F of the design prediction. This result is within the design tolerance of ±3 pcm/°F. The measured ITC of -2.87 pcm/°F meets the Core Operating Limits Report (COLR) 2.1.1 criterion that the moderator temperature coefficient (MTC) be less than or equal to +6.0 pcm/°F. When the Doppler temperature coefficient and a 0.5 pcm/°F uncertainty are accounted for in the MTC limit, the MTC requirement is satisfied as long as the ITC is less than or equal to +3.75 pcm/°F.

6. Mode 1 (see Reference 4) core power distributions were within established design tolerances. Generally, the measured core power distribution was within 1.3% of the design predictions. The heat flux hot channel factors, F-Q(Z), and enthalpy rise hot channel factors, F-DH(N), were within the limits of COLR Sections 2.5.1 and 2.6, respectively.

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

Table 1.1

NORTH ANNA 1 - CYCLE 11 STARTUP PHYSICS TESTS
CHRONOLOGY OF TESTS

Test	Date	Time	Power	Reference Procedure
Hot Rod Drop - Hot Full Flow	10/08/94	0549	HSD	1-PT-17.2
Zero Power Testing Range	10/08/94	2354	HZP	1-PT-94.0
Reactivity Computer Checkout	10/09/94	0057	HZP	1-PT-94.0
Temperature Coefficient - ARO	10/09/94	0512	HZP	1-PT-94.0
Boron Endpoint - ARO	10/09/94	0515	HZP	1-PT-94.0
Bank B Worth	10/09/94	0649	HZP	1-PT-94.0
Boron Endpoint - B in	10/09/94	1000	HZP	1-PT-94.0
Bank D Worth - Rod Swap	10/09/94	1047	HZP	1-PT-94.0
Bank C Worth - Rod Swap	10/09/94	1140	HZP	1-PT-94.0
Bank A Worth - Rod Swap	10/09/94	1210	HZP	1-PT-94.0
Bank SB Worth - Rod Swap	10/09/94	1233	HZP	1-PT-94.0
Bank SA Worth - Rod Swap	10/09/94	1309	HZP	1-PT-94.0
Flux Map - 30% Power	10/10/94	1048	30%	1-PT-21.1
Peaking Factor Verification				1-PT-21.2
& Power Range Calibration				1-PT-22.4
Flux Map - 74% Power	10/12/94	1641	74%	1-PT-21.1
Peaking Factor Verification				1-PT-21.2
& Power Range Calibration				1-PT-22.4
Flux Map - 100% Power	10/31/94	1148	100%	1-PT-21.1
Peaking Factor Verification				1-PT-21.2
& Power Range Calibration *				1-PT-22.4

* Power range calibration calculation was performed which verified that the existing calibration was satisfactory.

Figure 1.1

NORTH ANNA UNIT 1 - CYCLE 11
CORE LOADING MAP

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						11A 1A6	12A 0B9	11A 2A7							1
				N2/11A 0L6	9A J22	13B 5C1	12B 4B3	13B 6C2	9A J34	N2/11A 0L4					2
			10B K60	13B 4C4	13B 5C8	12B 3B1	13B 4C1	12B 2B7	13B 3C4	13B 4C7	10B K58				3
		10B K47	12A 2B3	13B 3C5	12B 3B9	13A 1C0	12A 1B9	13A 0C2	12B 5B3	13B 5C6	12A 1B5	10B K56			4
	N2/11A 0L3	13B 6C3	13B 5C3	12B 5B8	13A 1C9	12A 1B1	13A 2C7	12A 1B2	13A 2C5	12B 5B0	13B 4C0	13B 2C9	N2/11A 0L2		5
	9A J27	13B 3C9	12B 3B6	13A 2C3	12A 2B0	13A 0C6	12B 5B6	13A 1C7	12A 0B3	13A 1C3	12B 3B3	13B 5C9	9A J32		6
11A 1A1	13B 4C6	12B 3B4	13A 0C5	12A 0B6	13A 1C5	12B 4B5	12B 5B2	12B 6B0	13A 0C1	12A 0B2	13A 2C2	12B 3B2	13B 5C0	11A 1A8	7
12A 1B7	12B 3B5	13B 3C1	12A 2B1	13A 0C3	12B 5B1	12B 4B1	N2/10B Y32	12B 2B6	12B 2B5	13A 0C8	12A 0B5	13B 6C4	12B 4B0	12A 0B1	8
11A 1A3	13B 5C7	12B 4B4	13A 1C2	12A 1B6	13A 2C1	12B 3B8	12B 4B7	12B 3B0	13A 1C1	12A 2B4	13A 1C6	12B 5B4	13B 3C3	11A 0A6	9
	9A J18	13B 4C9	12B 4B2	13A 1C8	12A 2B2	13A 2C8	12B 4B6	13A 1C4	12A 0B7	13A 0C4	12B 5B7	13B 4C5	9A J2[illegible]		10
	N2/11A 0L8	13B 4C2	13B 6C1	12B 5B5	13A 0C9	12A 1B4	13A 2C0	12A 1B8	13A 2C6	12B 4B8	13B 5C5	13B 3C8	N2/11A 0L5		11
		10B K59	12A 0B8	13B 3C7	12B 2B9	13A 2C4	12A 1B3	13A 0C7	12B 4B9	13B 3C2	12A 1B0	10B K52			12
			10B K64	13B 5C4	13B 3C0	12B 5B9	13B 5C2	12B 3B7	13B 6C0	13B 4C8	N2/9B X44				13
				N2/11A 0L1	9A J06	13B 4C3	12B 2B8	13B 3C6	9A J15	N2/11A 0L7					14
						11A 1A2	12A 0B4	11A 0A3							15

--> BATCH
--> ASSEMBLY ID

FUEL ASSEMBLY DESIGN PARAMETERS

	SUB-BATCH									
	N2/9B	N2/10B	N2/11A	9A	10B	11A	12A	12B	13A	13B
INITIAL ENRICHMENT (W/O U-235)	4.0057	4.2051	4.0155	3.7944	4.0007	4.0065	4.0036	4.2052	4.0082	4.2097
BURNUP AT BOC 11 (MWD/MTU)	36335	23397	26053	39222	36795	38783	26092	22805	0	0
ASSEMBLY TYPE	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17
NUMBER OF ASSEMBLIES	1	1	8	8	7	8	24	36	28	36
FUEL RODS PER ASSEMBLY	264	264	264	264	264	264	264	264	264	264

Figure 1.2

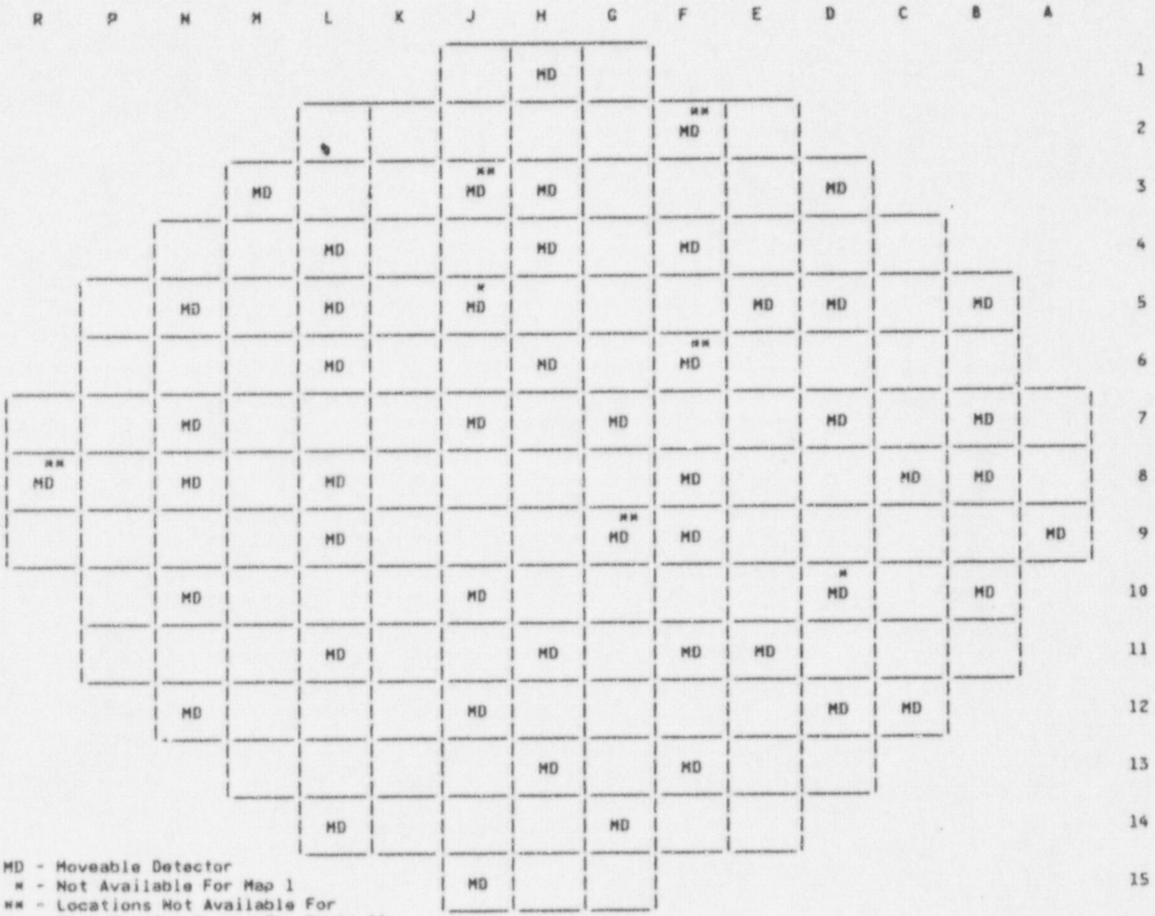
NORTH ANNA UNIT 1 - CYCLE 11
BEGINNING OF CYCLE FUEL ASSEMBLY BURNUPS

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						1A6 38163	0B9 26778	2A7 39008							1
				0L6 26550	J22 38672	5C1 0	4B3 20760	6C2 0	J34 39247	0L4 26564					2
			K60 36139	4C4 0	5C8 0	3B1 23328	4C1 0	2B7 24376	3C4 0	4C7 0	K58 36605				3
		K47 37905	2B3 25918	3C5 0	3B9 25498	1C0 0	1B9 25627	0C2 0	5B3 25154	5C6 0	1B5 26011	K56 35945			4
	0L3 26069	6C3 0	5C3 0	5B8 20687	1C9 0	1B1 25775	2C7 0	1B2 25569	2C5 0	5B0 21056	4C0 0	2C9 0	0L2 25638		5
	J27 39751	3C9 0	3B6 25338	2C3 0	2B0 25781	0C6 0	5B6 24953	1C7 0	0B3 26017	1C3 0	3B3 25512	5C9 0	J32 38874		6
1A1 38920	4C6 0	3B4 23974	0C5 0	0B6 26350	1C5 0	4B5 19848	5B2 19704	6B0 20106	0C1 0	0B2 26360	2C2 0	3B2 23764	5C0 0	1A8 38208	7
1B7 26737	3B5 21453	3C1 0	2B1 25937	0C3 0	5B1 25039	4B1 20823	Y32 23397	2B6 20162	2B5 24871	0C8 0	0B5 25947	6C4 0	4B0 21686	0B1 26445	8
1A3 38790	5C7 0	4B4 23232	1C2 0	1B6 25345	2C1 0	3B8 20456	4B7 19876	3B0 19550	1C1 0	2B4 25257	1C6 0	5B4 24576	3C3 0	0A6 39154	9
	J18 39369	4C9 0	4B2 24710	1C8 0	2B2 26751	2C8 0	4B6 24730	1C4 0	0B7 26015	0C4 0	5B7 24933	4C5 0	J28 38794		10
	0L8 26023	4C2 0	6C1 0	5B5 21067	0C9 0	1B4 25708	2C0 0	1B8 26329	2C6 0	4B8 21478	5C5 0	3C8 0	0L5 26253		11
		K59 36560	0B8 26786	3C7 0	2B9 25073	2C4 0	1B3 26825	0C7 0	4B9 25664	3C2 0	1B0 26165	K52 37254			12
			K64 37153	5C4 0	3C0 0	5B9 24108	5C2 0	3B7 23312	6C0 0	4C8 0	X44 36335				13
				0L1 25720	J06 39842	4C3 0	2B8 20996	3C6 0	J15 39231	0L7 25607					14
						1A2 38985	0B4 25782	0A3 39033							15

|--> ASSEMBLY ID
|--> ASSEMBLY BURNUP (MWD/MTU)

Figure 1.3

NORTH ANNA UNIT 1 - CYCLE 11
AVAILABLE INCORE MOVEABLE DETECTOR LOCATIONS



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

MD - Moveable Detector
* - Not Available For Map 1
** - Locations Not Available For Flux Mapping System For Cycle 11

Figure 1.4

NORTH ANNA UNIT 1 - CYCLE 11
ASSEMBLY INSERT LOCATIONS

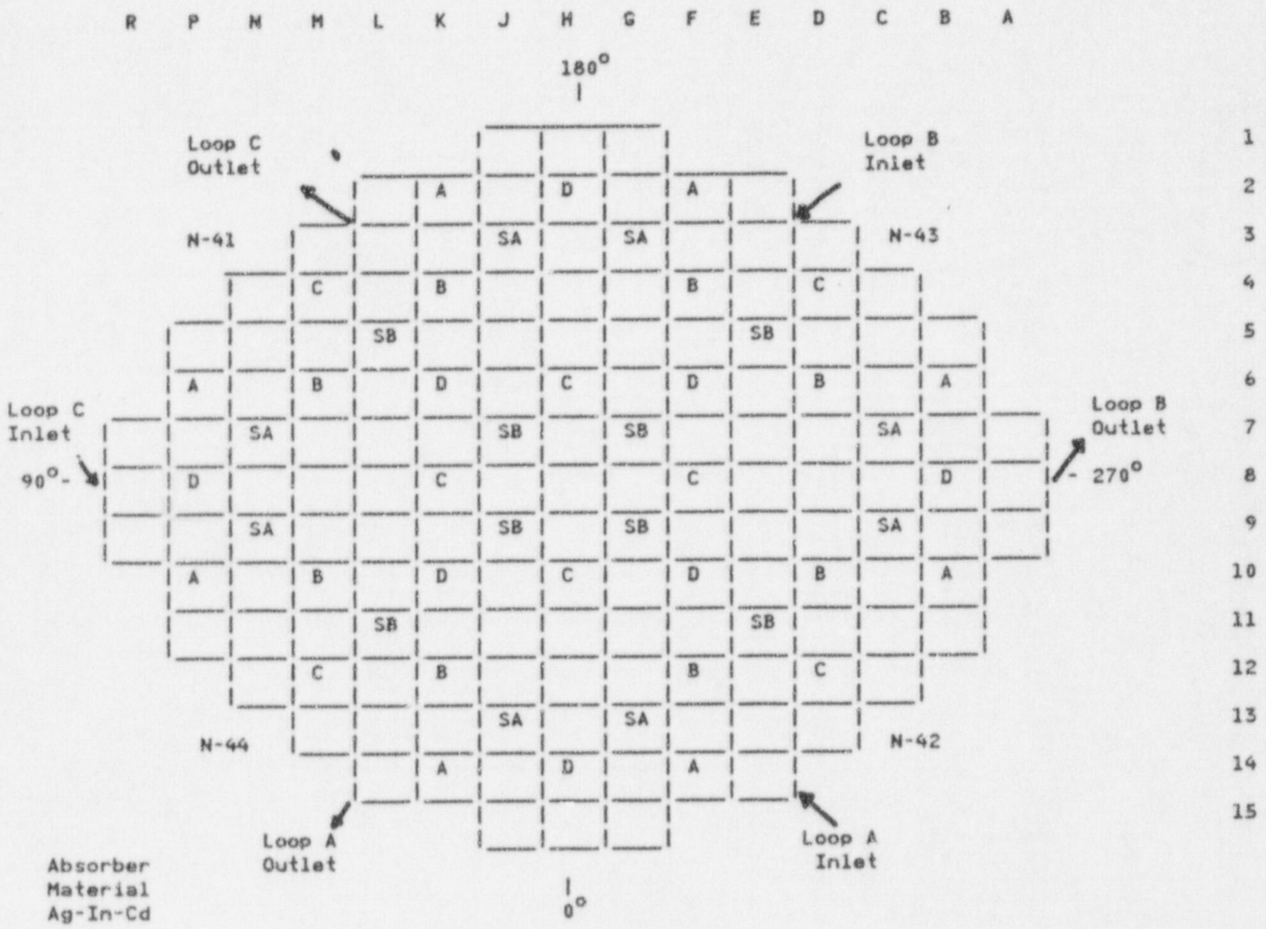
R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						VSDA	VSDA	VSDA							1
				VSDA		2P BP333		2P BP334		VSDA					2
				6P BP365	18P BP349		20P BP321		18P BP350	6P BP367					3
				20P BP357		24P BP309	SS19	24P BP310		20P BP360					4
	VSDA	6P BP366	20P BP358		24P BP341		24P BP311		24P BP342		20P BP359	6P BP368	VSDA		5
		18P BP356		24P BP343		24P BP325		24P BP326		24P BP344		18P BP351			6
VSDA	2P BP339		24P BP312		24P BP331		4P BP305		24P BP327		24P BP313		2P BP335	VSDA	7
VSDA		20P BP322		24P BP314		4P BP306		4P BP307		24P BP315		20P BP324		VSDA	8
VSDA	2P BP340		24P BP316		24P BP332		4P BP308		24P BP328		24P BP317		2P BP336	VSDA	9
		18P BP355		24P BP345		24P BP329		24P BP330		24P BP346		18P BP352			10
	VSDA	6P BP371	20P BP363		24P BP347		24P BP318		24P BP348		20P BP362	6P BP369	VSDA		11
				20P BP364		24P BP319	SS20	24P BP320		20P BP361					12
				6P BP372	18P BP354		20P BP323		18P BP353	6P BP370					13
				VSDA		2P BP337		2P BP338		VSDA					14
						VSDA	VSDA	VSDA							15

2P - 2 BURNABLE POISON ROD CLUSTER
4P - 4 BURNABLE POISON ROD CLUSTER
6P - 6 BURNABLE POISON ROD CLUSTER
18P - 18 BURNABLE POISON ROD CLUSTER
20P - 20 BURNABLE POISON ROD CLUSTER
24P - 24 BURNABLE POISON ROD CLUSTER
SSxx - SECONDARY SOURCE
VSDA - VIBRATION SUPPRESSION DAMPING ASSEMBLY

| xxP or SSxx | - # OF BP RODS or SECONDARY SOURCE ID
| BP### or VSDA | - BP ASSEMBLY ID or VSDA

Figure 1.5

NORTH ANNA UNIT 1 - CYCLE 11
CONTROL ROD LOCATIONS



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

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
Shutdown Bank SB	8
Shutdown Bank SA	8

Called North ↑

SECTION 2

CONTROL ROD DROP TIME MEASUREMENTS

The drop time of each control rod was measured at hot full-flow reactor coolant system (RCS) conditions in order to verify that the time from initiation of the rod drop to the entry of the rod into the dashpot was less than or equal to the maximum allowed by Technical Specification 3.1.3.4. The control rod drop times were measured in Mode 3[*] with the RCS Tavg above 500°F and all reactor coolant pumps operating.

The rod drop times were measured by withdrawing a rod bank 229 steps and then removing the moveable gripper coil fuse and stationary gripper coil fuse for the particular rod of the bank to be dropped. This allowed the rod to drop into the core as it would during a plant trip. The stationary gripper coil voltage and the Individual Rod Position Indication (IRPI) primary coil voltage signals were recorded to determine the rod drop time. This procedure was repeated for each control rod.

As shown on the sample rod drop trace in Figure 2.1, the initiation of the rod drop is indicated by the decay of the stationary gripper coil voltage when the stationary gripper coil fuse is removed. As the rod drops, a voltage is induced in the IRPI primary coil. The magnitude of this voltage is a function of control rod velocity. As the rod enters the dashpot region of the guide tube, its velocity slows causing a voltage decrease in the IRPI coil. This voltage reaches a minimum when the rod reaches the bottom of the dashpot. Subsequent variations in the trace are caused by rod bouncing.

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 2.7 seconds with the RCS at hot, full flow conditions. These test results satisfied this limit.

Table 2.1

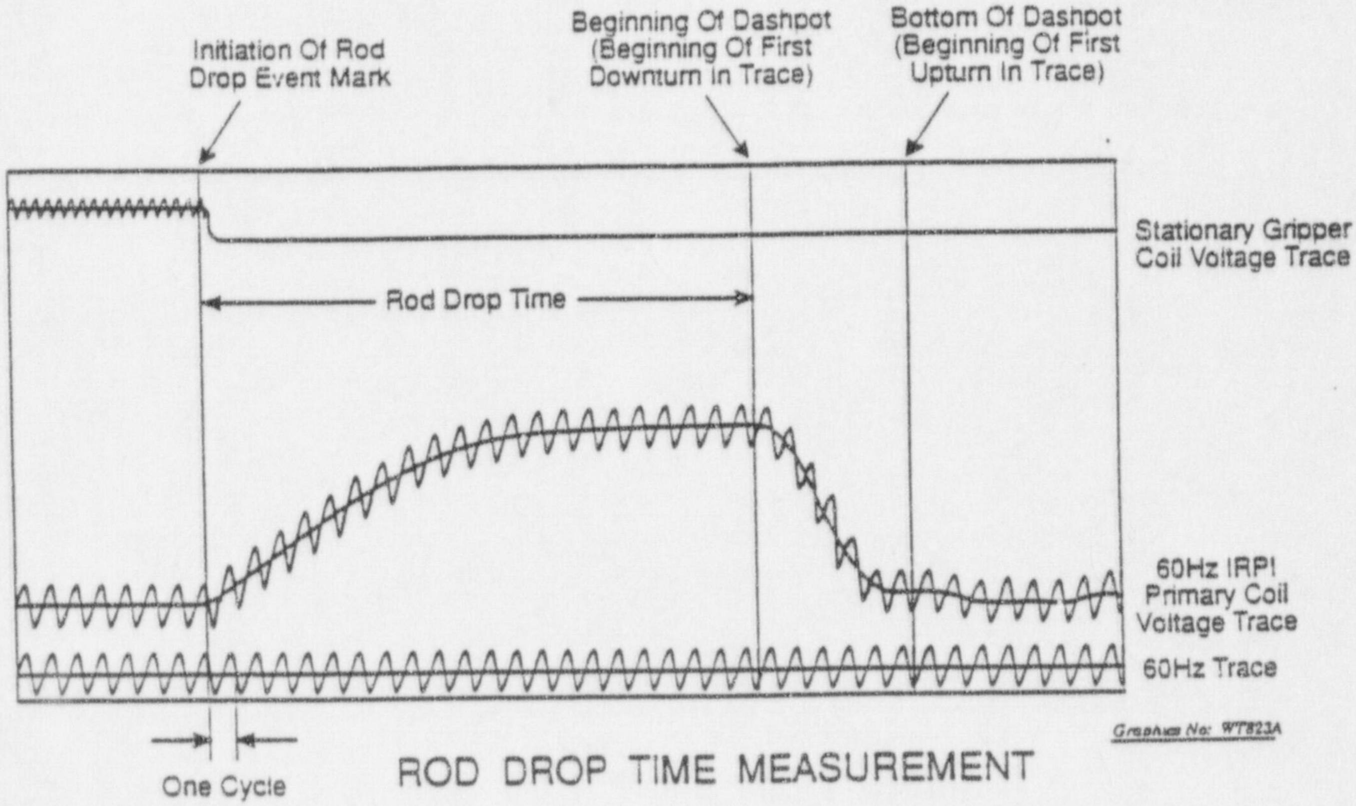
NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
HOT ROD DROP TIME SUMMARY

ROD DROP TIME TO DASHPOT ENTRY

SLOWEST ROD	FASTEST ROD	AVERAGE TIME
B-06 2.04 sec.	C-09 1.58 sec.	1.77 sec.

Figure 2.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
TYPICAL ROD DROP TRACE



ROD DROP TIME MEASUREMENT

Figure 2.2

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
ROD DROP TIME - HOT FULL FLOW CONDITIONS

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
															1
					1.79		1.67		1.74						2
						1.72		1.76							3
			1.78		1.70				1.80		1.76				4
				1.78						1.76					5
	1.68		1.81		1.73		1.74		1.76		1.78		2.04		6
		1.76				1.69		1.74				1.77			7
	1.80				1.76				1.73				1.93		8
		1.80				1.69		1.70				1.58			9
	1.78		1.79		1.70		1.74		1.83		1.75		1.83		10
				1.85						1.77					11
			1.70		1.83				1.72		1.76				12
						1.72		1.74							13
					1.99		1.78		1.84						14
															15

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

SECTION 3

CONTROL ROD BANK WORTH MEASUREMENTS

Control rod bank worths were measured for the control and shutdown banks using the rod swap technique[2,5]. The initial step of the rod swap method diluted the predicted most reactive control rod bank (hereafter referred to as the reference bank) into the core and measured its reactivity worth using conventional test techniques. The reactivity changes resulting from the reference bank movements were recorded continuously by the reactivity computer and were used to determine the differential and integral worth of the reference bank. For Cycle 11, Control Bank B was used as the reference bank.

After the completion of the reference bank reactivity worth measurement, the reactor coolant system temperature and boron concentration were stabilized with the reactor just critical and 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 with all other banks fully withdrawn and recording the core reactivity and moderator temperature. From this point, a rod swap maneuver was performed by withdrawing the reference bank several steps and then inserting one of the other control rod banks (i.e., a test bank) to balance the reactivity of the reference bank withdrawal. This sequence was repeated until the test bank was fully inserted and the reference bank was positioned such that the core was just critical or near the initial statepoint condition. This measured critical position (MCP) of the reference bank with the test bank fully inserted was used to determine the integral reactivity worth of the test bank. The 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 then was repeated in reverse such that the reference bank again was near full insertion with the test bank fully withdrawn from the core. This rod swap process was then repeated for each of the other control and shutdown banks.

A summary of the test results is given in Table 3.1. As shown in this table and the Startup Physics Test Results and Evaluation Sheets given in the Appendix, the individual measured bank worths for the control and shutdown banks were within the design tolerance (±10% for the reference bank, ±15% for test banks of worth greater than 600 pcm, and ±100 pcm for test banks of worth less than or equal to 600 pcm.) The sum of the individual measured rod bank worths was within 1.9% 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 3.1 and 3.2, respectively. The design predictions and the measured data are plotted together in order to illustrate their agreement. In summary, the measured rod worth values were satisfactory.

Table 3.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS CONTROL ROD BANK WORTH SUMMARY

BANK	MEASURED WORTH (PCM)	PREDICTED WORTH (PCM)	PERCENT DIFFERENCE (%) (M-P)/P X 100
B-Reference Bank	1250.0	1310.0	-4.6
D	978.0	1003.7	-2.6
C	823.0	812.8	1.3
A	266.0	263.2	1.1 *
SB	1089.0	1076.9	1.1
SA	937.0	980.3	-4.4
Total Worth	5343.0	5446.9	-1.9

* Difference is less than 100 pcm.

Figure 3.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
CONTROL BANK B INTEGRAL ROD WORTH - HZP
ALL OTHER RODS WITHDRAWN

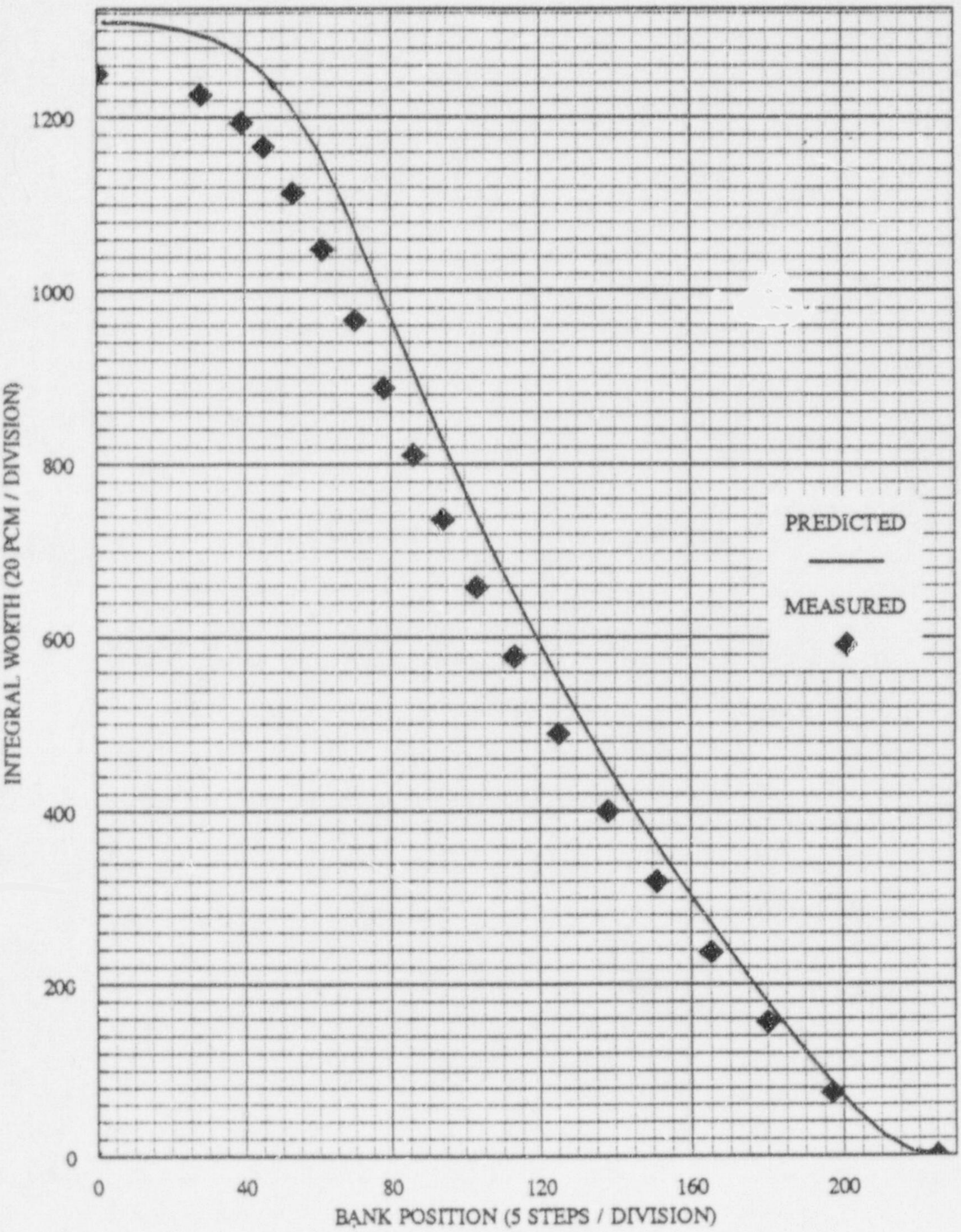
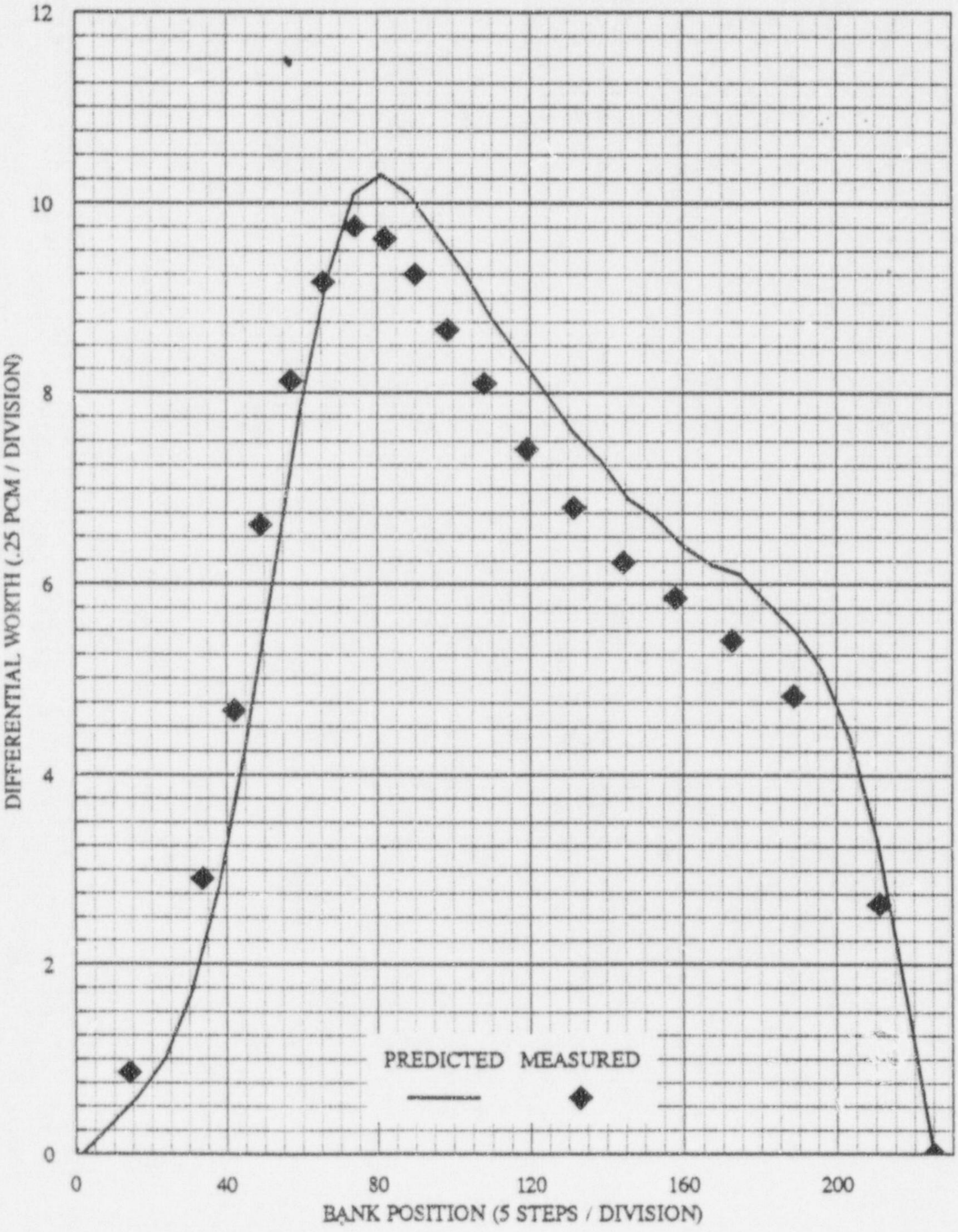


Figure 3.2

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
CONTROL BANK B DIFFERENTIAL ROD WORTH - HZP
ALL OTHER RODS WITHDRAWN



SECTION 4

BORON ENDPOINT AND WORTH MEASUREMENTS

Boron Endpoint

With the reactor critical at hot zero power, reactor coolant system (RCS) boron concentrations were measured at selected rod bank configurations to enable a direct comparison of measured boron endpoints with design predictions. For each critical boron concentration measurement, the RCS conditions were stabilized with the control banks at or very near a selected endpoint position. Adjustments to the measured critical boron concentration values were made to account for off-nominal control rod position and moderator temperature, if necessary.

The results of these measurements are given in Table 4.1. As shown in this table and in the Startup Physics Test Results and Evaluation Sheets given in the Appendix, the measured critical boron endpoint values were within their respective design tolerances. The ARO endpoint comparison to the predicted value met the requirements of Technical Specification 4.1.1.1.2 regarding core reactivity balance. In summary, the boron endpoint results were satisfactory.

Boron Worth Coefficient

The measured boron endpoint values provide stable statepoint data from which the boron worth coefficient or differential boron worth (DBW) was determined. 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 DBW over the range of boron endpoint concentrations was obtained.

A plot of the boron concentration versus inserted control rod worth is shown in Figure 4.1. As indicated in this figure and in the Appendix, the measured DBW was -6.72 pcm/ppm. This is within 1.0% of the predicted value of -6.79 pcm/ppm and is well within the design tolerance of ±10%. In summary, the measured boron worth coefficient was satisfactory.

Table 4.1

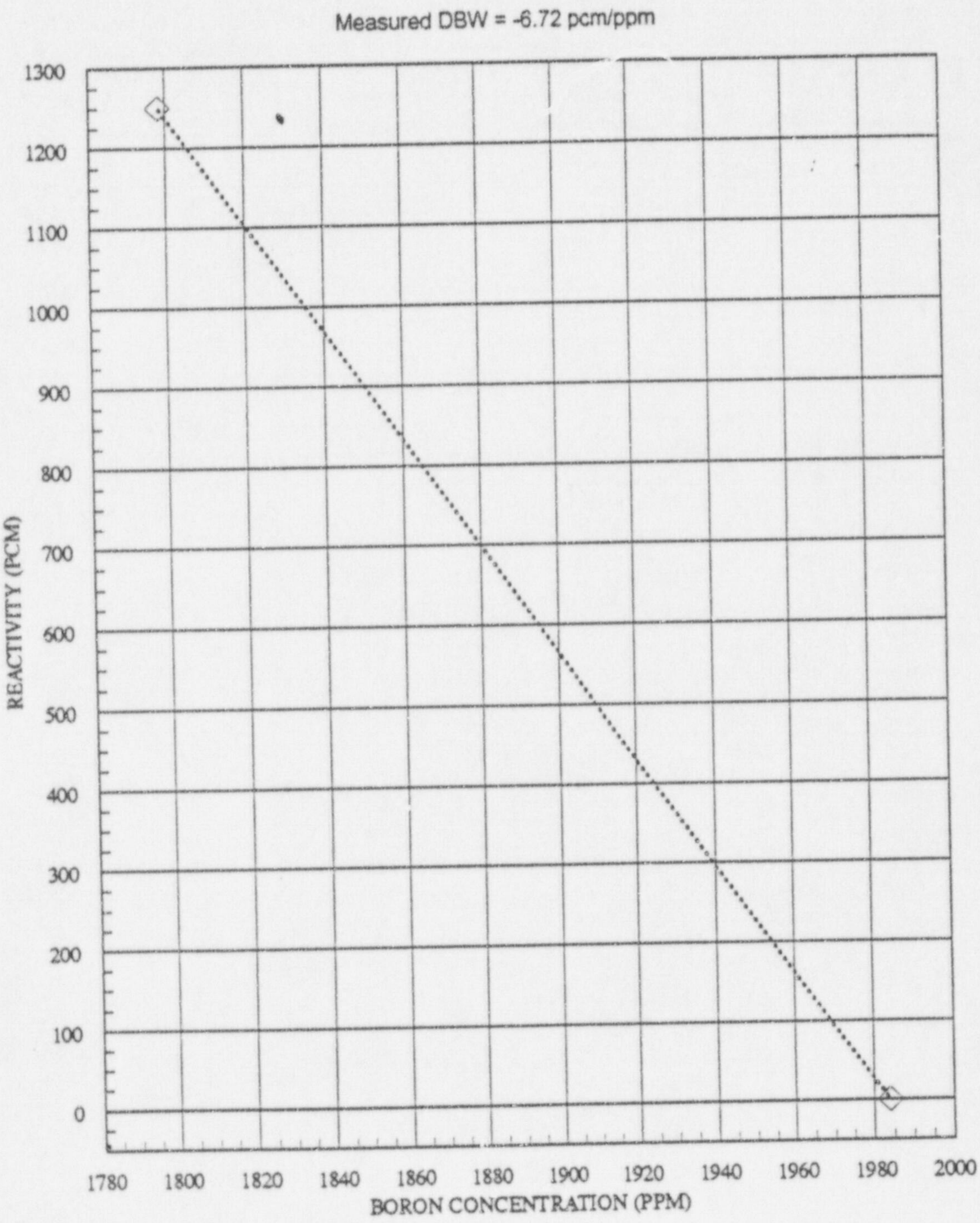
NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
BORON ENDPOINTS SUMMARY

Control Rod Configuration	Measured Endpoint (ppm)	Predicted Endpoint (ppm)	Difference M-P (ppm)
ARO	1984	1983	1
B Bank In	1798	1791*	7

* The predicted endpoint for the B Bank In configuration was 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 Sheet in the Appendix.

Figure 4.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
BORON WORTH COEFFICIENT



SECTION 5

TEMPERATURE COEFFICIENT MEASUREMENT

The isothermal temperature coefficient (ITC) at the all-rods-out condition is measured by controlling the reactor coolant system (RCS) temperature with the steam dump valves to the condenser, establishing a constant heatup or cooldown rate, and monitoring the resulting reactivity changes on the reactivity computer.

Reactivity was measured during the RCS cooldown of 3.4°F and RCS heatup of 3.1°F. Reactivity and temperature data were taken from the reactivity computer and strip chart recorders. Using the statepoint method, the temperature coefficient was determined by dividing the change in reactivity by the change in RCS temperature. An X-Y plotter, which plotted reactivity versus temperature, confirmed the statepoint method in calculating the measured ITC.

The predicted and measured isothermal temperature coefficient values are compared in Table 5.1. As can be seen from this summary and from the Startup Physics Test Results and Evaluation Sheet given in the Appendix, the measured isothermal temperature coefficient value was within the design tolerance of ±3 pcm/°F. The moderator temperature coefficient was determined to be -1.12 pcm/°F which met the requirements of COLR Section 2.1.1. In summary, the measured result was satisfactory.

Table 5.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS ISOTHERMAL TEMPERATURE COEFFICIENT SUMMARY

BANK POSITION (STEPS)	TEMPERATURE RANGE (°F)	BORON CONCENTRATION (ppm)	ISOTHERMAL TEMPERATURE COEFFICIENT (PCM/°F)				
			C/D	H/U	AVE. MEAS.	PRED.	DIFFER. (M-P)
D/212	544.4 to 547.8	1984	-2.50	-3.23	-2.87	-3.61	0.74

SECTION 6

POWER DISTRIBUTION MEASUREMENTS

The core power distributions were measured using the moveable incore detector flux mapping system. This system consists of five fission chamber detectors which traverse fuel assembly instrumentation thimbles in up to 50 core locations. Figure 1.3 shows the available locations monitored by the moveable detectors for the ramp to full power flux maps for Cycle 11. For each traverse, the detector voltage output is continuously monitored on a strip chart recorder, and scanned for 61 discrete axial points by the PRODAC P-250 process computer. Full core, three-dimensional power distributions are determined from this data using a Virginia Power modified version of the Combustion Engineering computer program, CECOR[3]. CECOR couples the measured voltages with predetermined analytic power-to-flux ratios in order to determine the power distribution for the whole core.

A list of the full-core flux maps taken during the startup test program and the measured values of the important power distribution parameters are given in Table 6.1. A comparison of these measured values with their COLR limits is given in Table 6.2. Flux map 1 was taken at 30% power to verify the radial power distribution (RPD) predictions at low power. Figure 6.1 shows the measured RPDs from this flux map. Flux maps 2 and 3 were taken at 74% and 100% power, respectively, with different control rod configurations. These flux maps were taken to check at-power design predictions and to measure core power distributions at various operating conditions. The radial power distributions for these maps are given in Figures 6.2 and 6.3. The radial power distributions for the maps given in Figures 6.1, 6.2, and 6.3 show that the measured relative assembly power values were generally within 1.3% of the predicted values. Further, the measured F-Q(Z) and F-DH(N) peaking factor values for the at-power flux maps were within the limits of COLR Sections 2.5.1 and 2.6, respectively. Flux maps 1, 2, and 3 were used to perform power range detector calibrations (flux map 3 verified that the existing calibration was satisfactory, thus no adjustments to the power range detector calibration were required).

In conclusion, the power distribution measurement results were considered to be acceptable with respect to the design tolerances, the accident analysis acceptance criteria, and the COLR. It is therefore anticipated that the core will continue to operate safely throughout Cycle 11.

TABLE 6.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
INCORE FLUX MAP SUMMARY

MAP DESCRIPTION	MAP NO.	DATE	BURN UP MWD/MTU	PWR (%)	BANK D STEPS	(1) F-Q(Z) HOT CHANNEL FACTOR			F-DH(N) HOT CHNL.FACTOR		CORE F(Z) MAX		(2) CORE TILT		AXIAL OFF SET (%)	NO. OF THIMBLES
						ASSY	AXIAL POINT	F-Q(Z)	ASSY	F-DH(N)	AXIAL POINT	F(Z)	MAX	LOC		
LOW POWER	1	10-10-94	4	30	124	N05	37	2.297	N05	1.525	36	1.419	1.011	NW	-13.39	43
P.F.V. (3)	2	10-12-94	37	74	179	G14	35	2.011	N06	1.434	35	1.290	1.007	NW	-7.55	45
HOT FULL POWER	3	10-31-94	764	100	225	N06	37	1.833	N06	1.394	36	1.208	1.004	NW	-3.53	45

NOTES: HOT SPOT LOCATIONS ARE SPECIFIED BY GIVING ASSEMBLY LOCATIONS (E.G. H-8 IS THE CENTER-OF-CORE ASSEMBLY) AND CORE HEIGHT (IN THE "Z" DIRECTION THE CORE IS DIVIDED INTO 61 AXIAL POINTS STARTING FROM THE TOP OF THE CORE).

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

(2) CORE TILT - DEFINED AS THE AVERAGE QUADRANT POWER TILT FROM CECOR.

(3) P.F.V. - PEAKING FACTOR VERIFICATION.

(4) MAPS 1, 2, AND 3 WERE USED FOR POWER RANGE DETECTOR CALIBRATIONS. THE CALIBRATION FOR FLUX MAP 3 VERIFIED THE ACCEPTABILITY OF THE EXISTING CALIBRATION.

Table 6.2

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS COMPARISION OF MEASURED POWER DISTRIBUTION PARAMETERS WITH THEIR CORE OPERATING LIMITS

MAP NO.	PEAK F-Q(Z) HOT CHANNEL FACTOR*			F-Q(Z) HOT CHANNEL FACTOR** (AT NODE OF MINIMUM MARGIN)				F-DH(N) HOT CHANNEL FACTOR		
	MEAS.	LIMIT	NODE	MEAS.	LIMIT	NODE	MARGIN (%)	MEAS.	LIMIT	MARGIN (%)
1	2.297	4.380	37	2.297	4.380	36	47.6	1.525	1.804	15.5
2	2.011	2.959	35	2.011	2.959	35	32.0	1.434	1.606	10.7
3	1.833	2.190	37	1.833	2.190	37	16.3	1.394	1.490	6.4

* The Core Operating Limit for the heat flux hot channel factor, F-Q(Z), is a function of core height and power level. The value for F-Q(Z) listed above is the maximum value of F-Q(Z) in the core. The COLR limit listed above is evaluated at the plane of maximum F-Q(Z).

** The value for F-Q(Z) listed above is the value at the plane of minimum margin. The minimum margin values listed above are the minimum percent difference between the measured values of F-Q(Z) and the COLR limit for each map.

The measured F-Q(Z) hot channel factors include 8.15% total uncertainty.

Figure 6.1

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
30% POWER

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
		PREDICTED MEASURED PCT DIFFERENCE				0.253 0.252 -0.6	0.326 0.321 -1.6	0.256 0.253 -0.9				PREDICTED MEASURED PCT DIFFERENCE			1
				0.382 0.383 0.1	0.501 0.500 0.0	1.057 1.054 -0.3	0.825 0.820 -0.5	1.069 1.060 -0.8	0.503 0.498 -0.9	0.383 0.378 -1.3					2
			0.411 0.407 -1.1	1.220 1.224 0.3	1.357 1.359 0.2	1.211 1.209 -0.2	1.273 1.264 -0.7	1.216 1.208 -0.7	1.360 1.347 -0.9	1.219 1.202 -1.4	0.401 0.389 -2.8				3
		0.396 0.407 2.8	0.875 0.886 1.3	1.361 1.373 0.9	1.296 1.303 0.5	1.213 1.214 0.1	1.158 1.146 -1.0	1.215 1.208 -0.5	1.298 1.290 -0.6	1.361 1.342 -1.4	0.878 0.853 -2.9	0.413 0.399 -3.4			4
	0.381 0.394 3.4	1.212 1.261 4.0	1.357 1.384 2.0	1.309 1.328 1.5	1.207 1.220 1.1	1.136 1.148 1.1	1.156 1.162 0.5	1.136 1.139 0.3	1.207 1.203 -0.4	1.312 1.297 -1.1	1.366 1.310 -4.1	1.225 1.180 -3.7	0.384 0.371 -3.4		5
	0.501 0.510 1.9	1.356 1.384 2.1	1.296 1.312 1.2	1.206 1.204 -0.1	0.969 0.984 1.5	1.140 1.170 2.6	1.170 1.192 1.8	1.139 1.159 1.7	0.968 0.971 0.3	1.207 1.186 -1.7	1.299 1.252 -3.6	1.359 1.314 -3.3	0.500 0.491 -2.0		6
0.255 0.258 1.2	1.066 1.079 1.3	1.212 1.227 1.2	1.210 1.221 0.8	1.130 1.137 0.6	1.131 1.158 2.4	1.216 1.285 5.7	1.217 1.259 3.5	1.207 1.255 3.9	1.127 1.136 0.8	1.130 1.108 -1.9	1.211 1.151 -5.0	1.209 1.170 -3.2	1.054 1.058 0.4	0.253 0.253 0.2	7
0.325 0.328 0.9	0.821 0.830 1.1	1.268 1.273 0.4	1.154 1.157 0.3	1.148 1.141 -0.6	1.154 1.171 1.5	1.199 1.233 2.8	1.224 1.252 2.3	1.203 1.224 1.7	1.156 1.164 0.7	1.149 1.131 -1.6	1.155 1.116 -3.3	1.268 1.214 -4.3	0.822 0.823 0.2	0.325 0.324 -0.4	8
0.253 0.254 0.6	1.053 1.059 0.5	1.208 1.211 0.3	1.210 1.215 0.4	1.129 1.134 0.5	1.125 1.139 1.2	1.205 1.225 1.6	1.217 1.230 1.1	1.218 1.217 0.0	1.132 1.101 -2.7	1.131 1.109 -1.9	1.211 1.183 -2.3	1.213 1.182 -2.5	1.066 1.048 -1.7	0.255 0.248 -2.8	9
	0.500 0.501 0.2	1.358 1.358 0.0	1.298 1.306 0.6	1.206 1.219 1.0	0.968 0.979 1.2	1.139 1.156 1.4	1.170 1.174 0.3	1.141 1.136 -0.4	0.970 0.956 -1.4	1.206 1.192 -1.2	1.296 1.278 -1.4	1.356 1.333 -1.7	0.501 0.490 -2.2		10
	0.384 0.385 0.4	1.225 1.231 0.5	1.365 1.378 1.0	1.311 1.336 1.9	1.207 1.218 0.9	1.135 1.137 0.2	1.156 1.144 -1.0	1.136 1.127 -0.8	1.207 1.192 -1.3	1.310 1.310 0.0	1.357 1.352 -0.4	1.213 1.201 -1.0	0.381 0.376 -1.3		11
		0.413 0.418 1.2	0.878 0.886 1.0	1.360 1.374 1.0	1.297 1.302 0.4	1.214 1.205 -0.7	1.158 1.153 -0.5	1.213 1.208 -0.4	1.297 1.287 -0.8	1.362 1.360 -0.1	0.876 0.887 1.3	0.396 0.397 0.3			12
			0.401 0.404 0.8	1.219 1.228 0.8	1.360 1.365 0.4	1.216 1.216 0.0	1.273 1.276 0.3	1.211 1.216 0.4	1.358 1.341 -1.2	1.221 1.214 -0.6	0.411 0.412 0.2				13
				0.383 0.389 1.5	0.503 0.505 0.3	1.069 1.069 0.0	0.825 0.835 1.3	1.057 1.097 3.8	0.501 0.504 0.8	0.382 0.382 -0.2					14
		STANDARD DEVIATION =1.158				0.256 0.244 -4.5	0.326 0.327 0.5	0.253 0.261 3.0				AVERAGE PCT DIFFERENCE = 1.3			15

SUMMARY

MAP NO: N1-11-01 DATE: 10/19/94 POWER: 30%

CONTROL ROD POSITIONS: F-Q(Z) = 2.297 CORE TILT:

D BANK AT 124 STEPS F-DH(N) = 1.525

NW 1.011	NE 0.989
SW 1.006	SE 0.993

F(Z) = 1.419

BURNUP = 4 MWD/MTU A.O. = -13.39%

Figure 6.2

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
74% POWER

PREDICTED
MEASURED
PCT DIFFERENCE

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
						0.285 0.279 -2.1	0.378 0.361 -4.3	0.287 0.281 -2.1							1
				0.385 0.382 -0.6	0.513 0.509 -0.9	1.107 1.092 -1.4	0.957 0.939 -1.9	1.118 1.103 -1.3	0.515 0.511 -0.9	0.385 0.382 -0.7					2
			0.409 0.404 -1.3	1.166 1.160 -0.5	1.306 1.298 -0.6	1.207 1.195 -1.0	1.286 1.265 -1.6	1.213 1.201 -0.9	1.308 1.302 -0.5	1.165 1.157 -0.7	0.398 0.394 -1.0				3
		0.394 0.403 2.2	0.848 0.853 0.6	1.291 1.288 -0.2	1.250 1.249 -0.1	1.185 1.180 -0.4	1.147 1.131 -1.5	1.186 1.182 -0.4	1.251 1.255 0.3	1.289 1.279 -0.8	0.850 0.832 -2.2	0.410 0.398 -2.9			4
	0.384 0.394 2.7	1.160 1.200 3.4	1.287 1.307 1.5	1.271 1.280 0.8	1.203 1.212 0.7	1.138 1.147 0.8	1.146 1.155 0.8	1.138 1.145 0.7	1.203 1.204 0.1	1.272 1.260 -1.0	1.293 1.246 -3.7	1.170 1.130 -3.4	0.386 0.367 -4.8		5
	0.514 0.519 0.9	1.306 1.324 1.4	1.251 1.265 1.2	1.202 1.216 1.2	1.089 1.106 1.6	1.165 1.197 2.8	1.178 1.213 3.0	1.164 1.189 2.2	1.088 1.092 0.4	1.203 1.188 -1.2	1.253 1.216 -2.9	1.307 1.269 -2.9	0.513 0.502 -2.1		6
0.287 0.286 -0.3	1.117 1.115 -0.2	1.210 1.208 -0.1	1.184 1.191 0.6	1.133 1.147 1.2	1.156 1.187 2.6	1.234 1.300 5.3	1.227 1.274 3.9	1.226 1.278 4.3	1.152 1.168 1.4	1.133 1.120 -1.1	1.184 1.137 -3.9	1.205 1.173 -2.7	1.104 1.100 -0.3	0.284 0.282 -0.8	7
0.378 0.375 -0.7	0.955 0.947 -0.8	1.282 1.264 -1.4	1.143 1.143 0.0	1.139 1.144 0.4	1.163 1.187 2.1	1.210 1.248 3.2	1.232 1.267 2.9	1.213 1.244 2.5	1.165 1.184 1.6	1.140 1.134 -0.5	1.144 1.118 -2.3	1.283 1.239 -3.4	0.955 0.939 -1.6	0.378 0.370 -2.1	8
0.284 0.282 -0.7	1.104 1.097 -0.7	1.204 1.197 -0.6	1.184 1.187 0.3	1.132 1.149 1.5	1.151 1.172 1.8	1.225 1.252 2.2	1.227 1.249 1.8	1.236 1.249 1.1	1.157 1.152 -0.5	1.134 1.128 -0.5	1.184 1.172 -1.1	1.211 1.192 -1.6	1.117 1.101 -1.5	0.287 0.271 -5.5	9
	0.513 0.510 -0.6	1.306 1.299 -0.6	1.252 1.256 0.4	1.202 1.216 1.1	1.087 1.100 1.2	1.163 1.188 2.1	1.178 1.189 0.9	1.166 1.169 0.3	1.089 1.081 -0.8	1.202 1.202 0.0	1.251 1.250 -0.1	1.306 1.302 -0.3	0.514 0.520 1.2		10
	0.386 0.385 -0.2	1.169 1.170 0.[illegible]	1.293 1.301 0.6	1.272 1.290 1.5	1.203 1.211 0.7	1.137 1.139 0.2	1.146 1.138 -0.7	1.138 1.132 -0.5	1.203 1.191 -1.0	1.272 1.285 1.0	1.288 1.298 0.8	1.160 1.162 0.2	0.384 0.385 0.5		11
		0.410 0.411 0.2	0.850 0.854 0.4	1.289 1.295 0.4	1.251 1.249 -0.2	1.186 1.171 -1.3	1.147 1.135 -1.0	1.185 1.179 -0.5	1.250 1.246 -0.4	1.291 1.300 0.7	0.849 0.870 2.5	0.394 0.392 -0.6			12
			0.398 0.399 0.2	1.165 1.164 -0.1	1.308 1.301 -0.6	1.213 1.197 -1.3	1.286 1.265 -1.7	1.207 1.203 -0.3	1.306 1.297 -0.7	1.166 1.168 0.2	0.409 0.414 1.2				13
				0.385 0.384 -0.3	0.515 0.510 -1.0	1.118 1.099 -1.8	0.957 0.949 -0.8	1.107 1.128 1.9	0.513 0.516 0.5	0.385 0.386 0.3					14
						0.287 0.263 -8.3	0.378 0.371 -1.9	0.285 0.287 0.9							15

STANDARD
DEVIATION
=1.243

AVERAGE
PCT DIFFERENCE
= 1.3

SUMMARY

MAP NO: N1-11-02

DATE: 10/1?/94

POWER: 74%

CONTROL ROD POSITIONS:

D BANK AT 179 STEPS

F-Q(Z) = 2.011

F-DH(N) = 1.434

F(Z) = 1.290

BURNUP = 37 MWD/MTU

CORE TILT:

NW 1.007	NE 0.992
SW 1.002	SE 0.999

A.O. = -7.55%

Figure 6.3

NORTH ANNA UNIT 1 - CYCLE 11 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
100% POWER

```
     R       P       N       M       L       K       J       H       G       F       E       D       C       B       A

                ................                .........................               ................
                .   PREDICTED  .                . 0.295 . 0.397 . 0.298 .               .   PREDICTED  .
                .   MEASURED   .                . 0.291 . 0.391 . 0.294 .               .   MEASURED   .                    1
                .PCT DIFFERENCE.                .  -1.4 .  -1.5 .  -1.3 .               .PCT DIFFERENCE.
                ................ ......................................................  ................
                                . 0.386 . 0.519 . 1.109 . 1.004 . 1.120 . 0.521 . 0.387 .
                                . 0.382 . 0.513 . 1.093 . 0.986 . 1.106 . 0.517 . 0.386 .                                   2
                                .  -1.1 .  -1.2 .  -1.4 .  -1.7 .  -1.3 .  -0.8 .  -0.4 .
                        .........................................................................
                        . 0.410 . 1.141 . 1.285 . 1.193 . 1.289 . 1.197 . 1.287 . 1.139 . 0.400 .
                        . 0.410 . 1.129 . 1.273 . 1.177 . 1.256 . 1.184 . 1.282 . 1.137 . 0.403 .                           3
                        .   0.0 .  -1.0 .  -1.0 .  -1.3 .  -2.5 .  -1.1 .  -0.4 .  -0.2 .   0.9 .
                .........................................................................................
                . 0.396 . 0.840 . 1.271 . 1.230 . 1.184 . 1.140 . 1.185 . 1.230 . 1.270 . 0.842 . 0.411 .
                . 0.399 . 0.859 . 1.252 . 1.223 . 1.180 . 1.133 . 1.183 . 1.232 . 1.265 . 0.827 . 0.401 .                   4
                .   0.9 .  -0.1 .  -1.4 .  -0.5 .  -0.3 .  -0.6 .  -0.2 .   0.2 .  -0.4 .  -1.8 .  -2.5 .
        .........................................................................................................
        . 0.386 . 1.135 . 1.268 . 1.257 . 1.219 . 1.141 . 1.153 . 1.141 . 1.219 . 1.257 . 1.273 . 1.144 . 0.388 .
        . 0.391 . 1.154 . 1.278 . 1.268 . 1.228 . 1.156 . 1.164 . 1.151 . 1.224 . 1.255 . 1.225 . 1.110 . 0.382 .           5
        .   1.2 .   1.6 .   0.8 .   0.9 .   0.8 .   1.3 .   1.0 .   0.9 .   0.5 .  -0.2 .  -3.7 .  -3.0 .  -1.5 .
        .........................................................................................................
        . 0.520 . 1.285 . 1.230 . 1.218 . 1.152 . 1.185 . 1.174 . 1.184 . 1.151 . 1.218 . 1.232 . 1.285 . 0.519 .
        . 0.522 . 1.295 . 1.236 . 1.218 . 1.169 . 1.218 . 1.203 . 1.211 . 1.161 . 1.209 . 1.196 . 1.249 . 0.509 .           6
        .   0.4 .   0.8 .   0.5 .   0.0 .   1.5 .   2.7 .   2.5 .   2.3 .   0.9 .  -0.8 .  -2.8 .  -2.8 .  -2.0 .
.........................................................................................................................
. 0.298 . 1.120 . 1.196 . 1.183 . 1.137 . 1.178 . 1.227 . 1.212 . 1.220 . 1.174 . 1.136 . 1.182 . 1.191 . 1.106 . 0.295 .
. 0.296 . 1.117 . 1.201 . 1.187 . 1.146 . 1.208 . 1.295 . 1.259 . 1.276 . 1.195 . 1.127 . 1.134 . 1.154 . 1.094 . 0.292 .   7
.  -0.5 .  -0.2 .   0.4 .   0.3 .   0.8 .   2.5 .   5.6 .   3.9 .   4.6 .   1.8 .  -0.8 .  -4.1 .  -3.1 .  -1.1 .  -1.0 .
.........................................................................................................................
. 0.397 . 1.002 . 1.285 . 1.138 . 1.147 . 1.162 . 1.198 . 1.217 . 1.200 . 1.163 . 1.148 . 1.138 . 1.286 . 1.002 . 0.397 .
. 0.393 . 0.988 . 1.259 . 1.133 . 1.150 . 1.184 . 1.235 . 1.251 . 1.232 . 1.190 . 1.144 . 1.110 . 1.234 . 1.001 . 0.394 .   8
.  -1.2 .  -1.3 .  -2.0 .  -0.4 .   0.3 .   1.9 .   3.1 .   2.8 .   2.7 .   2.4 .  -0.3 .  -2.4 .  -4.0 .   0.0 .  -0.8 .
.........................................................................................................................
. 0.295 . 1.106 . 1.191 . 1.182 . 1.136 . 1.173 . 1.218 . 1.212 . 1.228 . 1.178 . 1.138 . 1.183 . 1.196 . 1.120 . 0.298 .
. 0.290 . 1.089 . 1.171 . 1.181 . 1.159 . 1.194 . 1.242 . 1.232 . 1.240 . 1.172 . 1.133 . 1.170 . 1.178 . 1.112 . 0.289 .   9
.  -1.5 .  -1.6 .  -1.7 .  -0.1 .   2.0 .   1.8 .   2.0 .   1.6 .   1.0 .  -0.6 .  -0.4 .  -1.1 .  -1.5 .  -0.7 .  -3.0 .
.........................................................................................................................
        . 0.519 . 1.285 . 1.231 . 1.218 . 1.150 . 1.184 . 1.174 . 1.186 . 1.152 . 1.219 . 1.231 . 1.285 . 0.520 .
        . 0.508 . 1.250 . 1.226 . 1.233 . 1.166 . 1.200 . 1.182 . 1.188 . 1.149 . 1.222 . 1.230 . 1.284 . 0.526 .           10
        .  -2.1 .  -2.8 .  -0.3 .   1.2 .   1.3 .   1.3 .   0.7 .   0.2 .  -0.3 .   0.2 .  -0.1 .  -0.1 .   1.0 .
        .........................................................................................................
        . 0.388 . 1.144 . 1.273 . 1.257 . 1.219 . 1.141 . 1.153 . 1.141 . 1.219 . 1.257 . 1.268 . 1.135 . 0.386 .
        . 0.383 . 1.135 . 1.278 . 1.282 . 1.231 . 1.144 . 1.145 . 1.135 . 1.207 . 1.277 . 1.284 . 1.145 . 0.389 .           11
        .  -1.2 .  -0.8 .   0.4 .   1.9 .   1.0 .   0.3 .  -0.6 .  -0.5 .  -1.0 .   1.6 .   1.3 .   0.8 .   0.9 .
        .........................................................................................................
                . 0.411 . 0.841 . 1.270 . 1.230 . 1.185 . 1.140 . 1.184 . 1.230 . 1.271 . 0.841 . 0.396 .
                . 0.420 . 0.848 . 1.281 . 1.233 . 1.177 . 1.129 . 1.175 . 1.222 . 1.282 . 0.869 . 0.405 .                   12
                .   2.1 .   0.8 .   0.9 .   0.3 .  -0.6 .  -1.0 .  -0.8 .  -0.6 .   0.9 .   3.4 .   2.2 .
                .........................................................................................
                        . 0.400 . 1.139 . 1.287 . 1.197 . 1.289 . 1.193 . 1.285 . 1.141 . 0.410 .
                        . 0.402 . 1.144 . 1.286 . 1.187 . 1.265 . 1.182 . 1.264 . 1.139 . 0.416 .                           13
                        .   0.6 .   0.4 .  -0.1 .  -0.8 .  -1.8 .  -0.9 .  -1.6 .  -0.1 .   1.4 .
                        .........................................................................
                                . 0.387 . 0.521 . 1.120 . 1.004 . 1.109 . 0.519 . 0.386 .
                                . 0.387 . 0.519 . 1.111 . 0.997 . 1.119 . 0.517 . 0.386 .                                   14
                                .   0.0 .  -0.4 .  -0.8 .  -0.7 .   0.9 .  -0.4 .  -0.2 .
                ................ ......................................................  ................
                .   STANDARD   .                . 0.298 . 0.397 . 0.295 .               .    AVERAGE   .
                .   DEVIATION  .                . 0.292 . 0.395 . 0.296 .               .PCT DIFFERENCE.                    15
                .    =1.009    .                .  -1.9 .  -0.7 .   0.5 .               .     = 1.2    .
                ................                .........................               ................
```

```
                                      SUMMARY

MAP NO:  N1-11-03          DATE: 10/31/94         POWER: 100%

CONTROL ROD POSITIONS:     F-Q(Z)  = 1.833        CORE TILT:

 D BANK AT 225 STEPS       F-DH(N) = 1.394        NW  1.004  | NE  0.995
                                                  ___________|___________
                           F(Z)    = 1.208        SW  1.001  | SE  1.000

                           BURNUP  =  764 MWD/MTU  A.O. = -3.53%
```

SECTION 7

REFERENCES

1. P. D. Banning, "North Anna Unit 1, Cycle 11 Design Report", Technical Report NE-997, Revision 0, Virginia Power, October, 1994.

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

3. T. W. Schleicher, "The Virginia Power CECOR Code Package", Technical Report NE-831, Revision 2, Virginia Power, March, 1994.

4. North Anna Unit 1 Technical Specifications, Sections 1.19, 3.1.3.4, 3.2.2, 3.2.3, 3.1.1.4, 4.1.1.1.2, and 4.2.2.2 and Core Operating Limits Report (COLR) for North Anna 1, Cycle 11 Pattern BW, Revision 0 (September, 1994) Sections 2.1.1, 2.5.1, and 2.6.

5. Letter from W. L. Stewart (Virginia Power) to the U.S.N.R.C, "Surry Power Station Units 1 and 2, North Anna Power Station Units 1 and 2: Modification of Startup Physics Test Program - Inspector Followup Item 280, 281/88-29-01", Serial No. 89-541, December 8, 1989.

6. R. F. Villaflor, "North Anna Unit 1, Cycle 11 TOTE Calculations", PM-553 Revision 0, October, 1994.

7. R. A. Hall, et al, "North Anna 1, Cycle 11 Flux Map Analysis", PM-560, Revision 0, and Addenda A and B, October-November, 1994.

APPENDIX

STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEETS

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Zero Power Testing Range Determination Proc No / Section: 1-PT-94.0	Sequence Step No:______
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225* CC: * CD: *	RCS Temperature (^{o}F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 223 CD: 95	RCS Temperature (^{o}F): 546.0 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/8/94 23:54	
	Reactivity Computer Initial Flux Background Reading	1.7×10^{-9} amps
	Flux Reading At Point of Nuclear Heating	6.0×10^{-7} amps
	Zero Power Testing Range	1×10^{-8} to 10×10^{-8} amps
	Reference	Not Applicable
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable
	Reference	Not Applicable
VI Comments	Design Tolerance is met** : ✓ YES ____ NO Acceptance Criteria is met** : ✓ YES ____ NO	
	* At The Just Critical Position ** Design Tolerance and Acceptance Criteria are met if ZPTR is below the Point of Nuclear Heating and above background.	

Prepared By:

Reviewed By:

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Reactivity Computer Checkout Proc No / Section: 1-PT-94.0	Sequence Step No:____
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225* CC: * CD: *	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 98	RCS Temperature (°F): 546.3 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 00:57	
	Measured Parameter (Description)	ρ_c = Measured Reactivity using ρ-computer ρ_t = Predicted Reactivity
	Measured Value	ρ_c = +48.0 ρ_t = +47.42 %D = +1.22%
	Design Value	%D = $\{(\rho_c - \rho_t)/\rho_t\} \times 100\% \leq 4.0\%$
	Reference	WCAP 7905, Rev. 1, Table 3.6
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable
	Reference	Not Applicable
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	
	* At The Just Critical Position The allowable range will be set based on the above results, as well as the results from the benchmark test. Allowable Range = ± 50 pcm	

Prepared By: Thomas S.

Reviewed By:

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Critical Boron Concentration - ARO Proc No / Section: 1-PT-94.0 Sequence Step No:_____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 225	RCS Temperature (°F): 545.6 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 05:15	
	Measured Parameter (Description)	$(C_B)^M_{ARO}$; Critical Boron Concentration - ARO
	Measured Value (Design Conditions)	$(C_B)^M_{ARO} =$ 1984 ppm
	Design Value (Design Conditions)	$C_B = 1983 \pm 50$ ppm
	Reference	Technical Report NE-997, Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	$\alpha C_B \times C_B^D \leq 1000$ pcm
	Reference	Technical Specification 4.1.1.1.2
VI Comments	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	
	αC_B = -6.71 pcm/ppm $C_B^D = \lvert (C_B)^M_{ARO} - C_B \rvert$; C_B is design value	

Prepared By: ________ Reviewed By: ________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Isothermal Temperature Coefficient - ARO Proc No / Section: 1-PT-94.0 Sequence Step No:_____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225, SDB: 225 CA: 225 CB: 225 CC: 225 CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 212	RCS Temperature (°F): 547.8° Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 05:12	
	Measured Parameter (Description)	$(\alpha_T^{ISO})_{ARO}$; Isothermal Temperature Coeff - ARO
	Measured Value	$(\alpha_T^{ISO})_{ARO} = -2.87$ pcm/°F (C_B = 1984 ppm)
	Design Value (Actual Conditions)	$(\alpha_T^{ISO})_{ARO} = -3.61$ pcm/°F (C_B = 1984 ppm)
	Design Value (Design Conditions)	$(\alpha_T^{ISO})_{ARO} = -3.62 \pm 3.0$ pcm/°F (C_B = 1983 ppm)
	Reference	Technical Report NE-997, Rev. 0
V Acceptance Criteria	FSAR/COLR	$\alpha_T^{ISO} \leq 3.75$* pcm/°F $\alpha_T^{DOP} = -1.75$ pcm/°F
	Reference	COLR 2.1.1, Technical Report NE-997, Rev. 0
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	
	* Uncertainty on αT_{MOD} = 0.5 pcm/°F (Reference: memorandum from C. T. Snow to E. J. Lozito dated June 27, 1980).	

Prepared By: ____________ Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Control Bank B Worth Measurement. Rod Swap Ref. Bank Proc No / Section: 1-PT-94.0	Sequence Step No:_____
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (^{O}F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (^{O}F): 545.5 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	I_B^{REF} ; Integral Worth of Control Bank B, All Other Rods Out
	Measured Value	I_B^{REF} = 1250
	Design Value (Design Conditions)	I_B^{REF} = 1310 ± 131 pcm
	Reference	Technical Report NE-997, Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded. SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	

Prepared By: 10/9/94

Reviewed By: 10/9/94

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Critical Boron Concentration - B Bank In Proc No / Section: 1-PT-94.0	Sequence Step No:_____
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 0 CC: 225 CD: 225	RCS Temperature (^{O}F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 0 CC: 225 CD: 225	RCS Temperature (^{O}F): 545.3 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	$(C_B)^M_B$; Critical Boron Concentration. Bank B In
	Measured Value (Design Conditions)	$(C_B)^M_B$ = 1798
	Design Value (Design Conditions)	$C_B = 1790 + \Delta C_B^{Prev} \pm (10 + 131.0/\lvert\alpha C_B\rvert)$ ppm C_B = 1791 ppm
	Reference	Technical Report NE-997, Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable
	Reference	Not Applicable
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	
	αC_B = -6.79 pcm/ppm $\Delta C_B^{Prev} = (C_B)^M_{ARO}$ - 1983 ppm	

Prepared By: ____________ Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: HZP Boron Worth Coefficient Measurement Proc No / Section: 1-PT-94.0	Sequence Step No:_____
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 545.3 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	αC_B ; Boron Worth Coefficient
	Measured Value	$\alpha C_B = -6.72$
	Design Value (Design Conditions)	$\alpha C_B = -6.79 \pm 0.68$ pcm/ppm
	Reference	Technical Report NE-997, Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable
	Reference	Not Applicable
VI Comments	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	

Prepared By: ____________

Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

<table>
<tr><td>I
Reference</td><td colspan="3">Test Description: Control Bank D Worth Measurement. Rod Swap
Proc No / Section: 1-PT-94.0 Sequence Step No:_____</td></tr>
<tr><td rowspan="2">II
Test
Conditions
(Design)</td><td colspan="2">Bank Positions (Steps)</td><td rowspan="2">RCS Temperature (^{O}F): 547
Power Level (% F.P.): 0
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td colspan="2">SDA: 225 SDB: 225 CA: 225
CB: moving CC: 225 CD: moving</td></tr>
<tr><td rowspan="2">III
Test
Conditions
(Actual)</td><td colspan="2">Bank Positions (Steps)</td><td rowspan="3">RCS Temperature (^{O}F): 545.5
Power Level (% F.P): 0
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td colspan="2">SDA: 225 SDB: 225 CA: 225
CB: moving CC: 225 CD: moving</td></tr>
<tr><td rowspan="6">IV
Test
Results</td><td colspan="2">Date/Time Test Performed:
10/9/94 0700</td></tr>
<tr><td>Measured Parameter
(Description)</td><td colspan="2">I_D^{RS} ; Integral Worth of Control Bank D,
Rod Swap</td></tr>
<tr><td>Measured Value</td><td colspan="2">I_D^{RS} = 978 (Adjusted Measured Critical
Reference Bank Position = 159 steps)</td></tr>
<tr><td>Design Value
(Actual Conditions)</td><td colspan="2">I_D^{RS} = 1003.7 (Adjusted Measured Critical
Reference Bank Position = 159 steps)</td></tr>
<tr><td>Design Value
(Design Conditions)</td><td colspan="2">I_D^{RS} = 1001 ± 150 pcm
(Critical Reference Bank Position = 159 steps)</td></tr>
<tr><td>Reference</td><td colspan="2">Technical Report NE-997, Rev. 0. VEP-FRD-36A</td></tr>
<tr><td rowspan="2">V
Acceptance
Criteria</td><td>FSAR/Tech Spec</td><td colspan="2">If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.</td></tr>
<tr><td>Reference</td><td colspan="2">VEP-FRD-36A</td></tr>
<tr><td rowspan="2">VI
Comments</td><td colspan="3">Design Tolerance is met : ✓ YES ____ NO
Acceptance Criteria is met : ✓ YES ____ NO</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Prepared By: ______________ Reviewed By: ______________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Control Bank C Worth Measurement, Rod Swap Proc No / Section: 1-PT-94.0 Sequence Step No:_____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: moving CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: moving CC: moving CD: 225	RCS Temperature (°F): 545.5 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	I_C^{RS} ; Integral Worth of Control Bank C, Rod Swap
	Measured Value	I_C^{RS} = 823 ' (Adjusted Measured Critical Reference Bank Position = 134 steps)
	Design Value (Actual Conditions)	I_C^{RS} = 812.8 ' (Adjusted Measured Critical Reference Bank Position = 134 steps)
	Design Value (Design Conditions)	I_C^{RS} = 812 ± 122 pcm (Critical Reference Bank Position = 132 steps)
	Reference	Technical Report NE-997, Rev. 0, VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	

Prepared By: ____________ Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

<table>
<tr><td>I
Reference</td><td colspan="2">Test Description: Control Bank A Worth Measurement, Rod Swap
Proc No / Section: 1-PT-94.0 Sequence Step No:_____</td></tr>
<tr><td rowspan="2">II
Test
Conditions
(Design)</td><td>Bank Positions (Steps)</td><td rowspan="2">RCS Temperature (°F): 547
Power Level (% F.P.): 0
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td>SDA: 225 SDB: 225 CA: moving
CB: moving CC: 225 CD: 225</td></tr>
<tr><td rowspan="2">III
Test
Conditions
(Actual)</td><td>Bank Positions (Steps)</td><td rowspan="2">RCS Temperature (°F): 545.5
Power Level (% F.P.): 0
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td>SDA: 225 SDB: 225 CA: moving
CB: moving CC: 225 CD: 225</td></tr>
<tr><td rowspan="7">IV
Test
Results</td><td colspan="2">Date/Time Test Performed:
10/9/94 0700</td></tr>
<tr><td>Measured Parameter
(Description)</td><td>I_A^{RS} ; Integral Worth of Control Bank A, Rod Swap</td></tr>
<tr><td>Measured Value</td><td>I_A^{RS} = 266 (Adjusted Measured Critical Reference Bank Position = 68 steps)</td></tr>
<tr><td>Design Value
(Actual Conditions)</td><td>I_A^{RS} = 263.2 (Adjusted Measured Critical Reference Bank Position = 68 steps)</td></tr>
<tr><td>Design Value
(Design Conditions)</td><td>I_A^{RS} = 269 ± 100 pcm
(Critical Reference Bank Position = 73 steps)</td></tr>
<tr><td>Reference</td><td>Technical Report NE-997, Rev. 0. VEP-FRD-36A</td></tr>
<tr><td rowspan="2">V
Acceptance
Criteria</td><td>FSAR/Tech Spec</td><td>If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.</td></tr>
<tr><td>Reference</td><td>VEP-FRD-36A</td></tr>
<tr><td rowspan="2">VI
Comments</td><td colspan="2">Design Tolerance is met : ✓ YES ____ NO
Acceptance Criteria is met : ✓ YES ____ NO</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Prepared By: ____________ Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Shutdown Bank B Worth Measurement. Rod Swap Proc No / Section: 1-PT-94.0 Sequence Step No:____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: moving CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: moving CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 545.5 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	I_{SB}^{RS} ; Integral Worth of Shutdown Bank B, Rod Swap
	Measured Value	I_{SB}^{RS} = 1089 (Adjusted Measured Critical Reference Bank Position = 179 steps)
	Design Value (Actual Conditions)	I_{SB}^{RS} = 1076.9 (Adjusted Measured Critical Reference Bank Position = 179 steps)
	Design Value (Design Conditions)	I_{SB}^{RS} = 1077 ± 162 pcm (Critical Reference Bank Position = 171 steps)
	Reference	Technical Report NE-997, Rev. 0. VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	

Prepared By:________________ Reviewed By:________________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Shutdown Bank A Worth Measurement, Rod Swap Proc No / Section: 1-PT-94.0 Sequence Step No:_____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: moving SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: moving SDB: 225 CA: 225 CB: moving CC: 225 CD: 225	RCS Temperature (°F): 545.5 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	I_{SA}^{RS} ; Integral Worth of Shutdown Bank A, Rod Swap
	Measured Value	I_{SA}^{RS} = 937 (Adjusted Measured Critical Reference Bank Position = 152 steps)
	Design Value (Actual Conditions)	I_{SA}^{RS} = 980.3 (Adjusted Measured Critical Reference Bank Position = 152 steps)
	Design Value (Design Conditions)	I_{SA}^{RS} = 981 ± 147 pcm (Critical Reference Bank Position = 156 steps)
	Reference	Technical Report NE-997, Rev. 0. VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ____ NO Acceptance Criteria is met : ✓ YES ____ NO	

Prepared By: ______________ Reviewed By: ______________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Total Rod Worth. Rod Swap Proc No / Section: 1-PT-94.0 Sequence Step No:_____	
II Test Conditions (Design)	Bank Positions (Steps) SDA: moving SDB: moving CA:moving CB: moving CC: moving CD:moving	RCS Temperature (°F): 547 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	RCS Temperature (°F): 545.5 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 10/9/94 0700	
	Measured Parameter (Description)	I_{Total}; Integral Worth of All Banks. Rod Swap
	Measured Value	I_{Total} = 5343
	Design Value (Actual Conditions)	I_{Total} = 5446.9
	Design Value (Design Conditions)	I_{Total} = 5450 ± 545 pcm
	Reference	Technical Report NE-997, Rev. 0. VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. Additional testing must be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	

Prepared By: ____________ Reviewed By: ____________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

<table>
<tr><td>I
Reference</td><td colspan="5">Test Description: M/D Flux Map - At Power
Proc No / Section: 1-PT-94.0, 1-PT-21.1, 1-PT-21.2 Sequence Step No:____</td></tr>
<tr><td rowspan="2">II
Test
Conditions
(Design)</td><td colspan="3">Bank Positions (Steps)</td><td colspan="2" rowspan="2">RCS Temperature (^{o}F): $T_{Ref} \pm 1$
Power Level (% F.P.): ≤30
Other (specify):
Must have ≥ 38 thimbles**</td></tr>
<tr><td colspan="3">SDA: 225 SDB: 225 CA: 225
CB: 225 CC: * CD: *</td></tr>
<tr><td rowspan="2">III
Test
Conditions
(Actual)</td><td colspan="3">Bank Positions (Steps)</td><td colspan="2" rowspan="3">RCS Temperature (^{o}F): TREF
Power Level (% F.P.): 29.7%
Other (specify):
43 Thimbles</td></tr>
<tr><td colspan="3">SDA: 225 SDB: 225 CA: 225
CB: 225 CC: 225 CD: 124</td></tr>
<tr><td rowspan="5">IV
Test
Results</td><td colspan="3">Date/Time Test Performed:
10/10/94 10:48</td></tr>
<tr><td>Measured Parameter (Description)</td><td>Max. Relative Assembly Power % DIFF (M-P)/P</td><td>Nuclear Enthalpy Rise Hot Channel Factor FΔH(N)</td><td>Total Heat Flux Hot Channel Factor $F_Q(Z)$</td><td>Maximum Possible Incore Quadrant Power Tilt</td></tr>
<tr><td>Measured Value</td><td>RPD≥0.9 5.7%
RPD<0.9 4.5%</td><td>1.525</td><td>2.297</td><td>1.011</td></tr>
<tr><td>Design Value (Design Conds)</td><td>± 10% for $P_i \geq 0.9$
± 15% for $P_i < 0.9$
(P_i = assy pwr)</td><td>N/A</td><td>N/A</td><td>≤ 1.0203</td></tr>
<tr><td>Reference</td><td>WCAP- 7905 Rev. 1</td><td>None</td><td>None</td><td>WCAP-7905 Rev. 1</td></tr>
<tr><td rowspan="2">V
Acceptance
Criteria</td><td>FSAR/COLR</td><td>None</td><td>$F\Delta H(N) \leq 1.49(1+0.3(1-P))$</td><td>$F_Q(Z) \leq 4.38^{*}K(Z)$</td><td>None</td></tr>
<tr><td>Reference</td><td>None</td><td>COLR 2.6</td><td>COLR 2.5.1</td><td>None</td></tr>
<tr><td rowspan="2">VI
Comments</td><td colspan="5">Design Tolerance is met : ✓ YES ___ NO
Acceptance Criteria is met : ✓ YES ___ NO</td></tr>
<tr><td colspan="5">* As required
** Must have at least 16 thimbles for quarter core maps for multi-point calibrations</td></tr>
</table>

Prepared By:________ Reviewed By:________

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - At Power Proc No / Section: 1-PT-94.0, 1-PT-21.1, 1-PT-21.2 Sequence Step No:_____				
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: *			RCS Temperature (°F): $T_{Ref} \pm 1$ Power Level (% F.P.): $65 \le P \le 75$ Other (specify): Must have ≥ 38 thimbles**	
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 179			RCS Temperature (°F): Tref Power Level (% F.P.): 74.02 Other (specify): 45 Thimbles	
IV Test Results	Date/Time Test Performed: 10/12/94 16:41				
	Measured Parameter (Description)	Max. Relative Assembly Power % DIFF (M-P)/P	Nuclear Enthalpy Rise Hot Channel Factor FΔH(N)	Total Heat Flux Hot Channel Factor $F_Q(Z)$	Maximum Possible Incore Quadrant Power Tilt
	Measured Value	5.3% RPD ≥0.9 -8.3% RPD <0.9	1.434	2.011	1.007
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = assy pwr)	N/A	N/A	≤ 1.0201
	Reference	WCAP-7905 Rev. 1	None	None	WCAP-7905 Rev. 1
V Acceptance Criteria	FSAR/COLR	None	$F\Delta H(N) \leq 1.49(1+0.3(1-P))$	$F_Q(Z) \leq 2.19/P * K(Z)$	None
	Reference	None	COLR 2.6	COLR 2.5.1	None
VI Comments	Design Tolerance is met : X YES ___ NO Acceptance Criteria is met : X YES ___ NO				
	* As required ** Must have at least 16 thimbles for quarter core maps for multi-point calibrations				

Prepared By: Pamela D. Banning

Reviewed By: Thomas J. Prink

NORTH ANNA POWER STATION UNIT 1 CYCLE 11
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - At Power Proc No / Section: 1-PT-94.0, 1-PT-21.1, 1-PT-21.2 Sequence Step No: 37				
II Test Conditions (Design)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: *		RCS Temperature (^{o}F): $T_{Ref} \pm 1$ Power Level (% F.P.): $95 \le P \le 100$ Other (specify): Must have ≥ 38 thimbles**		
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 225 SDB: 225 CA: 225 CB: 225 CC: 225 CD: 225		RCS Temperature (^{o}F): T_{REF} Power Level (% F.P.): 100.0 Other (specify): 45 THIMBLES 763.6 MWD/MTU		
IV Test Results	Date/Time Test Performed: 10/31/94 11:48				
	Measured Parameter (Description)	Max. Relative Assembly Power % DIFF (M-P)/P	Nuclear Enthalpy Rise Hot Channel Factor FΔH(N)	Total Heat Flux Hot Channel Factor $F_Q(Z)$	Maximum Possible Incore Quadrant Power Tilt
	Measured Value	5.6% RPD≥0.9 3.4% RPD<0.9	1.394	1.833	1.0044
	Design Value (Design Conds)	± 10% for $P_i \ge 0.9$ ± 15% for $P_i < 0.9$ (P_i = assy pwr)	N/A	N/A	≤ 1.0201
	Reference	WCAP- 7905 Rev. 1	None	None	WCAP-7905 Rev. 1
V Acceptance Criteria	FSAR/COLR	None	$F\Delta H(N) \le 1.49(1+0.3(1-P))$	$F_Q(Z) \le 2.19/P * K(Z)$	None
	Reference	None	COLR 2.6	COLR 2.5.1	None
VI Comments	Design Tolerance is met : _X_ YES ___ NO Acceptance Criteria is met : _X_ YES ___ NO				
	* As required ** Must have at least 16 thimbles for quarter core maps for multi-point calibrations				

Prepared By: ____________

Reviewed By: RSMcAndrew