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VIRGINIA ELECTRIC AND POWER COMPANY

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SPECIAL TEST PROCEDURE FOR NORTH ANNA POWER STATION UNIT # 2

TITLE: NATURAL CIRCULATION WITH SIMULATED LOSS OF POWER CONDITIONS

3

Prepared By: G. A. KANN Date: 06-12-80

Engineering Recommended Approval: G. A. Kann Date: 6-12-80

4

STATION NUCLEAR SAFETY AND OPERATING COMMITTEE REVIEW OF PROCEDURE:

Unreviewed Safety Question: ☒ Yes ☐ No

Disposition: ☒ Approved ☐ Disapproved ☐ Approved as Modified

Chairman's Signature: W. R. Cartwright Date: 6/12/80

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SYSTEM NUCLEAR SAFETY AND OPERATING COMMITTEE REVIEW OF PROCEDURE:

NOTE: Review not required unless an unreviewed safety question is involved as determined above.

Disposition: ☐ Approved ☐ Disapproved ☐ Approved as Modified

Chairman's Signature: _____ Date: _____

6

VERIFICATION OF NRC APPROVAL:

☐ Approved ☐ Not Required

Station Manager's Signature: _____ Date: _____

7

TEST RESULTS REVIEWED BY ENGINEERING: _____ Date: _____

8

TEST RESULTS REVIEWED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE:

Chairman's Signature: _____ Date: _____

Comments: _____

10

DISCREPANCIES (List by number): _____

11

RESOLUTION OF DISCREPANCIES (List by number corresponding to above): _____

12

CRITIQUE: _____

CHRONOLOGICAL LOG (Use add'l pages as needed) Page __ of ___

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION
UNIT NO. 2

NATURAL CIRCULATION WITH SIMULATED LOSS OF POWER CONDITIONS

References:

1. Precautions, Limitation and Setpoints for Westinghouse NSSS
2. Technical Specifications, North Anna Unit No. 2
3. WCAP-8747: North Anna Nuclear Design Report
4. North Anna Station Curve Book
5. 2-OP-5.2
6. 2-OP-31.2

1.0 Purpose

1.1 To demonstrate that decay heat can be removed via the steam generators by maintaing steam generator level with the auxiliary feedwater system simulated conditions of loss of offsite power.

1.2 To demonstrate that decay heat can be removed via the steam generators by maintaining steam generator level with auxiliary feedwater system under simulated conditions of loss of offsite and onsite AC power.

1.3 To provide operations personnel with experience in unit operation under natural circulation conditions.

Initials

2.0 Initial Conditions

_____ 2.1 The reactor is critical in manual rod control at 1 percent power. Bank D is in Bank Select.

_____ 2.2 All three reactor coolant pumps are in operation.

_____ 2.3 Pressurizer pressure and level control are in automatic maintaining RCS pressure at approximately 2235 psig and pressurizer level at approximately 22 percent.

_____ 2.4 Steam dump valves are in the pressure control mode maintaining steam generator pressure at approximately 1005 psig and RCS temperature at approximately 547°F.

_____ 2.5 Steam generator level is being maintained at approximately 33 percent narrow range. Main feedwater system in automatic or manual control on bypass valves.

_____ 2.6 Shutdown banks are fully withdrawn and control banks are above their insertion limits. Control bank D is near 160 steps: this is to establish a zero moderator temperature coefficient.

_____ 2.7 Steam generator chemistry is in a condition such that blowdown may be isolated for the duration of this test.

_____ 2.8 Excess letdown is available for service if required during this test; however do not use excess letdown unless abolutely required.

_____ 2.9 The CVCS is in a normal at-power makeup and letdown configuration.

_____ 2.10 Temperoary instrumentation is installed in accordance with Attachment 6.3.

NOTE: Record the following on each strip chart:

a.) Test number
b.) Recorder QA Number
c.) Time and Date
d.) Chart Speed
e.) Scale Used
f.) Test Point
g.) Parameters

Initials

2.0 Initial Conditions (cont.)

_____ 2.11 The computer trend printer is set up to monitor the parameters indicated in Attachment 6.4.

_____ 2.12 The analog trend recoder on the main control board is set up to monitor the hottest incore T/C in each quadrant, as determined by the P-250 incore thermocouple map. Saturation margin (U0969) is being monitored on the P-250 digital display.

_____ 2.13 All test equipment to be used in the performance of this test is operational and in calibration, and has been recorded on the TEST EQUIPMENT DATA SHEET (Attachment 6.1).

_____ 2.14 Immediately prior to the performance of this test, the Test Engineer has reviewed the latest revisions of the applicable references in order to improve his familiarity with this procedure and insure that it is still valid for the test, i.e., changes to the system, equipment, or component since the procedure was approved will not affect its performance.

_____ 2.15 The Shift Supervisor on duty has been notified of the impending test and will coordinate its performance.

_____ 2.16 Pressurizer backup heaters groups 1 and 4 are in AUTO.

_____ 2.17 Engineered Safety Features and Reactor Protection modifications have been made accordance with Attachment 6.6.

_____ 2.18 Sound powered phone communications have been established between the Auxiliary Feedwater Pump House and the control room.

_____ 2.19 Motor-operated feedwater isolation valves MOV-FW254A, B, and C, and main feed control valves FCV-2478, 2488, and 2498 are shut.

Initials

3.0 Precautions

_____ 3.1 Refer to Operational Safety Criteria in Attachment 6.7.

_____ 3.2 Do not exceed 5 percent thermal power at any time while the test is in progress.

_____ 3.3 Ensure seal flow to each reactor coolant pump is maintained between 7-11 gpm during the test, and adjust as necessary at least every 100 psi change in RCS pressure (2-OP-5.2).

_____ 3.4 The Operational Safety Criteria is prominently displayed in the Main Control Room.

_____ 3.5 Avoid rapid or sudden changes in steam pressure and feedwater flow to prevent rapid cooling of the reactor coolant.

_____ 3.6 After the reactor coolant pumps are tripped, the normal ΔT and T_{AVG} indications will become unreliable. ΔT and T_{AVG} shall be calculated by taking the difference and the average of the hot and cold leg wide range temperature indications respectively.

_____ 3.7 Do not exceed primary to secondary differential pressure of 1600 psi.

_____ 3.8 Maintain less than 100 psi differential pressure between any two steam lines and greater than 600 psi in each steam generator.

_____ 3.9 Note possible effects of polarity changes in moderator temperature coefficient as temperature changes.

_____ 3.10 Maintain pressurizer pressure at about 2235 psig.

Initials

3.0 Precautions (cont.)

_____ 3.11 The pressurizer temperature shall be limited to a normal maximum heatup or cooldown of 90°F in any one hour period, with a maximum spray water temperature to pressurizer temperature differential of 320°F. Auxiliary spray must be isolated if letdown is isolated.

_____ 3.12 Do not borate under natural circulation conditions while the reactor is critical.

_____ 3.13 Pressurizer spray should be initiated slowly to minimize thermal stess. Maintain continuous flow for uniform chemistry unless otherwise directed.

_____ 3.14 The reactor coolant system (except the pressurizer) temperature and pressure shall be limited in accordance with the limit lines shown on figures 3.4-2 and 3.4-3 of the technical specifications during heatup or cooldown, with a miximum heatup or cooldown of 50°F in any one hour period.

_____ 3.15 Should a reactor trip occur during natural circulation, close spray valves (PCV-2455A & B) and restart reactor coolant pump 2-RC-P-1C prior to closing the reactor trip breaker.

_____ 3.16 Maintain control bank D at > 100 steps during the conduct of this test. Should this limit be reached, insert control bank D to zero steps and restart RCP's per instructions in this procedure. Contact Reactor Engineer for further instructions.

Initials

4.0 Instructions

_____ 4.1 Record the time on the data recorder charts in the instrument rack room and start the recorders at 125 mm/min.

_____ 4.2 Begin recording on the reactivity computer.

_____ 4.3 Prepare the plant computer to record data as specified in Attachment 6.4. Record the initial steady state values as specified in Attachment 6.2.

_____ 4.4 Place the pressurizer level controlleer LC 2459B in manual. Adjust, if necessary, to match letdown to maintain constant pressurizer level prior to tripping the RC pumps.

CAUTION: Continously monitor main steam line pressures and carefully control feedwater addition during the transient to insure that differential pressure between any two steam lines does not exceed 100 psid.

NOTE: Steam generator pressure, level and flow conditions should be held as close as possible to stable conditions as natural circulation develops.

NOTE: At the initiation of natural circulation (RCP trip), the following system response is expected:

a) Wide range T_{Hot} - increase (7 to 26°F at ∿ 1 percent power)
b) Wide range T_{Cold} - slight increase or constant
c) Core exit thermocouple - increase (7 to 26°F at ∿ 1 percent power)
d) Pressurizer level - increase (3 to 10 percent at ∿ 1 percent power)
e) Pressurizer pressure - increase

CAUTION: Following reactor coolant pump trip, T_{avg} and ΔT indication will be unreliable.

CAUTION: After tripping RC pumps, the RCS pressure is expected to increase as much as 50 psi depending on power level of the core. Be prepared to use auxiliary spray to control pressure as stated in Steps 4.8 and 4.9 below.

Initials

4.0 Instructions (cont.)

_____ 4.5 To simulate the loss of offsite power, perform the following actions:

4.5.1 Shut auxiliary feedwater control valves MOV-FW200D, MOV-FW200B, and HCV-200C.

_____ 4.5.2 Position steam dump controls 2-SD2A and 2-SD2B to OFF and position controllers to MANUAL.

_____ 4.5.3 Trip and lockout pressurizer backup heaters groups 2 and 5, and control heaters group 3.

_____ 4.5.4 Simultaneously trip all three reactor coolant pumps and the operating main feedwater pump by placing their control switches in the "Pull-to-Lock" position.

_____ 4.6 Observe auto start of all three auxiliary feedwater pumps and auto isolation of blowdown.

_____ 4.7 Place spray valve controllers PC-2444G and H in MANUAL and then open pressurizer spray valves PCV-2455A and B.

_____ 4.8 If RCS pressure exceeds 2285 psig, open auxiliary spray valve HCV-2311. Maintain regenerative heat exchanger charging outlet temperature (TI-2123) above 350°F or confirm that the 320°F temperature differential of precaution 3.11 can be maintained.

_____ 4.9 If RCS pressure exceeds 2310 PSIG, close charging line valve HCV-2310 and manually throttle spray valves PCV-2455A and B as required to maintain RC pressure below 2310 psig.

CAUTION: If auxiliary spray is initiated to limit RCS pressure, insure that a minumum continuous auxiliary spray flow is maintained to the pressurizer by turning on one bank of backup pressurizer heaters and adjusting the position of PCV-2455A and B to maintain the RCS pressure at approximately 2235 psig.

Initials

4.0 Instructions (cont.)

_____ 4.10 Maintain RCP seal injection at 7-11 GPM to each pump.

_____ 4.11 Maintain charging flow to match letdown in order to maintain a constant RCS water mass. (Maintain pressurizer level approximately constant after equilibrium has been reached on natural circulation by manually adjusting charging flow.)

NOTE: Allow the pressurizer level to increase when the average RCS temperature increases (expected increase is approximately 3/4 percent per °F increase in average RC temperature).

_____ 4.12 Carefully control additions of feedwater to the steam generators to maintain levels at approximately 33 percent by positioning valves MOV-FW200D, MOV-FW200B, and HCV-FW200C from the control room.

NOTE: After tripping RC pumps, the SG levels may shrink slightly and then swell as natural circulation develops.

_____ 4.11 Adjust the pressure setpoint on atmospheric steam dump pressure controller PC-MS201A, B, and C as required to maintain RC cold leg temperatures within ± 5°F of the initial values.

NOTE: Natural circulation flow will be stable (within approximately 10 to 20 minutes) when:

a) ΔT between wide range T_{Hot} and T_{Cold} is constant
b) ΔT between side range T_{Cold} and core exit temperature as indicated by the core exit T/Cs is constant
c) Wide range T_{Hot} is approximately equal to core exit T/C average temperature (See Attachment 6.8)

_____ 4.14 When directed by the Test Engineer (after approximately 30 minutes of steady-state conditions) station personnel in the Auxiliary Feed Pump House and man the headsets in preparation for simulated loss of all AC power.

Initials

4.0 Instructions (cont.)

_____ 4.15 Place the control switch for the Auxiliary Feed Pump House Turbine Pump Room Exhaust Fan 2-HV-F-69 to OFF.

_____ 4.16 Place the control switches for the Auxiliay Feed Pump House Motor Pump Room Exhaust Fans 2-HV-F-70A and B to OFF.

_____ 4.17 Place the control switches for the motor driven Auxiliary Feed Pumps 2-FW-P-3A and B to Pull-To-Lock and for pressurizer heater groups 1 and 4 to Pull-To-Lock.

_____ 4.18 Close MOV-FW200D.

_____ 4.19 Close MOV-FW200B.

_____ 4.20 Open 2-FW-317 (header isolation valve for 2-FW-P-2).

_____ 4.21 Open 2-FW-64 (header isolation valve for MOV-FW200A).

_____ 4.22 Open 2-FW-128 (header isolation valve for MOV-FW200C.

NOTE: During the performance of Step 4.23, 4.24 and 4.25, steam generator level control will be adjusted by positioning valves locally using the hand wheel. These valves are located in the auxiliary feed water pump house. Personnel operating these valves will be incommunication with the control room by use of sound powered phones. Positioning of these valves will be under the direction of the control room operator.

_____ 4.23 Control Steam Generator 2-RC-E-1A level with MOV-FW200A.

_____ 4.24 Control Steam Generator 2-RC-E-1B level with MOV-FW200B.

_____ 4.25 Control Steam Generator 2-RC-E-1C level with MOV-FW200C.

_____ 4.26 When directed by the Test Engineer (after approximately 30 minutes of steady-state conditions), perform the following:

_____ 4.26.1 Adjust steam dump controller PC-2464B to 0 percent output.

_____ 4.26.2 Position steam dump controls 2-SD2A and 2-SD2B to ON.

_____ 4.26.3 Place steam dump controllers to AUTO and adjust to continue maintaining T_{COLD} as before. Return atmospheric dump valve controls to normal.

Initials

4.0 Instructions (cont.)

_____ 4.27 Insert control Bank D to zero steps.

_____ 4.28 If auxiliary spray is being used to control pressurizer pressure, open normal charging HCV-2310 and shut auxiliary spray valve HCV-2311.

_____ 4.29 Place pressurizer spray controllers in manual/closed prior to starting the first reactor coolant pump.

_____ 4.30 When $T_H - T_C \leq 5°F$ restart all three reactor coolant pumps in accordance with 2-OP-5.2, beginning with C, A and then B. Allow conditions to stabilize between pump starts.

_____ 4.31 Stop the recorders and trend printers.

_____ 4.32 Return charging and letdown to normal.

_____ 4.33 Return RCS pressure to 2235 psig (return heaters to normal).

_____ 4.34 Start a main feedwater pump in accordance with 2-OP-31 and observe that TV-MS211A and B shut and the steam driven auxiliary feedwater pump 2-FW-P-2 stops. Control steam generator levels with FCV-2479, 2489, and 2499.

_____ 4.35 Close and lock 2-FW-128.

_____ 4.36 Close and lock 2-FW-64.

_____ 4.37 Close and lock 2-FW-317.

_____ 4.38 Open MOV-FW200B.

_____ 4.39 Open MOV-FW200D.

_____ 4.40 Place the control switches for the motor driven Auxiliary Feed Pumps 2-FW-P-3A and B to "AUTO".

_____ 4.41 Place the control switch for the Auxiliary Feed Pump House Turbine Pump Room Exhaust Fan 2-HV-F-69 to AUTO.

Initials

4.0 Instructions (cont.)

_____ 4.42 Place the control switches for the Auxiliary Feed Pump House Motor Pump Room Exhaust Fans 2-HV-F-70A and B to AUTO.

_____ 4.43 Remove ESF and RTP actuation blocks in accordance with Attachment 6.6, unless the next test is to be performed requires this modification to be made. If this is the case, disregard this step, place N/A in the signature line and initial.

NOTE: Re-Instate all safety function if a delay of testing of 12 hours or more is anticipated.

_____ 4.44 Notify Shift Supervisor that the test is complete.

_____ 4.45 Keep the printouts and charts from the recorders and trend printer with this procedure and remove the recorders if this concludes the natural circulation testing .

Completed By: _____

Time/Date: _____

Initials

5.0 Acceptance Criteria

_____ 5.1 Natural circulation cooling was established and maintained under steady conditions while maintaining steam generator level with all auxiliary feedwater pumps (simulated loss of offsite power).

_____ 5.2 Natural circulation cooling was maintained under steady conditions while maintaining steam generator level with the steam driven auxiliary feedwater pump (simulated loss of offsite and onsite AC power).

6.0 Attachments

6.1 Test Equipment Data Sheet

6.2 Initial Conditions

6.3 Temporary Recorders

6.4 Process Computer Trend Block Data

6.5 Core Power Determination

6.6 Engineered Safety Features and Reactor Protection Modifications

6.7 Operational Safety Criteria

6.8 Core ΔT With Natural Circulation

6.9 Training Log

TEST EQUIPMENT DATA SHEET

TEST EQUIPMENT DESCRIPTION*	MODEL NUMBER	VEPCO QA NUMBER

* NOTE: 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.

Completed By: _____

Date: _____

INITIAL CONDITIONS

Pressurizer Pressure
PR-2444 Red Pen _____ psig

Pressurizer Level
LR-2459 Red Pen _____ %

RCS Loop 1 Hot Leg Temperature
TR-2413 Red Pen _____ °F

RCS Loop 1 Cold Leg Temperature
TR-2410 Red Pen _____ °F

RCS Loop 2 Hot Leg Temperature
TR-2423 Green Pen _____ °F

RCS Loop 2 Cold Leg Temperature
TR-2420 Green Pen _____ °F

RCS Loop 3 Hot Leg Temperature
TR-2433 Blue Pen _____ °F

RCS Loop 3 Cold Leg Temperature
TR-2430 Blue Pen _____ °F

Steam Generator 1 Level (NR)
(LI-2474) _____ %

Steam Generator 2 Level (NR)
(LI-2484) _____ %

Steam Generator 3 Level (NR)
(LI-2494) _____ %

Steam Generator 1 Level (WR)
LR-2477 Pen 1 Red Pen _____ %

Steam Generator 2 Level (WR)
LR-2477 Pen 2 Green Pen _____ %

Steam Generator 3 Level (WR)
LR-2477 Pen 3 Blue Pen _____ %

INITIAL CONDITIONS

Steam Generator 1 Pressure
PI-2474 _____ psig

Steam Generator 2 Pressure
PI-2484 _____ psig

Steam Generator 3 Pressure
PI-2494 _____ psig

Steam Generator 1 Feedwater Flow
(FI-2476) _____ $X10^6$ #/hr

Steam Generator 2 Feedwater Flow
(FI-2486) _____ $X10^6$ #/hr

Steam Generator 3 Feedwater Flow
(FI-2496) _____ $X10^6$ #/hr

Steam Generator 1 Steam Flow
(FI-2474) _____ $X10^6$ lbs/hr

Steam Generator 2 Steam Flow
(FI-2484) _____ $X10^6$ lbs/hr

Steam Generator 3 Steam Flow
(FI-2494) _____ $X10^6$ lbs/hr

Loop 1 Tavg protection
(TI-2412D) _____ °F

Loop 2 Tavg protection
(TI-2422D) _____ °F

Loop 3 Tavg protection
(TI-2432D) _____ °F

INITIAL CONDITIONS

Loop 1 ΔT protection (TI-2412A) _____ %

Loop 2 ΔT protection (TI-2422A) _____ %

Loop 3 ΔT protection (TI-2423A) _____ %

NIS Channel N-41 _____ %

NIS Channel N-42 _____ %

NIS Channel N-43 _____ %

NIS Channel N-44 _____ %

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

Temperature in Turbine - Drive Aux Feed Pump Room _____ °F

Control Room Temperature _____ °F

Outside Temperatue _____ °F

Completed By: _____

Date: _____

TEMPORARY RECORDERS

Connect temporary strip-chart recorders as indi ed below.

6.3.1 Reactivity-Computer Recorder

a. Flux

b. Average wide range T_{COLD}

b. Average wide range T_{HOT}

d. Reactivity

Set the chart speed on the following records to 125 mm/min.

6.3.2 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	FP-455B, C1-427	Pressurizer Pressure
5	FP-459B, C1-442	Pressurizer Level

6.3.3 Strip Chart Recorder No. 2

Channel	Connection	Monitoring
1	PP-474B, C2-433	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

TEMPORARY RECORDERS (cont.)

6.3.4 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	CC-424	S/G No. 1 Aux Feed Flow
-	CD-425	S/G No. 2 Aux Feed Flow
6	CB-426	S/G No. 3 Aux Feed Flow

6.3.5 Strip-Chart Recorder No. 4

Channe	Connection	Monitoring
1	FD-122, C6-556	RCS Charging Flow
2	FD-150, C6-456	RCS Letdown Flow
3	PP-403A, C4-443	Wide Range RCS Pressure
4	TD-454, C6-636	Pressurizer Steam Temp.
5	TD-453, C6-636	Pressurizer Liquid Temp.

6.3.6 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.

_____ / _____
Signature Date

The above installation has been removed.

_____ / _____
Signature Date

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	P0498A	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
14	AS REQUIRED	HOTTEST T/C (QUADRANT 1)	°F
15	AS REQUIRED	HOTTEST T/C (QUADRANT 2)	°F
16	AS REQUIRED	HOTTEST T/C (QUADRANT 3)	°F
17	AS REQUIRED	HOTTEST T/C (QUADRANT 4)	°F
18	U0969	SATURATION MARGIN	°F

PROCESS COMPUTER TREND BLOCK C

COLUMNS	ADDRESS	PARAMETER	UNITS
1	T0003A	INCORE T/C	°F
2	T0006A	INCORE T/C	°F
3	T0002A	INCORE T/C	°F
4	T0005A	INCORE T/C	°F
5	T0020A	INCORE T/C	°F
6	T0024A	INCORE T/C	°F
7	T0022A	INCORE T/C	°F
8	T0023A	INCORE T/C	°F
9	T0045A	INCORE T/C	°F
10	T0033A	INCORE T/C	°F
11	T0036A	INCORE T/C	°F
12	T0029A	INCORE T/C	°F
13	T0030A	INCORE T/C	°F
14	T0046A	INCORE T/C	°F
15	T0048A	INCORE T/C	°F
16	T0044A	INCORE T/C	°F
17	P0499A	RC SYSTEM P	PSIG
18	P0484A	PRESSURIZER P	PSIG

CORE POWER DETERMINATION

NOTE: This Attachment will be completed by the Reactor Engineer at his discretion.

1.0 PURPOSE

The PWRMONT program provides a method for using the movable detector system to obtain a measure of reactor power during natural circulation testing. The program is first normalized to actual reactor power using a steady state calorimetric and single pass map. Single pass maps are then run during natural circulation to measure reactor power.

The PWRMONT package consists of the PWRMONT task and certain modifications to the existing Westinghouse PRIORITY SCAN and M/D COMPUTATIONS programs.

Description

The PWRMONT program uses data generated by the M/C COMPUTATIONS program to calculate reactor power based on the following equation:

$$\text{Calculated Power} = \left(\sum_{i=1}^{5} Ni\right) \times K0864$$

Where: Ni = Normalized integral for detector i

K0864 = PWRMONT calibration factor
(See Section 3 Usage)

In addition to the above calculation, the PWRMONT program retrieves valves calculated by the M/D COMPUTATIONS programs and outputs them in the format shown on Figure 1. This format is self-explanatory except the column labled "SCALE". This column indicated the gain setting for each detector and is interpreted as follows:

SCALE	GAIN
1	50 MA
2	150 MA
3	500 MA
4	1500 MA
5	5000 MA

Initials

2.0 Initial Conditions

_____ 2.1 All initial conditions for 1-OP-57 have been verified.

_____ 2.2 Notify the Shift Supervisor on duty of the impending test and coordinate its performance through him.

3.0 Precaution

_____ 3.1 Step 2, Instruction must be performed if the normalized integrals shown on Figure 1 are to be useful.

_____ 3.2 The upper and lower limit switch settings for the chosen 10-path locations must be accurate if the axial off-sets shown on Figure 1 are to be useful. These limit switch settings can be verified by observing F/M chart recorders and calculating relative detector location by observing flux depressions at known grid strap locations.

_____ 3.3 Do not change the value of K0900 during natural circulation testing except when starting a new test, i.e. K0900 = 0.

NOTE: If more than 35 passes are taken during natural circulation, K0900 will automatically return to 1 and the PWRMONT program will operate correctly.

_____ 3.4 Do not request any movable detector data output via the operator's console during natural circulation testing.

4.0 Instructions

_____ 4.1 Load the paper tape containing the PRIORITY SCAN and M/D COMPUTATIONS program modifications.

_____ 4.2 Update the movable detector normalization constants K0908-K0912 using standard flux mapping procedures by insecting each detector in J-7. (A common group thimble may be used if location J-7 is not available).

4.0 Instructions (cont.)

Calculate the normalization factors by determining the ratio of each Norm Integral to Detector A as follows:

$$\text{Norm Factor Det. A} = \frac{\text{Norm Integral A}}{\text{Norm Integral A}} = 1.0$$

$$\text{Norm Factor Det. B} = \frac{\text{Norm Integral B}}{\text{Norm Integral A}} = \_\_\_\_$$

$$\text{Norm Factor Det. C} = \frac{\text{Norm Integral C}}{\text{Norm Integral A}} = \_\_\_\_$$

$$\text{Norm Factor Det. D} = \frac{\text{Norm Integral D}}{\text{Norm Integral A}} = \_\_\_\_$$

$$\text{Norm Factor Det. E} = \frac{\text{Norm Integral E}}{\text{Norm Integral A}} = \_\_\_\_$$

This step should be repeated at an interval prescribed by the Reactor Engineer based on experience with detector drift.

Record Initial Norm constants below:

Det. A K0908	1.0	Det. D K0911	_____
Det. B K0909	_____	Det. E K0912	_____
Det. C K0910	_____		

_____ 4.3 Choose the 10-path locations for each of the five detectors. These locations should be chosen to give the best overall core power monitoring using available core locations. Select detector gain settings to range recorder traces which perk between 3 and 10 when the detector scans the selected thimble.

_____ 4.4 Set U0072 to -1. This prevents the FQSUREY program from interfering with the PWRMONT program.

_____ 4.5 Set K0900 to 0. This sets the current M/D pass number to 0.

_____ 5.6 Set K0864 to 1.0. This sets the PWRMONT calibration factor to 1.0.

4.0 Instructions (cont.)

_____ 4.7 Simultaneously initiate a singe pass flux map and a calorimetric.

_____ 4.8 Determine new K0864 value as follows:

$$\text{New (K0864)} = \text{Current (K0864)} \times \frac{\text{(Calorimetric Calculated Power)}}{\text{(PWRMONT Calculated Power)}}$$

NOTE: The PWRMONT calculated power will be output on the utility printer following the single pass map as shown in Firgure 1.

_____ 4.9 Repeat Steps 7 and 8 as necessary until the calorimetric power and the PWRMONT power agree to the desired accuracy (± 1% RTP).

_____ 4.10 Set K0900 to 0. This sets the current M/D pass number to 0.

_____ 4.11 Initiate single pass maps at will during natural circulation tests to measure reactor power. The movable detectors do not need to be withdrawn between passes.

_____ 4.12 The PWRMONT program also puts calculated power into addressable constant U0012. Therefore, this point can be trended if desired.

_____ 4.13 Following natural circulation testing, reload the tape containing the original PRIORITY SCAN nad M/D COMPUTATIONS Westinghouse programs.

NORTH ANNA UNIT 2 - M/D POWER MONITORING - 05-15-80

Det Norm Factors:

K0908	K0909	K0910	K0911	K0912
1.000	1.000	1.000	1.000	1.000

CALORIMETRIC CALIB CONST = 2.206

TIME 18:42 PASS NO. 1 CALC PWR 99.376 %

DET	THIMBLE	SCALE	NORM INTEGRAL	AO
MD-1	H-03	3	7.486	-3.412
MD-2	C-08	4	10.189	-3.488
MD-3	F-04	4	10.006	-3.041
MD-4	C-12	3	7.319	-11.726
MD-5	G-09	4	10.050	2.452

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.
.

PASS 5

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.
.

TIME 18:50 PASS NO. 12 CALC PWR 99.498 %

DET	THIMBLE	SCALE	NORM INTEGRAL	AO
MD-1	H-03	3	7.485	-3.141
MD-2	C-08	4	10.191	-3.134
MD-3	F-04	4	10.003	-2.731
MD-4	C-12	3	7.371	-10.225
MD-5	G-09	4	10.055	2.639

FIGURE I

PWRMONT PROGRAM OUTPUT

ENGINEERED SAFETY FEATURES AND REACTOR PROTECTION MODIDICATIONS

During the performance of these tests, modifications will made to the Engineered Safety Features and the Reactor Protection systems. The systems will operate as specified below.

A. All automatic Safety Injection (SI) functions, except reactor trip, will be blocked. A Safety Injection actuation signal will result in the following:
   1. Reactor Trip
   2. Control Room Trip Indication and Alarms
B. Safety Injection actuation can be initiated by manual switch operation.
C. The High Steam Line Flow Coincident with Low Steam Line Pressure or Low-Low T_{AVG} signal will result from a Low Steam Line Pressure only.
D. The High Steam Line differential Pressure signal will be blocked.
E. Containment Spray and acutation system will not be changed.
F. Containment Phase A isolation will not operate automatically. It can be initiated manually by Phase A manual actuation or Safety Injection manual actuation.
G. Phase B isolation system will not be changed.
H. Steam Line Isolation will result from any one of the following.
   1. Manual
   2. Containment Pressure - Interm .. ce High-High
   3. Steam Line Pressure Low
I. Feedwater Isolation will result from:
   1) High-High Steam Generator Water Level.
   2) Manual Safety Injection.
   3) Reactor trip with low T_{avg}.

J. Auxiliary Feedwater Pump start will result from any one of the following.

1. Station Blackout
2. Main Feedwater Pump Trip
3. Steam Genrator Low-Low Level

   NOTE: Setpoint changed from 18 percent NR to 5 percent NR

4. Manual initiation of Safety Injection

K. The following Reactor Trip signals will be blocked.

1. Overtemperature delta T
2. Overpower delta T

L. The following Reactor Trip signals will be blocked by the normal P-7 interlock.

1. Low Primary Coolant Flow
2. Undervoltage
3. Underfrequency
4. Pressurizer Low Pressure
5. Pressurizer High Level
6. Turbine Trip Signal

M. The following Reactor Trip signals will be operable at the setpoint specified.

1. Power Range, Low Range Neutron Flux	7 percent RTP
2. Intermediate Range, Neutron Flux	7 percent RTP
3. Steam Generator Water Level	5 percent NR

N. The following Reactor Trip signals will not be changed.

1. Pressurizer High Pressure
2. Low Feedwater Flow

3. Safety Injection Input

4. Manual Reactor Trip

5. Power Range, Neutron Flux High Positive Rate

6. Power Range, Neutron Flux High Negative Rate

7. Source Range, Neutron Flux

8. Power Range, High Range Neutron Flux

O. Hardware Modifications

Initial

_____ 1.0 Prepare the required SSPS test boards as follows:

_____ 1.1 (6.6 A, F, I J) Remove CR48 from each of two SSPS Universal Boards (6056D21G01). Label each board and record its serial number as follows:

"A313 TEST BOARD - TRAIN A" _____

"A313 TEST BOARD - TRAIN B" _____

_____ 1.2 (6.6, C) Remove CR35, CR36 and CR48 from each of two SSPS Universal Boards (6056D21G01) and connect a jumper from the anode hole of CR35 to the anode hole of CR36. Label each board and record its serial number as follows:

"A206 TEST BOARD - TRAIN A" _____

"A206 TEST BOARD - TRAIN B" _____

_____ 1.3 (6.6, D) Remove CR2, CR3, CR8 and CR9 from each of two SSPS Safeguards Output Board (6056D32G01). Label each board and record its serial number as follows:

"A516 TEST BOARD - TRAIN A" _____

"A516 TEST BOARD - TRAIN B" _____

Initials

Remove CR1 and CR7 from each of two SSPS Safeguards Output Boards (6056D32G01). Label each board and record its serial number as follows:

"A517 TEST BOARD - TRAIN A" _____

"A517 TEST BOARD - TRAIN B" _____

_____ 1.4 (6.6, K) Remove CR23, and CR24 from each of two SSPS U.V. Output Board (6058D45G01). Label each board and record its serial number as follows:

"A515 TEST BOARD - TRAIN A" _____

"A515 TEST BOARD - TRAIN B" _____

_____ 2.0 Place SSPS Train "A" in test as follows:

_____ 2.1 Place the "Multiplexer Test" switch for Train "A" in the "Normal" position. Then, have the Operator close the BYPASS breaker which parallels the reactor trip breaker for Train "A". Confirm this action by verifying the following:

NOTE: The Operator must rack-in the BYPASS breaker prior to closing.

_____ 2.1.1 The "General Warning" lamp for the Train "A" illuminates.

_____ 2.1.2 The red breaker position indicator "BYA" (for Train A under test) is illuminated on the MCB.

_____ 2.1.3 Annunciators 1K G-1, "SFGDS PROT SYS TR A TROUBLE," actuates.

_____ 2.2 On the Output Relay Test Panel, place the MODE SELECTOR switch in the "TEST" position and verify that the "OPERATE" lamp goes off.

Initials

_____ 2.3 On the Logic Test Panel, place the INPUT ERROR INHIBIT switch in the "INHIBIT" position.

_____ 3.0 Remove the following Train "A" SSPS boards and record their Serial numbers below:

_____ A313 _____

_____ A206 _____

_____ A516 _____

_____ A517 _____

_____ A515 _____

_____ 4.0 Install the test boards prepared in Section 1.0 in their appropriate slots.

_____ "A313 TEST BOARD - TRAIN A"

_____ "A206 TEST BOARD - TRAIN A"

_____ "A516 TEST BOARD - TRAIN A"

_____ "A517 TEST BOARD - TRAIN A"

_____ "A515 TEST BOARD - TRAIN A"

_____ 5.0 Return SSPS Train "A" to service as follows:

_____ 5.1 Place the MODE SELECTOR switch to "OPERATE".

_____ 5.2 Have the Operator place the following manual block switches for Trains A and B in the "BLOCK" position:

NOTE: Blocks will not be set unless their associated permissives are present.

SOURCE RANGE BLOCK & RESET

INTERMEDIATE RANGE BLOCK

POWER RANGE BLOCK LO S.P.

LO T-AVE SI - A(B) BLOCK & RESET

LO PRZ SI - A(B) BLOCK & RESET

Initials

_____ 5.3 Place the INPUT ERROR INHIBIT switch to "NORMAL".

_____ 5.4 Verify that both Reactor Trip Breakers are closed.

_____ 5.5 Have the Operator open and rack out the BYPASS breaker which was closed in Step 2.1.

NOTE: The "General Warning" lamp should go off.

CAUTION: If the MULTIPLEXER TEST switch will pass through the "INHIBIT" position in the following step, ensure that there is no "General Warning" for the opposite train.

_____ 5.6 Return the MULTIPLEXER TEST switch for Train "A" to the "A" + B" position.

_____ 5.7 Verify that Control Room annunciator 1K-7 for Train A is extinguished.

_____ 6.0 Place SSPS Train "B" in test as follows:

_____ 6.1 Place the "Multiplexer Test" switch for Train "A" in the "Normal" position. Then, have the Operator close the BYPASS breaker which parallels the reactor trip breaker for Train "B". Confirm this action by verifying the following:

NOTE: The Operator must rack-in the BYPASS breaker prior to closing.

_____ 6.1.1 The "General Warning" lamp for train "B" illuminates.

_____ 6.1.2 The red breaker position indicator "BYB" (for Train B under test) is illuminated on the MCB.

_____ 6.1.3 Annunciators 1K G-2, "SFGDS PROT SYS TR B TROUBLE," actuates.

Initials

_____ 6.2 On the Output Relay Test Panel, place the MODE SELECTOR switch in the "TEST" position and verify that the "OPERATE" lamp goes off.

_____ 6.3 On the Logic Test Panel, place the INPUT ERROR INHIBIT switch in the "INHIBIT" position.

_____ 7.0 Remove the following Train "B" SSPS boards and record their Serial numbers below:

_____ A313 _____

_____ A206 _____

_____ A516 _____

_____ A517 _____

_____ A515 _____

_____ 8.0 Install the test boards prepared in Sectin 1.0 in their appropriate slots.

_____ "A313 TEST BOARD - TRAIN B"

_____ "A206 TEST BOARD - TRAIN B"

_____ "A516 TEST BOARD - TRAIN B"

_____ "A517 TEST BOARD - TRAIN B"

_____ "A515 TEST BOARD - TRAIN B"

_____ 9.0 Return SSPS Train "B" to service as follows:

_____ 9.1 Place the MODE SELECTOR switch to "OPERATE".

_____ 9.2 Have the Operator place the following manual block switches for Trains A and B in the "BLOCK" position:

NOTE: Blocks will not be set unless their associated permissives are present.

SOURCE RANGE BLOCK & RESET

INTERMEDIATE RANGE BLOCK

Initials

POWER RANGE BLOCK LO S.P.

LO T-AVE SI - A(B) BLOCK & RESET

LO PRZ SI - A(B) BLOCK & RESET

_____ 9.3 Place the INPUT ERROR INHIBIT switch to "NORMAL".

_____ 9.4 Verify that both Reactor Trip Breakers are closed.

_____ 9.5 Have the Operator open and rack out the BYPASS breaker which was closed in Step 6.0.

NOTE: The "General Warning" lamp should go off.

CAUTION: If the MULTIPLEXER TEST switch will pas through the "INHIBIT" position in the following step, ensure that there is no "General Warning" for the opposite train.

_____ 9.6 First return the Multiplexer Test switch for Train "A" to normal. Then return the "Multiplexer Test" switch for Train "A" to the "A" + B" position.

_____ 9.7 Verify that Control Room annunciator 1K-15 for Train B is extinguished.

_____ 10.0 Return the SSPS to normal as follows:

_____ 10.1 Place SSPS Train "A" in test in accordance with Steps 2.1 through 2.3.

_____ 10.2 Remove the test boards installed in Section 4.0.

_____ 10.3 Install the SSPS boards removed in Step 3.0 and record their serial numbers below:

_____ A313 _____

_____ A206 _____

_____ A516 _____

_____ A517 _____

_____ A515 _____

Initials

_____ 10.4 Return SSPS Train "A" to service in accordance with Section 5.0

_____ 10.5 Place SSPS Train "B" in test in accordance with Steps 6.1 through 6.3.

_____ 10.6 Remove the test boards installed in Section 8.0.

_____ 10.7 Install the SSPS boards removed in Step 7.0 and record their serial numbers below:

_____ A313 _____

_____ A206 _____

_____ A516 _____

_____ A517 _____

_____ A515 _____

_____ 10.8 Return SSPS Train "B" to service in accordance with Section 9.0.

_____ 10.9 Perform 2-PT-36.1 for SSPS Trains "A" and "B".

NOTE: Insure that the test board modifications are corrected prior to returning these boards to stock.

P. Setpoint Changes

_____ 1.0 Change 18% Steam Generator Lo-Lo trip to 5% by adjusting the Signal Comparator Card from 1.800 VDC trip to 0.500 VDC trip and from 1.900 VDC reset to 0.600 VDC reset.

	Signal Comparator Card	Procedure
_____	LC-474A	ICP-P-2-L-474
_____	LC-475A	ICP-P-2-L-475
_____	LC-476A	ICP-P-2-L-476
_____	LC-484A	ICP-P-2-L-484

Initial		
_____	LC-485A	ICP-P-2-L-485
_____	LC-486A	ICP-P-2-L-486
_____	LC-494A	ICP-P-2-L-494
_____	LC-495A	ICP-P-2-L-495
_____	LC-496A	ICP-P-2-L-496

_____ 2.0 Verify Power Range, Low Range Neutron Flux trip is set at 7 percent RTP.

_____ 3.0 Verify Intermediate Range, Neurton Flux trip is set at 7 percent RTP.

4.0 Following Natural Circulation testing or when directed to by the Test Engineer return Steam Generator Lo-Lo level trip from 5% to 18%.

	Signal Comparator Card	Procedure
_____	LC-474A	ICP-P-2-L-474
_____	LC-475A	ICP-P-2-L-475
_____	LC-476A	ICP-P-2-L-476
_____	LC-484A	ICP-P-2-L-484
_____	LC-485A	ICP-P-2-L-485
_____	LC-486A	ICP-P-2-L-486
_____	LC-494A	ICP-P-2-L-494
_____	LC-495A	ICP-P-2-L-495
_____	LC-496A	ICP-P-2-L-496

OPERATIONAL SAFETY CRITERIA

During the performance fo these tests, the operator must meet the following set of criteria for operation.

A. For all tests

a.	Primary System Subcooling (T_{sat} Margin)	> 20°F
b.	Steam Generator Water Level Span	~ 33 percent
c.	Pressurizer Water Level	
	(1) With RCP's Running	21 percent Span
	(2) Natural Criculation	≧ Value when RCP's tripped
d.	Loop ΔT	≦ 65°F
e.	T_{AVG}	≦ 580°F
f.	Core Exit Temperature (highest)	≦ 610°F
g.	Power Range Neutron Flux	< 5 percent RTP
h.	Control Bank D	> 100 steps withdrawn

B. Reactor trip and test termination must occur if any of the following conditions are met

a.	Primary System Subcooling (T_{sat} Margin)	≦ 15°F
b.	Steam Generator Water Level	< 5 percent Narrow Range Span
c.	NIS Power Range, 2 Channels	> 7 percent RTP
d.	Pressurizer Water Level	≦ 17 percent Span or an unexplained decrease of more than 5 percent not concurrent with a T_{avg} change
e.	Any Loop ΔT	> 65°F

f.	T_{AVG}	> 580°F
g.	Core Exit Temperature (highest)	> 610°F
h.	Uncontrolled rod motion	

C. Safety injection must be manually initiated if any of the following conditions are met

a.	Primary System Subcooling (T_{sat} Margin)	≦ 10°F
b.	Steam Generator Water Level	< 0 percent Narrow Range Span or Equivalent Wide Range Level
c.	Containment Pressure	≧ 17 psia
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

Safety injection termination must be in accordance with the termination criteria set forth in the Station Emergency Procedures.

CORE ΔT WITH NATURAL CIRCULATION
ESTIMATED RANGE

Power Level (%)	Core ΔT (°F) 2-Operating Loops	3-Operating Loops
1	10-35	7-36
1 1/2	19-45	13-31
3		26-45

NOTE: These values of core ΔT reflect an uncertainty of 0.5 core power.

TRAINING LOG

The following personnel PARTICIPATED in the performance of the test, as defined in 2-SU-1, Attachment 5.6:

Name (print)	Name (print)

The following personnel OBSERVED the performance of this test, as defined in 2-SU-1, Attachment 5.6:

Name (print)	Name (print)

The completed Individual Training Record, 2-SU-1, Attachment 5.6, Attachment A, for each of the above-named individuals has been attached to this procedure.

Shift Supervisor _____ _____/_____
Signature Date