501-7-005
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Revision 0

FARLEY NUCLEAR PLANT

UNIT 2

PHASE III TEST PROCEDURE

501-7-005

DRAFT

FORCED CIRCULATION COOLDOWN

Approved: DRAFT

_____

Plant Manager

Date Issued: _____

Diskette No. 6

FARLEY NUCLEAR PLANT
UNIT 2
PHASE III TEST PROCEDURE
501-7-005

FORCED CIRCULATION COOLDOWN

1.0 Purpose

This procedure contains the information necessary to determine excore detector indicated power correction factors as a function of the average RCS cold leg temperature. These factors will be determined during a FORCED CIRCULATION COOLDOWN and subsequent heatup of the RCS with the reactor at approximately 3% power.

2.0 Initial Conditions

____ 2.1 T_{ave} is approximately 547°F. The Steam Dump is operating (or available) to maintain T_{ave} in the Steam Pressure Mode.

____ 2.2 Pressurizer pressure is being maintained at approximately 2235 psig by automatic operation of the Pressurizer Pressure Control System.

____ 2.3 Pressurizer level is being maintained at approximately 22% by automatic operation of the Pressurizer Level Control System.

____ 2.4 The S/G's are being maintained at approximately 33%. The Main Feedwater or AFW System is operating (or available) to maintain S/G levels.

____ 2.5 All three RCP's are running.

____ 2.6 The CVCS is in a normal at-power lineup. Sufficient makeup is available for a cooldown to approximately 500°F.

____ 2.7 Both Shutdown Banks are fully withdrawn.

____ 2.8 The reactor is critical at approximately 3% power.

CAUTION

The PR and IR Excore Nuclear Instruments should not be relied upon as the only indication of core power. Thermocouple Maps, Loop ΔT's, and Incore Flux Maps should be used to verify power level.

____ 2.9 RCS boron concentration and control bank D position have been adjusted to establish a zero moderator temperature coefficient.

____ 2.10 The RCS and Pressurizer boron concentrations are within 50 ppm.

____ 2.11 The Reactivity Computer is operable and is capable of recording core power, reactivity, T_{COLD} and T_{HOT}.

____ 2.12 Temporary Instrumentation has been installed as required by Appendix B of this procedure.

____ 2.13 The computer trend printer is set up to monitor the parameters specified in Appendix C of this procedure.

____ 2.14 All test equipment to be used during the performance of this procedure is operational and in calibration, as verified on the Test Equipment Record, Data Sheet 1 of this procedure.

____ 2.15 The shift supervisor has been notified of the impending performance of this procedure.

____ 2.16 Prior to commencing this test, record the following information (as applicable) on each recorder strip chart.

Test Procedure Number
Recorder Number
Time and Date
Chart Speed
Scale of each Pen
Input to each Pen

3.0 Precautions and Limitations

3.1 A controlled Cooldown while maintaining the Reactor Critical requires careful coordination between Control Rod Position, Cooldown Rate and Boron Concentration. A low absolute value of moderator coefficient is expected, however the operator must remain alert to the possible effects of a changing moderator temperature coefficient polarity.

3.2 During this test do not exceed 5% Reactor Power. Caution should be used in maintaining the desired power level because of flux shadowing of the excore detectors. All possible means of determining core power should be used. Do not rely on excore detectors to provide the only indications of core power.

3.3 Control Bank D should be maintained above approximately 160 steps, if possible, to minimize the effects of rod shadowing on the excore detectors.

3.4 The Operational Safety Criteria is to be prominently displayed in the control room. During the performance of this test, operation will be in accordance with the guidelines presented in the Operational Safety Criteria, Appendix A.

3.5 Do not exceed a primary to secondary differential pressure of 1600 psi.

3.6 The Reactor Coolant System Heatup and Cooldown Rates should be limited to 50°F/HR.

3.7 Anytime speed is changed on any recorder; initials, time, date and speed should be listed on the recorder chart.

4.0 Instructions

____ 4.1 Determine the wide range Loop ΔT correction factors using Data Sheet 2 of this procedure.

____ 4.2 Record the initial plant conditions on Data Sheet 3 of this procedure.

NOTE

It is preferred that plant conditions (as specified in the Initial Conditions section of this procedure) be maintained as close to steady state as possible prior to continuing with this test.

____ 4.3 Perform the first Primary Calorimetric using Data Sheet 6 of this procedure. Simultaneously perform the first core power determination using Appendix E of this procedure.

____ 4.4 Verify that the Reactor Makeup System is capable of providing sufficient water and/or Boric Acid to compensate for coolant contraction during RCS cooldown.

NOTE

Depending on Control Bank D position, and the magnitude and polarity of the moderator temperature coefficient, dilution or boration may be required.

____ 4.5 Verify that FCV-122 is in AUTO such that a relatively constant Pressurizer level will be maintained during cooldown.

____ 4.6 If it is anticipated that the S/G Atmospheric Relief valves might be used for cooldown, complete FNP-2-RCP-385, "Radiological Control for Planned Operation of Main Steam Power Operated Relief Valves."

____ 4.7 Record the time on the recorder charts in the instrument rack area and/or control room, and start the recorders at an appropriate speed determined by the Test Supervisor.

____ 4.8 Begin recording on the Reactivity Computer.
/

____ 4.9 Start the computer trend printer.
/

____ 4.10 Record initial excore detector data on Data Sheet 4 of this procedure.
/

____ 4.11 Record initial incore detector data on Data Sheet 5 of this procedure.
/

____ 4.12 Obtain an incore thermocouple map.
/

____ 4.13 Initiate RCS cooldown with the Steam Dump, as follows:
/

NOTE

If the S/G Atmospheric Reliefs are to be used for the cooldown, proceed to Step 4.14.

____ 4.13.1 Place the Steam Pressure Controller in MANUAL.
/

____ 4.13.2 Using the Steam Pressure Controller, adjust the positions of Steam Dump valves "A" and "E" to establish a RCS cooldown rate.
/

CAUTION

Technical Specifications limits RCS cooldown rate to a maximum of 100°F in any one hour period. The PLS document suggests that cooldown rate be limited to 50°F per hour, or less.

4.13.3 As T_{ave} approaches 543°F place and hold both Steam Dump Interlock switches in the BYPASS INTERLOCK position. When the "Steam Dump Train A or B Bypass" status light on the Bypass and Permissive status panel comes ON, release the switches. The Steam Dump valves should remain throttled and RCS cooldown should continue.

4.13.4 Adjust Auxiliary Feedwater flow rate to maintain S/G levels at approximately 33%.

CAUTION

Variations in AFW flow will affect RCS cooldown rate. Re-adjustment of the Steam Dump position may be necessary.

4.13.5 Use the Control Rods and/or Boric Acid concentration changes to maintain core power at approximately 3%.

4.14 Initiate RCS cooldown with the S/G Atmospheric Relief valves, as follows:

4.14.1 Verify that the necessary radiological controls are met by completion of FNP-2-RCP-385

4.14.2 Adjust the S/G Atmospheric Relief valve controllers in AUTO or MANUAL to establish a RCS cooldown rate.

CAUTION

Technical Specification limits RCS cooldown rate to a maximum of 100°F in any one hour period. The PLS document suggests that cooldown rate be limited to 50°F per hour, or less.

4.14.3 Adjust Auxiliary Feedwater flow rate to maintain S/G levels at approximately 33%.

CAUTION

Variations in AFW flow rate will affect RCS cooldown rate. Re-adjustment of the S/G Atmospheric Relief valves may be necessary.

4.14.4 Monitor all three RCS loop temperatures and all three S/G pressures frequently to insure uniform RCS cooldown.

4.14.5 Use the Control Rods and/or Boric Acid Concentration changes to maintain core power at approximately 3%.

4.15 When T_{ave} has been reduced below 543°F, verify that the "Lo Lo T_{ave} Safety Injection Steam Dump Interlock P-12" status light on the Bypass and Permissive panel comes ON.

4.15.1 Momentarily place both Steam Line Isolation Block-Reset switches in the BLOCK position.

4.15.2 Verify that the "Steam Line Isolation Train A Blocked" and "Train B Blocked" status lights on the Bypass and Permissive panel both come ON.

CAUTION

If T_{ave} increases above 543°F, P-12 will automatically reset. The above steps will have to be repeated in order to block the Steam Line Isolation.

4.16 Verify that Charging flow remains adequate to compensate for coolant contraction.

4.17 Verify that the Makeup System is maintaining VCT level in the normal operating range.

4.18 Verify that the Pressurizer Pressure Control System automatically maintains pressure at approximately 2235 psig.

4.19 When T_{ave} reaches 540°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.19.1 Obtain the 540°F data required by the following Data Sheets and Appendix:

Data Sheet 4
Data Sheet 5
Data Sheet 6
Appendix E

4.19.2 Obtain an incore Thermocouple Map.

4.19.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.19.4 When data recording is completed and after all required calculations are done, continue the cooldown while maintaining core power at approximately 3%.

4.20 When T_{ave} reaches 530°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.20.1 Obtain the 530°F data required by the following Data Sheets and Appendix:

Data Sheet 4
Data Sheet 5
Data Sheet 6
Appendix E

4.20.2 Obtain an incore Thermocouple Map.

4.20.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.20.4 When data recording is completed and after all required calculations are done, continue the cooldown while maintaining core power at approximately 3%.

4.21 When T_{ave} reaches 520°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.21.1 Obtain the 520°F data required by the following Data Sheets and Appendix:

Data Sheet 4
Data Sheet 5
Data Sheet 6
Appendix E

4.21.2 Obtain an incore Thermocouple Map.

4.21.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.21.4 When data recording is completed and after all required calculations are done, continue the cooldown while maintaining core power at approximately 3%.

4.22 When T_{ave} reaches 510°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.22.1 Obtain the 510°F data required by the following Data Sheets and Appendix:

Data Sheet 4
Data Sheet 5
Data Sheet 6
Appendix E

4.22.2 Obtain an incore Thermocouple Map.

4.22.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.22.4 When data recording is completed and after all required calculations are done, continue the cooldown while maintaining core power at approximately 3%.

CAUTION

Control the cooldown carefully as T_{ave} approaches 500°F. Do not exceed a primary to secondary differential pressure of 1600 psi.

4.23 When T_{ave} reaches 500°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.23.1 Obtain the 500°F data required by the following Data Sheets and Appendix:

Data Sheet 4
Data Sheet 5
Data Sheet 6
Appendix E

4.23.2 Obtain an incore Thermocouple Map.

4.23.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.23.4 When data recording is completed and after all required calculations are done, proceed to Step 4.24.

4.24 While T_{ave} is being maintained at 500°F, perform the following steps:

4.24.1 Obtain the initial 500°F heatup data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.24.2 Obtain an incore Thermocouple Map.

4.24.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.24.4 When data recording is completed, and after all required calculations are done, proceed to Step 4.25.

4.25 While maintaining core power at approximately 3%, adjust the Steam Dump or the S/G Atmospheric Relief valves to begin a gradual RCS Heatup.

CAUTION

Technical Specifications Limits RCS Heatup Rate to a maximum of 100°F in any one hour period.

4.25.1 Use the Control Rods and/or Boric Acid Concentration changes to maintain core power at approximately 3%.

4.26 Verify that the Pressurizer Pressure Control System automatically maintains Pressure at approximately 2235 psig.

4.27 When T_{ave} reaches 510°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.27.1 Obtain the 510°F data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.27.2 Obtain an incore Thermocouple Map.

4.27.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.27.4 When data recording is completed and after all required calculations are done, continue the heatup while maintaining core power at approximately 3%.

4.28 When T_{ave} reaches 520°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.28.1 Obtain the 520°F data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.28.2 Obtain an incore Thermocouple Map.

4.28.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.28.4 When data recording is completed and after all required calculations are done, continue the heatup while maintaining core power at approximately 3%.

4.29 When T_{ave} reaches 530°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.29.1 Obtain the 530°F data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.29.2 Obtain an incore Thermocouple Map.

4.29.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.29.4 When data recording is completed and after all required calculations are done, continue the heatup while maintaining core power at approximately 3%.

4.30 When T_{ave} reaches 540°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.30.1 Obtain the 540°F data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.30.2 Obtain an incore Thermocouple Map.

4.30.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.30.4 When data recording is completed and after all required calculations are done, continue the heatup while maintaining core power at approximately 3%.

NOTE

As T_{ave} approaches 547°F the Steam Dump can be returned to AUTO with a setpoint of 1005 psig.

4.31 When T_{ave} reaches 547°F, adjust the Steam Dump or S/G Atmospheric Reliefs to stabilize T_{ave}.

4.31.1 Obtain the 547°F data required by the following Data Sheets and Appendix:

Data Sheet 6
Data Sheet 7
Data Sheet 8
Appendix E

4.31.2 Obtain an incore Thermocouple Map.

4.31.3 Record the time on the recorder charts in the instrument rack area and/or control room.

4.31.4 When data recording is completed and after all required calculations are done, proceed to Step 4.32.

4.32 When the Test Supervisor determines, based on the data collected, that the test can be terminated, perform the following steps:

4.32.1 Record the time on the recorder charts and stop all recorders and trend printers.

4.32.2 Shutdown the Reactor, unless operation is to be continued for other tests.

4.32.3 Notify the Shift Supervisor that this test is completed.

4.32.4 Attach the printouts and charts from the recorders and trend printer to this procedure.

4.33 Data Reduction should be performed, as follows:

4.33.1 Use both the cooldown and heatup data. If for some reason the data was not obtained at exactly the required temperature plateaus mark through that temperature on the respective data sheet and record the actual measurement temperature.

4.33.2 Excore data: Sum the top and the bottom currents for each detector at each temperature plateau and enter under the sum column. The excore channel with the reactivity computer hooked up will be read as Keithly Amplifier output and entered in the sum column. Transfer data to Data Sheets 9 and 10.

4.33.3 Incore flux Tracing: Transfer the calculated power level at each temperature plateau to Data Sheets 9 and 10.

4.33.4 Primary Calorimetric: Transfer the power level calculated in Data Sheet 6 to Data Sheets 9 and 10.

4.33.5 Average Power (Data Sheets 9 and 10): Using the incore data and the primary calorimetric data determine the actual core power at each temperature plateau. A straight average should be used.

4.33.6 Power Normalization to Reference Average Power (Data Sheet 9): Divide the average power obtained at each temperature plateau by the average power obtained at 550°F to correct the excore outputs.

4.33.7 Power Corrected Excore Currents and Keithly Amp Output: Divide the measured excore detector currents by the Power Normalization factor. This in effect corrects all data for fluctuations in core power. The resulting currents then will only be a function of the cold leg temperature.

4.33.8 Excore Current Multiplier as a function of cold leg temperature: Divide the power corrected excore currents obtained at each temperature plateau into the excore current obtained at reference conditions.

NOTE

The factors should increase as T_c decreases. Plot the correction factors as a function of T_c for each detector. The plots will be used in the Natural Circulation cooldown testing program.

5.0 Acceptance Criteria

____ 5.1 Excore detector indicated power correction factors have been determined as a function of cold leg temperature for temperatures from 547°F to 500°F.

6.0 References

6.1 PLS Document

6.2 Farley Unit 2 Technical Specifications

6.3 VEPCO North Anna Unit 2 Procedure 2-ST-7

6.4 Westinghouse Safety Evaluation for Farley Unit 2 Natural Circulation Testing.

7.0 Data Sheets, Appendices, and Attachments

501-7-005 Data Sheet 1:	TEST EQUIPMENT RECORD
501-7-005 Data Sheet 2:	WIDE RANGE ΔT CORRECTION
501-7-005 Data Sheet 3	INITIAL PLANT CONDITIONS
501-7-005 Data Sheet 4:	EXCORE DATA SHEET-COOLDOWN
501-7-005 Data Sheet 5:	LOW POWER FLUX MAP DATA-COOLDOWN
501-7-005 Data Sheet 6:	PRIMARY CALORIMETRIC
501-7-005 Data Sheet 7:	EXCORE DATA SHEET-HEATUP
501-7-005 Data Sheet 8:	LOW POWER FLUX MAP DATA-HEATUP
501-7-005 Data Sheet 9:	NI CORRECTION FACTOR CALCULATION-COOLDOWN
501-7-005 Data Sheet 10:	NI CORRECTION FACTOR CALCULATION-HEATUP
501-7-005 Appendix A:	OPERATIONAL SAFETY CRITERIA
501-7-005 Appendix B:	TEMPORARY RECORDERS
501-7-005 Appendix C:	PROCESS COMPUTER TREND BLOCKS
501-7-005 Appendix D:	PRIMARY CALORIMETRIC REFERENCE DATA
501-7-005 Appendix E:	CORE POWER DETERMINATION

DATA SHEET 1

TEST EQUIPMENT RECORD

TEST EQUIPMENT* DESCRIPTION	FNP or ID NUMBER	CAL DUE DATE	DATES USED

* This applies only to temporarily installed test equipment or instrumentation. Permanent instrumentation which is part of the system and shown on drawings, should not be included.

Test Supervisor _____ / _____

Signature Date

DATA SHEET 2

WIDE RANGE ΔT CORRECTION

LOOP A

Item No.	Parameter	Location Rack/Test Point	Reading Volts (1)	Parameter °F (2)	
1	Loop A Hot Leg				
2	Loop A Cold Leg				
3	Loop A W. R. ΔT	Item 1-Item 2 =		°F	
4	Loop A N. R. ΔT				
5	W. R. ΔT Correction Factor (C.F.) =	Item 4-Item 3 =		°F	(3)

LOOP B

1	Loop B Hot Leg				
2	Loop B Cold Leg				
3	Loop B W. R. ΔT	Item 1-Item 2 =		°F	
4	Loop B N. R. ΔT				
5	W. R. ΔT Correction Factor (C.F.) =	Item 4-Item 3 =		°F	(3)

LOOP C

1	Loop C Hot Leg			
2	Loop C Cold Leg			
3	Loop C W. R. ΔT	Item 1-Item 2 =		°F
4	Loop C N. R. ΔT			
5	W. R. ΔT Correction Factor (C.F.) =	Item 4-Item 3 =		°F (3)

(1) Using a Digital Voltmeter, measure the voltage at the specified test points as rapidly as possible.

(2) Determined by converting voltage reading to °F.

(3) The correction factor (C. F.) determined in item 5 is used on Data Sheet 6 to correct the calculated wide range ΔT for the ΔT across the core generated by the Reactor Coolant Pumps.

DATA SHEET 3

INITIAL PLANT CONDITIONS - STEADY STATE

REACTOR COOLANT SYSTEM

Pressurizer Pressure PR-444 (Red Pen) _____ psig

Pressurizer Level LR-459 (Red Pen) _____ %

RCS Loop 1 Hot Leg Temperature TR-413 (Red Pen) _____ °F

RCS Loop 1 Cold Leg Temperature TR-410 (Red Pen) _____ °F

RCS Loop 2 Hot Leg Temperature TR-413 (Blue Pen) _____ °F

RCS Loop 2 Cold Leg Temperature TR-410 (Blue Pen) _____ °F

RCS Loop 3 Hot Leg Temperature TR-413 (Green Pen) _____ °F

RCS Loop 3 Cold Leg Temperature TR-410 (Green Pen) _____ °F

Reactor Coolant Loop 2A T_{avg} TI-412D _____ °F

Reactor Coolant Loop 2B T_{avg} TI-422D _____ °F

Reactor Coolant Loop 2C T_{avg} TI-432D _____ °F

Reactor Coolant Loop 2A ΔT TI-412A _____ %

Reactor Coolant Loop 2B ΔT TI-422A _____ %

Reactor Coolant Loop 2C ΔT TI-432A _____ %

STEAM GENERATORS

Steam Generator 2A Level (NR) LI-474 _____ %

Steam Generator 2B Level (NR) LI-484 _____ %

Steam Generator 2C Level (NR) LI-494 _____ %

Steam Generator 1 Level (WR) LR-477 Pen 1 (Red) _____%

Steam Generator 2 Level (WR) LR-477 Pen 2 (Green) _____%

Steam Generator 3 Level (WR) LR-477 Pen 3 (Blue) _____%

Steam Generator 2A Pressure PI-474 _____ psig

Steam Generator 2B Pressure PI-484 _____ psig

Steam Generator 2C Pressure PI-494 _____ psig

Steam Generator 2A Feedwater Flow FI-476 _____ x 10^6 #/hr.

Steam Generator 2B Feedwater Flow FI-486 _____ x 10^6 #/hr.

Steam Generator 2C Feedwater Flow FI-496 _____ x 10^6 #/hr.

Steam Generator 2A Steam Flow FI-474 _____ x 10^6 lbs/hr.

Steam Generator 2B Steam Flow FI-484 _____ x 10^6 lbs/hr.

Steam Generator 2C Steam Flow FI-494 _____ x 10^6 lbs/hr.

REACTOR POWER

NIS Channel N-41 _____%

NIS Channel N-42 _____%

NIS Channel N-43 _____%

NIS Channel N-44 _____%

NIS Channel NI-35 _____amps

NIS Channel NI-36 _____amps

NOTE

Attach a copy of the computer printout of the Incore Thermocouple Temperature Map.

Data Taken By: _____

Date: _____

DATA SHEET 4

EXCORE DATA SHEET - COOLDOWN

Shutdown Bank Position: A_____ B_____

Date _____ Control Bank Position: A_____ B_____ C_____ D_____

Power _____

	N-41			N-42			N-43			N-44		
Time/Temp	Top	Bottom	Sum	Top	Bottom	Sum	Top	Bottom	Sum	Top	Bottom	Sum
/547												
/540												
/530												
/520												
/510												
/500												

NOTE: One of the PR Channels will be connected to the Reactivity Computer. Record Keithly Amplifier output for that channel, above.

COMMENTS:

Data Taken By: _____

Date: _____

DATA SHEET 5

LOW POWER FLUX MAP DATA - COOLDOWN

Map No.: _____ RCS T_{avg} (°F): Initial _____ Final _____ RCC Bank/RCCA Positions (steps) SDA_____ SDB_____

Date: _____ IR-35 (amps): _____ _____ CBA_____ CBB_____ CBC_____ CBD_____

Unit: _____ IR-36 (amps): _____ _____

	Time of RECORD	Detector-Core Location A	B	C	D	E	Detector-Range A	B	C	D	E	Calculated Power Level	P-250 U0906	Control Bank Position
547														
540														
530														
520														
510														
500														

NOTE: Refer to FNP-2-SOP-44.0 for operation of the Incore Movable Detector System.

Detector	A	B	C	D	E
Detector voltage					
Recorder Pot.					

Remarks: _____

Data Taken By: _____ Date: _____

DATA SHEET 6

PRIMARY CALORIMETRIC

Loop A - Cooldown

#1	#2		#3		#4	#5	#6	#7	#8
Approx. RCS Temp °F	HL Volts	HL °F(1)	CL Volts	CL °F(1)	T #2-#3 °F	#4+c.f.(2) °F	Loop h #5xCp(3) Btu/lb	Loop Flow (4) 10^6 lb/hr	Loop Rx Pwr #6 x #7 10^6 Btu/hr
547 (REF)									
540									
530									
520									
510									
500									

Loop A - Heatup

5[illegible]									
510									
520									
530									
540									
547									

(1) Using a Digital Voltmeter, measure the voltage as rapidly as possible. Convert the voltage reading to °F using the appropriate scaling.

(2) From Data Sheet 2.

(3) Cp from Appendix D.

(4) $\dot{m}$ from Appendix D.

Remarks: _____

_____

Dat by: _____

Date: _____

DATA SHEET 6

PRIMARY CALORIMETRIC

Loop B - Cooldown

#9	#10		#11		#12	#13	#14	#15	#16
Approx. RCS Temp °F	HL Volts	HL °F(1)	CL Volts	CL °F(1)	T #10-#11 °F	#12+c.f.(2) °F	Loop H_3 #13xCp(3) Btu/lb	Loop Flow(4) 10^6 lb/hr	Loop Rx Pwr #14 x #15 10^6 Btu/hr
547 (REF)									
540									
530									
520									
510									
500									

Loop B - Heatup

5[illegible]									
510									
520									
530									
540									
547									

Remarks: _____

_____

Data by: _____

Date: _____

DATA SHEET 6

PRIMARY CALORIMETRIC

Loop C - Cooldown

#17	#18		#19		#20	#21	#22	#23	#24
Approx. RCS Temp °F	HL Volts	HL °F(1)	CL Volts	CL °F(1)	T #18-#19 °F	#20+c.f.(2) °F	Loop H_3(3) #21xCp Btu/lb	Loop Flow(4) 10^6 lb/hr	Loop Rx Pwr #23 x #24 10^6 Btu/hr
547 (REF)									
540									
530									
520									
510									
500									

Loop C - Heatup

5(									
510									
520									
530									
540									
547									

Remarks: _____

_____

Data by: _____

Date: _____

DATA SHEET 6

PRIMARY CALORIMETRIC

Total - Cooldown

#25 Approx. RCS Temp °F	#26 Total Reactor Power #8 + #16 + #24 10^6 Btu/hr	#27 Reactor Power #26 x 0.29307 MWt	#28 % Reactor Power #27 X 0.02932 %
547 (REF)			
540			
530			
520			
510			
500			

Total- Heatup

5[illegible]			
510			
520			
530			
540			
547			

Remarks: _____

_____

Data by: _____

Date: _____

DATA SHEET 7

EXCORE DATA SHEET - HEATUP

Shutdown Bank Position: A_____ B_____

Date _____ Control Bank Position: A_____ B_____ C_____ D_____

Power _____

	N-41			N-42			N-43			N-44		
Time/Temp	Top	Bottom	Sum	Top	Bottom	Sum	Top	Bottom	Sum	Top	Bottom	Sum
/500												
/510												
/520												
/530												
/540												
/547												

NOTE: One of the PR Channels will be connected to the Reactivity Computer. Record Keithly Amplifier output for that channel, above.

COMMENTS:

Data Taken By: _____

Date: _____

DATA SHEET 8

LOW POWER FLUX MAP DATA - HEATUP

Map No.: _____ RCS T_{avg} (°F): Initial _____ Final _____ RCC Bank/RCCA Positions (steps)

Date: _____ IR-35 (amps): Initial _____ Final _____ SDA_____ SDB_____

Unit: _____ IR-36 (amps): Initial _____ Final _____ CBA_____ CBB_____ CBC_____ CBD_____

Time of RECORD	Detector-Core Location A	B	C	D	E	Detector-Range A	B	C	D	E	Calculated Power Level	P-250 U0906	Control Bank Position
500													
510													
520													
530													
540													
547													

NOTE: Refer to FNP-2-SOP-44.0 for operation of the Incore Movable Detector System.

Detector	A	B	C	D	E
Detector voltage					
Recorder Pot.					

Remarks: _____

Data Taken By: _____ Date: _____

DATA SHEET 9

NI CORRECTION FACTOR CALCULATION - COOLDOWN

APPROXIMATE AVERAGE COLD LEG TEMPERATURES (°F):			547 REF.	540	530	520	510	500
Item #	Parameters							
1	Movable Detector (% RTP)							
2	Primary Calorimetric (% RTP)							
3	Average Power (% RTP)							
4	Power Normalization to REF condition		1.00					
5	Excore Currents and Keithly Amp Output	N-						
		N-						
		N-						
		KA						
6	Power Corrected Excore Currents & Keithly Amp Output	N-						
		N-						
		N-						
		KA						
7	Correction Factors	N-	1.00					
		N-	1.00					
		N-	1.00					
		KA	1.00					

Remarks:

Completed By: _____

Date: _____

DATA SHEET 10

NI CORRECTION FACTOR CALCULATION - HEATUP

APPROXIMATE AVERAGE COLD LEG TEMPERATURES (°F):			500 REF.	510	520	530	540	547
Item #	Parameters							
1	Movable Detector (% RTP)							
2	Primary Calorimetric (% RTP)							
3	Average Power (% RTP)							
4	Power Normalization to REF condition		1.00					
5	Excore Currents and Keithly Amp Output	N-						
		N-						
		N-						
		KA						
6	Power Corrected Excore Currents & Keithly Amp Output	N-						
		N-						
		N-						
		KA						
7	Correction Factors	N-	1.00					
		N-	1.00					
		N-	1.00					
		KA	1.00					

Remarks:

Completed By: _____

Date: _____

APPENDIX A

OPERATIONAL SAFETY CRITERIA

During the performance of these tests, plant operations will be controlled or limited by the following set of criteria for operation.

1. Operational Guidelines (for all Tests)

a.	Primary System Subcooling (T_{sat} Margin)	(later)
b.	Steam Generator Water Level	~ 33 percent
c.	Pressurizer Water Level	
	(1) With RCP's running	$\geq$ 22 percent Span
	(2) Natural Circulation	$\geq$ Value when RCP's are tripped
d.	Loop ΔT	(later)
e.	T_{ave}	(later)
f.	Core Exit Temperature (highest)	(later)
g.	Power Range Neutron Flux	< 5 percent Reactor Power
h.	Control Bank D	(later)

2. Reactor Trip and Test termination must occur if any of the following limits are reached.

a.	Primary System Subcooling (T_{sat} Margin)	(later)
b.	Steam Generator Water Level	< 5 percent Narrow Range Span
c.	NIS Power Range, 2 Channels	> 7 percent Reactor Power
d.	Pressurizer Water Level	$\leq$ 17 percent Span or an unexplained decrease of more than (later) percent not concurrent with a T_{ave} change

e.	Any Loop ΔT	(later)
f.	T_{ave}	(later)
g.	Core Exit Temperature	(later)
h.	Uncontrolled Rod Motion	(later)

3. Safety Injection must be manually initiated if any of the following limits are reached.

a.	Primary System Subcooling (T_{sat} Margin)	(later)
b.	Steam Generator Water Level	< 0 percent Narrow Range Span or Equivalent Wide Range level
c.	Containment Pressure	(later)
d.	Pressurizer Water Level	< 10 percent Span or an unexplained decrease of more than 10 percent not concurrent with a T_{avg} change.
e.	Pressurizer Pressure	Decreases by 200 psi or more in an unexplained manner.

NOTE

Safety Injection termination will be in accordance with the termination criteria set forth in FNP-2-EOP-0.

APPENDIX B

TEMPORARY RECORDERS

Connect temporary strip-chart recorders as indicated below.

1.0 Reactivity-Computer Recorder

a. Flux

b. Average wide range T_{COLD}

c. Average wide range T_{HOT}

d. Reactivity

2.0 Strip Chart Recorder No. 1

Channel	Connection	Monitoring
1	FP-414B, C1-432	RCS Flow, Loop 1
2	FP-424B, C1-433	RCS Flow, Loop 2
3	FP-434B, C1-434	RCS Flow, Loop 3
4	PP-455F, C1-428	Pressurizer Pressure
5	LP-459B, C1-442	Pressurizer Level

3.0 Strip Chart Recorder No. 2

Channel	Connection	Monitoring
1	PP-474D, C2-443	S/G No. 1 Pressure
2	LP-474B, C1-429	S/G No. 1 Level
3	FP-474B, C3-741	S/G No. 1 Steam Flow
4	PP-484B, C2-444	S/G No. 2 Pressure
5	LP-484B, C1-430	S/G No. 2 Level
6	FP-484B, C3-746	S/G No. 2 Steam Flow

4.0 Strip-Chart Recorder No. 3

Channel	Connection	Monitoring
1	PP-494B, C2-445	S/G No. 3 Pressure
2	LP-494B, C1-431	S/G No. 3 Level
3	FP-494B, C3-748	S/G No. 3 Steam Flow
4	FQ-3229A, CJ-234, Pins 21 & 22	S/G No. 1 Aux Feed Flow
5	FQ-3229B, CJ-234, Pins 29 & 30	S/G No. 2 Aux Feed Flow
6	FQ-3229C, CJ-234, Pins 33 & 34	S/G No. 3 Aux Feed Flow

5.0 Strip-Chart Recorder No. 4 (optional)

Channel	Connection	Monitoring
1	FQY-122, C6-522	RCS Charging Flow
2	FQY-150, C6-433	RCS Letdown Flow
3	PP-403B, C4-433	Wide Range RCS Pressure
4	TD-454, C6-636	Pressurizer Steam Temp.
5	TD-453, C6-636	Pressurizer Liquid Temp.

6.0 Strip-Chart Recorder No. 5

Channel	Connection	Monitoring
1	TP-413A, C1-435	Wide Range T_{HOT} Loop 1
2	TP-410A, C2-435	Wide Range T_{COLD} Loop 1
3	TP-423A, C1-436	Wide Range T_{HOT} Loop 2
4	TP-420A, C2-436	Wide Range T_{COLD} Loop 2
5	TP-433A, C1-441	Wide Range T_{HOT} Loop 3
6	TP-430A, C2-441	Wide Range T_{COLD} Loop 3

The above installation has been completed and check-out is satisfactory.

Completed by: _____ / _____
Signature Date

Test Supervisor _____ / _____
Signature Date

The above installation has been removed.

Completed by: _____ / _____
Signature Date

Test Supervisor _____ / _____
Signature Date

APPENDIX C

PROCESS COMPUTER TREND BLOCK A

COLUMNS	ADDRESS	PARAMETER	UNITS
1	T0406A	RCL A T_{COLD}	°F
2	T0426A	RCL B T_{COLD}	°F
3	T0446A	RCL C T_{COLD}	°F
4	T0419A	RCL A T_{HOT}	°F
5	T0439A	RCL B T_{HOT}	°F
6	T0459A	RCL C T_{HOT}	°F
7	T0400A	T_{AVG} LOOP A	°F
8	T0420A	T_{AVG} LOOP B	°F
9	T0440A	T_{AVG} LOOP C	°F
10	T0403A	ΔT LOOP A	%
11	T0423A	ΔT LOOP B	%
12	T0443A	ΔT LOOP C	%
13	F0128A	CHARGING FLOW	GPM
14	F0134A	LETDOWN FLOW	GPM
15	U1250	HIGHEST REL FUEL ASSY PWR	
16	L0480A	PRESSURIZER LEVEL	%
17	L0112A	VCT LEVEL	%
18	U1251	HIGHEST REL ASSY PWR INDENT	

PROCESS COMPUTER TREND BLOCK B

COLUMNS	ADDRESS	PARAMETER	UNITS
1	L0400A	S/G A LEVEL	%
2	L0420A	S/G B LEVEL	%
3	L0440A	S/G C LEVEL	%
4	P0400A	S/G A PRESS	PSIG
5	P0420A	S/G B PRESS	PSIG
6	P0440A	S/G C PRESS	PSIG
7	P0483A	PRESSURIZER P	PSIG
8	P0499A	RC SYSTEM P	PSIG
9	P0142A	CHARGING PRESS	PSIG
10	U0482	AVG PZR PRESS	PSIG
11	U0483	AVG PZR LEVEL	%
12	U1118	RX THERMAL POWER	MW
13	U1170	AVG T/C TEMP	°F

APPENDIX D

PRIMARY CALORIMETRIC REFERENCE DATA

Temp. °F	Cp[1] Btu/lb. °F	$\dot{m}$ lbm/hr.
560	1.270	(later)
550 (REF)	1.246	(later)
540	1.221	(later)
530	1.202	(later)
520	1.183	(later)
510	1.168	(later)
500	1.152	(later)
490	1.140	(later)

(1) These values are from the 1967 ASME Steam Tables. Values are for a pressure of 2250 psia.

APPENDIX E

M/D POWER DETERMINATION

1. Set up the movable detector system for a 1 pass partial core flux map. Select flux thimbles as per the table below for the flux map.

Detector	Core Location	10-Path Position
A	H-11	9
B	D-10	10
C	D-3	9
D	N-5	7
E	H-6	6

These positions may be altered by the test engineer, based upon low-power physics testing results and previous special testing experience.

2. With all 5-path selector switches set to normal, run a flux trace while obtaining data for a Primary Calorimetric.

From the pass printout on the line printer obtain the Integral voltages for each detector.

Calculate the volts per % power as follows: $$V_P = \frac{\Sigma_1^5 \int V_{Det.}}{P}$$

Where: V_P = Volts per % power

V_{Det} = Integral volts of the detector.

P = % power from primary calorimetric.

3. For power determination, obtain a 1 pass partial care flux map. Determine the % power as follows:

$$P = \frac{\Sigma_1^5 \int V_{Det.}}{V_P}$$

Where: V_{Det} = Integral volts of the detector

V_P = Volts per % power (previously calculated)

P = % power