VIRGINIA ELECTRIC AND POWER COMPANY

2 ST 13 [1]

Revision No.: 0

Date: _____

[2]

STARTUP TEST PROCEDURE FOR NORTH ANNA POWER STATION UNIT # 2

TITLE: SIMULATED LOSS OF ALL ONSITE AND OFFSITE AC POWER

[3]

Prepared By: E.R. SMITH, JR. Date: _____

Engineering Recommended Approval: _____ Date: _____

[4]

STATION NUCLEAR SAFETY AND OPERATING COMMITTEE APPROVAL OF PROCEDURE:

Chairman's Signature: _____ Date: _____

[5]

All personnel conducting actual testing in accordance with this procedure will verify by their signature that they have read it in its entirety prior to commencing any testing:

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

NOT A CONTROLLED DOCUMENT
NOR ACCEPTABLY THE LATEST REVISION

[6]

TEST RESULTS REVIEWED BY ENGINEERING: _____ Date: _____

[7]

TEST RESULTS APPROVED BY STATION NUCLEAR SAFETY AND OPERATING COMMITTEE:

Chairman's Signature: _____ Date: _____

Comments: _____

TEST RESULTS (Use additional pages as needed) Page 2 of ___

DISCREPANCIES (List by number): 10

RESOLUTION OF DISCREPANCIES (List by number corresponding to above): 11

CRITIQUE: 12

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

T3

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

SIMULATED LOSS OF ALL ONSITE AND OFFISTE AC POWER

References:

1. Precautions, Limitation and Setpoints for Westinghouse NSSS system
2. Technical Specifications, North Anna Unit #2
3. WCAP-8747: North Anna Nuclear Design Report
4. North Anna Station Curve Book
5. 2-OP-5.2
6. 2-OP-30
7. 2-OP-31
8. 2-OP-32.1

1.0 Purpose

1.1 To demonstrate that following a loss of all onsite and offsite power, including the emergency diesel generators, the decay heat can be removed by natural circulation using the auxiliary feedwater system in the manual mode.

1.2 Verify that hot standby conditions can be maintained by manual control of the auxiliary feedwater system.

1.3 To verify that critical plant operations can be performed using emergency lighting, that the 125-volt DC system has the ability to supply the 125-volt vital AC and that certain equipment areas do not exceed maximum design temperature.

2.0 Initial Conditions

_____ 2.1 Low Power Physics Testing has been completed to the extent necessary for conduct of this test.

_____ 2.2 Reactor is critical and manually controlled at approximately 1% power with control banK D at ~ 160 steps or as specified by test engineer. (Power determined as indicated in Appendix 6.3.)

_____ 2.3 All three reactor coolant pumps are in operation.

_____ 2.4 Pressurizer pressure control and level control are in automatic, maintaining RCS pressure at approximately 2235 psig and pressurizer level at approximately 22%.

_____ 2.5 Steam dump valves are in the pressure control mode, maintaining steam generator pressure at approximately 1005 psig.

_____ 2.6 Steam generator level is being maintained at approximately 33% on the narrow range indicators.

_____ 2.7 Feedwater and condensate systems are in service in accordance with 2-OP-30 and 2-OP-31.

_____ 2.8 RCS temperature (T_{avg}) is being maintained at approximately 547 °F.

_____ 2.9 Record the following parameters.

_____ 2.9.1 Install brush recorders to record data at the following locations.

Brush Recorder No. 1	Connect To:	Monitoring
Channel No. 1	FP-414B, C1-432	RCS Flow, Loop 1
Channel No. 2	FP-424B, C1-433	RCS Flow, Loop 2
Channel No. 3	FP-434B, C1-434	RCS Flow, Loop 3
Channel No. 4	PP-455B, C1-427	Pressurizer Pressure
Channel No. 5	FP-459B, C1-442	Pressurizer Level

Initials

2.0 Initial Conditions (cont.)

Brush Recorder No. 2	Connect To:	Monitoring
Channel No. 1	PP-474B, C2-433	Steam Gen. #1 Press.
Channel No. 2	LP-474B, C1-429	Steam Gen. #1 Level
Channel No. 3	FP-474B, C3-741	Steam Gen. #1 Stm. Flow
Channel No. 4	PP-484B, C2-444	Steam Gen. #2 Pressure
Channel No. 5	CP-489B, C1-430	Steam Gen. #2 Level
Channel No. 6	FP-484B, C3-746	Steam Gen. #2 Steam Flow

Brush Recorder No. 3	Connect To:	Monitoring
Channel No. 1	PP-494B, C2-445	Steam Gen. #3 Press.
Channel No. 2	LP-494B, C1-431	Steam Gen. #3 Level
Channel No. 3	FP-494B, C3-748	Steam Gen. #3 Stm. Flow
Channel No. 4		S/6A Aux Feed Flow
Channel No. 5		S/6B Aux Feed Flow
Channel No. 6		S/6C Aux Feed Flow

_____ 2.9.2 Record the following on eact strip chart:

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

_____ 2.9.3 Record on reactivity-computer recorder

a. Flux
b. Average wide range T_{cold}
c. Average wide range T_{hot}
d. Average Steam generator pressure

_____ 2.10 Four incore T/C may be trended on the analog trend recorder on the main control board. (Suggest trending the four hottest thermocouples, one from each quadrant.)

_____ 2.11 A steady feed to the steam generators should be set up to minimize temperature variation in the RCS.

_____ 2.12 Auxiliary feedwater system lined up in standby in accordance with 2-OP-32.1.

Initials

2.0 Initial Conditions (cont.)

_____ 2.13 Steam generator chemistry in a condition that the absolute minimum steam generator blowdown can be maintained during the duration of this test. (Zero blowdown is possible).

_____ 2.14 Excess letdown is available for service if required during the test.

_____ 2.15 Verify that battery-powered lights are located in areas where operation of equipment is required after normal lighting is de-energized. (Operations to supply lights and position them where desired).

NOTE: These temporary lights should only be located in areas where operation of equipment would not normally take place in a black-out. Areas which must be operated during a blackout should be supplied with permanent battery-powered lights.

_____ 2.16 125 VDC Busses and 125 VAC Vital Busses are in normal alignment.

_____ 2.17 Evacuate non-essential personnel from all Unit 2 work areas in the auxiliary and containment buildings, if applicable.

NOTE: This is a safety measure since these work areas will be without lighting for approximately 2 hours.

_____ 2.18 Block auto actuation of safety injection on Hi Steam Δ P.

_____ 2.19 Notify the Shift Supervisor on duty of the impending test and co-ordinates its performance through him.

3.0 Precautions

_____ 3.1 Do not exceed 5% nuclear power.

_____ 3.2 Do not exceed any of the following temperature limits.

3.2.1 610°F for anycore outlet thermocouple.

3.2.2 65°F for any loop Delta-T.

3.2.3 580.3°F for any loop T_{avg}.

Initials

3.0 Precautions (cont)

_____ 3.3 Do not exceed primary to secondary differential pressure of 1600 psi.

_____ 3.4 Avoid rapid changes in steam pressure, steam generator level, and feedwater flow to prevent rapid cooling of the reactor coolant.

_____ 3.5 Do not exceed 100 psi differential pressure between any two steam lines. This will result in a safety injection signal.

_____ 3.6 Maintain reactor coolant pump seal and thermal barrier differential requirements as given in 2-OP-5.2.

_____ 3.7 After the reactor coolant pumps are tripped, the normal T_{avg} and ΔT indications will become unreliable. ΔT and T_{avg} should be calculated by taking the difference and the average of the hot and cold leg termperatures indications respectively.

NOTE: Observe the TSAT meter.

_____ 3.8 Maintain T_{cold} at the pretrip temperatures by adjusting the steam dump setpoint.

_____ 3.9 Note possible effects of a positive moderator temperature coefficient.

_____ 3.10 When equilibrium is established after the initial transient, avoid any sudden changes in Auxiliary Feedwater flow or in the Steam Generator water level.

_____ 3.11 Ensure seal flow to each Reactor Coolant pump is maintained at or slightly above 6 gpm during the test.

_____ 3.12 When the Reactor Coolant pumps are first tripped, Steam Generator water level will first shrink (due to flow coastdown)

Initials

3.0 Precautions (cont)

and then swell (as natural circulation reaches equilibrium). When complete manual control of auxiliary feedwater is begun, do not reduct feedwater flow below 40 gpm to each steam generator during the swell. (Until normal level is established).

_____ 3.13 After the Reactor Coolant pumps are tripped, the normal T_{avg} and ΔT indication will become unreliable. ΔT and T_{avg} should be calculated by taking the difference and the average of the hot and cold leg temperature indications respectively.

_____ 3.14 If the primary system pressure drops to a point where it is obvious that saturation pressure for the existing wide range hot leg or incore T/C temperatures will soon be reached, the pressurizer heaters will have to be energized or charging flow reestablished to increase system pressure

_____ 3.15 NIS channels can be used to determine changes in core power level providing the RCS cold leg temperatures are maintained at approximately the same value that existed before tripping the reactor coolant pumps.

_____ 3.16 Test instrumentation should be connected to a reliable source of power.

4.0 Instructions

_____ 4.1 Shutdown the main control room air conditioning and place a room thermometer on the operator's desk to monitor control room air temperature.

Initials

4.0 Instructions (cont.)

_____ 4.2 Clear the auxiliary building of all non-essential personnel and announce over the Public Address System that a blackout test will be beginning shortly.

_____ 4.3 Manually adjust Pressurizer Spray Valve controllers to zero % output (closes pressurizer spray valves) and leave the controllers in manual control.

_____ 4.4 Ensure the pressurizer backup heaters will remain off by moving control switches to "pull to lock".

_____ 4.5 Ensure Auxiliary Feedwater motor driven pumps 1A and 1B will not start on the simulated blackout by moving switches to the "pull-to-lock" position.

_____ 4.6 Just prior to initiating RCP trips, reduce charging flow to the minimum required to maintain seal injection flow.

_____ 4.7 Isolate RCS letdown.

_____ 4.8 Close charging line stop valve MOV-2289A or 2289B once charging flow is reduced.

_____ 4.9 Record the data indicated on Attachment 6.2.

_____ 4.10 Start the Computer Trend printer printing at 1-minute intervals.

_____ 4.11 Record the time, date and initial the charts on the data recorders.

_____ 4.12 Start all three reactor coolant pump oil lift pumps.

NOTE: The following step should be conducted immediately before initiating the trips.

_____ 4.13 As quickly as possible shutdown the following equipment. As many people as possible should be utilized to complete this step so that a close approximation to a blackout can be simulated.

Initials

4.0 Instructions (cont.)

NOTE: Zero Time = _____

		Check √
a)	Trip pressurizer heater control group.	_____
b)	Trip all three reactor coolant pumps.	_____
c)	Close main steam isolation valves.	_____
d)	Trip the main feed pump presently in operation.	_____
e)	Place 25H2 (EDG2H OUTPUT BKR) in "Pull-to-Lock".	_____
f)	Place 25J2 (EDG2J OUTPUT BKR) in "Pull-to-Lock".	_____

NOTE: It will be necessary to realign aux. feed flow so that the turbine-driven aux feed pump is flowing to all three S/G's.

g)	Place Remote-Local control switches for EDG2H and 2J in Manual, Local position.	_____
h)	Trip and lock out 15E3 and 15F4. (This deenergizes 4KV Emerg Busses.)	_____
i)	Trip and lock out 25B1 and 25C1. (Bus 2A will remain energized to power a Rod Drive MG Set.)	_____
j)	Begin monitoring and recording the parameters indicated on Attachment 6.5, Data Sheets at the intervals indicated.	_____

NOTE: Monitor reactor power closely and make any adjustments necessary to maintain approximately 1% power. T_c for each leg should be maintained at approximately the pretrip temperature.

Initials

4.0 Instructions (cont.)

_____ 4.14 Verify the steam-driven Auxiliary Feedwater pump has started and flow established to each steam generator.

NOTE: Operators may be dispatched to take manual control of Auxiliary Feedwater and main steam power operated relief valves, if possible.

_____ 4.15 Verify natural circulation has been established.

_____ 4.16 Bring the steam generator levels back to normal operating level (approximately 33%) and manually adjust atmospheric dump and auxiliary feedwater flow to maintain the pretrip cold leg temperature. (Establish a steady feedwater flow. Do not stop and start flow to control the level.)

_____ 4.17 When equilibrium conditions have been established for each steam generator, make notes on Attachment 6.5 Data Sheets of the time and continue recording data.

_____ 4.18 Maintain steam generator level at approximately 33% and reactor power at 1% for a maximum of a two-hour period from the time of the simulated blackout.

NOTE: The pressurizer water level is not expected to rise above 80%, however, if it should, put excess letdown into service to reduce the RCS water volume. Maintain letdown until level reaches 50%. (Note letdown established on Attachment 6.5 Data Sheets).

_____ 4.19 Adjust the setpoint dial on the pressure controllers to 1005 psig and individually return the power-operated relief valves to "Auto" control.

CAUTION: Let each steam generator come to equilibrium before putting the next power relief valve in Auto.

_____ 4.20 Return pressurizer spray controllers to "Auto". (Spray will not be available until the reactor coolant pumps are restarted).

Initials

4.0 Instructions (cont.)

NOTE: If the RCS pressure is below 2210 psig, energize one of the pressurizer backup heaters. Realign the applicable emergency bus to power the heater. Control RCS pressure by energizing or deenergizing the backup heaters.

_____ 4.21 Insert Control bank D until the reactor is in the hot zero power test range.

_____ 4.22 Reclose 25B1 and 25C1.

_____ 4.23 Reclose 15E3 and 15F4.

_____ 4.24 Place EDG 2H and 2J Remote-Local switches to remote, auto condition.

_____ 4.25 Return 25H2 and 25J2 to "Auto".

_____ 4.26 Return to normal feedwater alignment and, when possible, return to condenser steam dump.

_____ 4.27 Return all three reactor coolant pumps to service.

_____ 4.28 Restore pressurizer heaters and establish stable RCS pressure control.

_____ 4.29 Discontinue trend recording.

_____ 4.30 Establish normal letdown and charging and return pressurizer level to the $\approx$ 22% level.

_____ 4.31 Place Aux feed pump motor driven pumps in "Auto".

_____ 4.32 Announce that blackout testing is complete.

_____ 4.33 Remove the block of auto actuation of SI on high steam line ΔP.

Completed by: _____

Date: _____

5.0 Acceptance Criteria

5.1 Core exit T/C temperature did not exceed 610°F.

5.2 Delta-T for any loop did not exceed 65°F.

5.3 Tavg for any loop did not exceed 580.3°F.

5.4 Natural circulation can be established and maintained with the degraded condition of a simulated loss of offsite and onsite power.

5.5 Emergency lighting in the plant is sufficient to operate critcial equipment in the loss of normal lighting.

5.6 Hot standby conditions can be maintained for a 2-hour period with critcial equipment operating off of vital battery power.

5.7 Manual operation of auxiliary feedwater system can be coordinated by the unit operator to maintain stable plant conditions.

6.0 Attachments

6.1 Test Equipment Data Sheet

6.2 Initial Conditions

6.3 Appendix A

6.4 Trend Blocks

6.5 Data Sheets

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 1 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 Temperature _____ °F

Completed By: _____

Date: _____

APPENDIX A

Outline

I. Core Power Determination

A. Primary Side Calorimetric (Forced Circulation Only)

1. Reference (~500°F) Calorimetric

a) Output used to adjust M/D Power Monitor Program's power conversion constant.

B. M/D Power Monitor Program

1. Power Conversion Constant Adjustment.

a) The output of the REF primary calorimetric will give a % power output; this output must be input to the M/D Power-Monitor Program so that the program output will be in percent power and equal to the primary calorimetric output.

2. Power Monitoring

a) The M/D Power Monitor Program will calculate the integral power as seen by one pass of 4 or 5 detectors. After the output has been calibrated to be equal to the REF primary calorimetric it will be rerun up to once every 2 minutes or as necessary to continuously monitor core power.

APPENDIX A
CORE POWER DETERMINATION

PART A: Primary side calorimetric - Data Sheet A.1 (Forced Circulation)

A.1 Use two DVMs and measure the voltage at the test points specified for each loop as rapid as possible.

A.2 Calculate the Δ T; multiply that Δ T by the specific heat and the Westinghouse best estimate flow rate of the core average temperature (Table A-1). (Special Test No. 9 uses wide range Δ T so a correction factor is required to compensate for pump heating, refer to Appendix B of 2-ST-7).

A.3 Sum the loop heat rates and convert to a percent reactor power. The output is used in Part B.

POOR ORIGINAL

Initials

2.0 Initial Conditions (cont.)

Brush Recorder No. 2	Connect To:	Monitoring
Channel No. 1	PP-474B, C2-433	Steam Gen. #1 Press.
Channel No. 2	LP-474B, C1-429	Steam Gen. #1 Level
Channel No. 3	FP-474B, C3-741	Steam Gen. #1 Stm. Flow
Channel No. 4	PP-484B, C2-444	Steam Gen. #2 Pressure
Channel No. 5	CP-489B, C1-430	Steam Gen. #2 Level
Channel No. 6	FP-484B, C3-746	Steam Gen. #2 Steam Flow

Brush Recorder No. 3	Connect To:	Monitoring
Channel No. 1	PP-494B, C2-445	Steam Gen. #3 Press.
Channel No. 2	LP-494B, C1-431	Steam Gen. #3 Level
Channel No. 3	FP-494B, C3-748	Steam Gen. #3 Stm. Flow
Channel No. 4		S/6A Aux Feed Flow
Channel No. 5		S/6B Aux Feed Flow
Channel No. 6		S/6C Aux Feed Flow

_____ 2.9.2 Record the following on eact strip chart:

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

_____ 2.9.3 Record on reactivity-computer recorder

a. Flux
b. Average wide range T_{cold}
c. Average wide range T_{hot}
d. Average Steam generator pressure

_____ 2.10 Four incore T/C may be trended on the analog trend recorder on the main control board. (Suggest trending the four hottest thermocouples, one from each quadrant.)

_____ 2.11 A steady feed to the steam generators should be set up to minimize temperature variation in the RCS.

_____ 2.12 Auxiliary feedwater system lined up in standby in accordance with 2-OP-32.1.

Initials

2.0 Initial Conditions (cont.)

_____ 2.13 Steam generator chemistry in a condition that the absolute minimum steam generator blowdown can be maintained during the duration of this test. (Zero blowdown is possible).

_____ 2.14 Excess letdown is available for service if required during the test.

_____ 2.15 Verify that battery-powered lights are located in areas where operation of equipment is required after normal lighting is de-energized. (Operations to supply lights and position them where desired).

NOTE: These temporary lights should only be located in areas where operation of equipment would not normally take place in a black-out. Areas which must be operated during a blackout should be supplied with permanent battery-powered lights.

_____ 2.16 125 VDC Busses and 125 VAC Vital Busses are in normal alignment.

_____ 2.17 Evacuate non-essential personnel from all Unit 2 work areas in the auxiliary and containment buildings, if applicable.

NOTE: This is a safety measure since these work areas will be without lighting for approximately 2 hours.

_____ 2.18 Block auto actuation of safety injection on Hi Steam Δ P.

_____ 2.19 Notify the Shift Supervisor on duty of the impending test and co-ordinates its performance through him.

3.0 Precautions

_____ 3.1 Do not exceed 5% nuclear power.

_____ 3.2 Do not exceed any of the following temperature limits.

3.2.1 610°F for anycore outlet thermocouple.

3.2.2 65°F for any loop Delta-T.

3.2.3 580.3°F for any loop T_{avg}.

Initials

3.0 Precautions (cont)

_____ 3.3 Do not exceed primary to secondary differential pressure of 1600 psi.

_____ 3.4 Avoid rapid changes in steam pressure, steam generator level, and feedwater flow to prevent rapid cooling of the reactor coolant.

_____ 3.5 Do not exceed 100 psi differential pressure between any two steam lines. This will result in a safety injection signal.

_____ 3.6 Maintain reactor coolant pump seal and thermal barrier differential requirements as given in 2-OP-5.2.

_____ 3.7 After the reactor coolant pumps are tripped, the normal T_{avg} and ΔT indications will become unreliable. ΔT and T_{avg} should be calculated by taking the difference and the average of the hot and cold leg termperature indications respectively.

NOTE: Observe the TSAT meter.

_____ 3.8 Maintain T_{cold} at the pretrip temperatures by adjusting the steam dump setpoint.

_____ 3.9 Note possible effects of a positive moderator temperature coefficient.

_____ 3.10 When equilibrium is established after the initial transient, avoid any sudden changes in Auxiliary Feedwater flow or in the Steam Generator water level.

_____ 3.11 Ensure seal flow to each Reactor Coolant pump is maintained at or slightly above 6 gpm during the test.

_____ 3.12 When the Reactor Coolant pumps are first tripped, Steam Generator water level will first shrink (due to flow coastdown)

Initials

3.0 Precautions (cont)

and then swell (as natural circulation reaches equilibrium). When complete manual control of auxiliary feedwater is begun, do not reduct feedwater flow below 40 gpm to each steam generator during the swell. (Until normal level is established).

_____ 3.13 After the Reactor Coolant pumps are tripped, the normal T_{avg} and ΔT indication will become unreliable. ΔT and T_{avg} should be calculated by taking the difference and the average of the hot and cold leg temperature indications respectively.

_____ 3.14 If the primary system pressure drops to a point where it is obvious that saturation pressure for the existing wide range hot leg or incore T/C temperatures will soon be reached, the pressurizer heaters will have to be energized or charging flow reestablished to increase system pressure

_____ 3.15 NIS channels can be used to determine changes in core power level providing the RCS cold leg temperatures are maintained at approximately the same value that existed before tripping the reactor coolant pumps.

_____ 3.16 Test instrumentation should be connected to a reliable source of power.

4.0 Instructions

_____ 4.1 Shutdown the main control room air conditioning and place a room thermometer on the operator's desk to monitor control room air temperature.

Initials

4.0 Instructions (cont.)

_____ 4.2 Clear the auxiliary building of all non-essential personnel and announce over the Public Address System that a blackout test will be beginning shortly.

_____ 4.3 Manually adjust Pressurizer Spray Valve controllers to zero % output (closes pressurizer spray valves) and leave the controllers in manual control.

_____ 4.4 Ensure the pressurizer backup heaters will remain off by moving control switches to "pull to lock".

_____ 4.5 Ensure Auxiliary Feedwater motor driven pumps 1A and 1B will not start on the simulated blackout by moving switches to the "pull-to-lock" position.

_____ 4.6 Just prior to initiating RCP trips, reduce charging flow to the minimum required to maintain seal injection flow.

_____ 4.7 Isolate RCS letdown.

_____ 4.8 Close charging line stop valve MOV-2289A or 2289B once charging flow is reduced.

_____ 4.9 Record the data indicated on Attachment 6.2.

_____ 4.10 Start the Computer Trend printer printing at 1-minute intervals.

_____ 4.11 Record the time, date and initial the charts on the data recorders.

_____ 4.12 Start all three reactor coolant pump oil lift pumps.

NOTE: The following step should be conducted immediately before initiating the trips.

_____ 4.13 As quickly as possible shutdown the following equipment. As many people as possible should be utilized to complete this step so that a close approximation to a blackout can be simulated.

Initials

4.0 Instructions (cont.)

NOTE: Zero Time = _____

		Check √
a)	Trip pressurizer heater control group.	_____
b)	Trip all three reactor coolant pumps.	_____
c)	Close main steam isolation valves.	_____
d)	Trip the main feed pump presently in operation.	_____
e)	Place 25H2 (EDG2H OUTPUT BKR) in "Pull-to-Lock".	_____
f)	Place 25J2 (EDG2J OUTPUT BKR) in "Pull-to-Lock".	_____

NOTE: It will be necessary to realign aux. feed flow so that the turbine-driven aux feed pump is flowing to all three S/G's.

g)	Place Remote-Local control switches for EDG2H and 2J in Manual, Local position.	_____
h)	Trip and lock out 15E3 and 15F4. (This deenergizes 4KV Emerg Busses.)	_____
i)	Trip and lock out 25B1 and 25C1. (Bus 2A will remain energized to power a Rod Drive MG Set.)	_____
j)	Begin monitoring and recording the parameters indicated on Attachment 6.5, Data Sheets at the intervals indicated.	_____

NOTE: Monitor reactor power closely and make any adjustments necessary to maintain approximately 1% power. T_c for each leg should be maintained at approximately the pretrip temperature.

Initials

4.0 Instructions (cont.)

_____ 4.14 Verify the steam-driven Auxiliary Feedwater pump has started and flow established to each steam generator.

NOTE: Operators may be dispatched to take manual control of Auxiliary Feedwater and main steam power operated relief valves, if possible.

_____ 4.15 Verify natural circulation has been established.

_____ 4.16 Bring the steam generator levels back to normal operating level (approximately 33%) and manually adjust atmospheric dump and auxiliary feedwater flow to maintain the pretrip cold leg temperature. (Establish a steady feedwater flow. Do not stop and start flow to control the level.)

_____ 4.17 When equilibrium conditions have been established for each steam generator, make notes on Attachment 6.5 Data Sheets of the time and continue recording data.

_____ 4.18 Maintain steam generator level at approximately 33% and reactor power at 1% for a maximum of a two-hour period from the time of the simulated blackout.

NOTE: The pressurizer water level is not expected to rise above 80%, however, if it should, put excess letdown into service to reduce the RCS water volume. Maintain letdown until level reaches 50%. (Note letdown established on Attachment 6.5 Data Sheets).

_____ 4.19 Adjust the setpoint dial on the pressure controllers to 1005 psig and individually return the power-operated relief valves to "Auto" control.

CAUTION: Let each steam generator come to equilibrium before putting the next power relief valve in Auto.

_____ 4.20 Return pressurizer spray controllers to "Auto". (Spray will not be available until the reactor coolant pumps are restarted).

Initials

4.0 Instructions (cont.)

NOTE: If the RCS pressure is below 2210 psig, energize one of the pressurizer backup heaters. Realign the applicable emergency bus to power the heater. Control RCS pressure by energizing or deenergizing the backup heaters.

_____ 4.21 Insert Control bank D until the reactor is in the hot zero power test range.

_____ 4.22 Reclose 25B1 and 25C1.

_____ 4.23 Reclose 15E3 and 15F4.

_____ 4.24 Place EDG 2H and 2J Remote-Local switches to remote, auto condition.

_____ 4.25 Return 25H2 and 25J2 to "Auto".

_____ 4.26 Return to normal feedwater alignment and, when possible, return to condenser steam dump.

_____ 4.27 Return all three reactor coolant pumps to service.

_____ 4.28 Restore pressurizer heaters and establish stable RCS pressure control.

_____ 4.29 Discontinue trend recording.

_____ 4.30 Establish normal letdown and charging and return pressurizer level to the $\approx$ 22% level.

_____ 4.31 Place Aux feed pump motor driven pumps in "Auto".

_____ 4.32 Announce that blackout testing is complete.

_____ 4.33 Remove the block of auto actuation of SI on high steam line ΔP.

Completed by: _____ _____

Date: _____

5.0 Acceptance Criteria

5.1 Core exit T/C temperature did not exceed 610°F.

5.2 Delta-T for any loop did not exceed 65°F.

5.3 Tavg for any loop did not exceed 580.3°F.

5.4 Natural circulation can be established and maintained with the degraded condition of a simulated loss of offsite and onsite power.

5.5 Emergency lighting in the plant is sufficient to operate critcial equipment in the loss of normal lighting.

5.6 Hot standby conditions can be maintained for a 2-hour period with critcial equipment operating off of vital battery power.

5.7 Manual operation of auxiliary feedwater system can be coordinated by the unit operator to maintain stable plant conditions.

6.0 Attachments

6.1 Test Equipment Data Sheet

6.2 Initial Conditions

6.3 Appendix A

6.4 Trend Blocks

6.5 Data Sheets

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 1 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 Temperature _____ °F

Completed By: _____

Date: _____

APPENDIX A

Outline

I. Core Power Determination

A. Primary Side Calorimetric (Forced Circulation Only)

1. Reference (~500°F) Calorimetric

a) Output used to adjust M/D Power Monitor Program's power conversion constant.

B. M/D Power Monitor Program

1. Power Conversion Constant Adjustment.

a) The output of the REF primary calorimetric will give a % power output; this output must be input to the M/D Power-Monitor Program so that the program output will be in percent power and equal to the primary calorimetric output.

2. Power Monitoring

a) The M/D Power Monitor Program will calculate the integral power as seen by one pass of 4 or 5 detectors. After the output has been calibrated to be equal to the REF primary calorimetric it will be rerun up to once every 2 minutes or as necessary to continuously monitor core power.

APPENDIX A
CORE POWER DETERMINATION

PART A: Primary side calorimetric - Data Sheet A.1 (Forced Circulation)

A.1 Use two DVMs and measure the voltage at the test points specified for each loop as rapid as possible.

A.2 Calculate the ΔT; multiply that ΔT by the specific heat and the Westinghouse best estimate flow rate of the core average temperature (Table A-1). (Special Test No. 9 uses wide range ΔT so a correction factor is required to compensate for pump heating, refer to Appendix B of 2-ST-7).

A.3 Sum the loop heat rates and convert to a percent reactor power. The output is used in Part B.

POOR ORIGINAL

APPENDIX A (Continued)
Core Power Determination

PART B: M/D Power Monitor Program

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.

Drive	10-Path Position	Core Location
A		
B		
C		
D		
E		

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

2. Determine the detector normalization constants and enter them into the P-250 as follows:

a) Enter a value of 1.0 into the P-250 for the addresses shown in the table below.

b) With all 5-path selector switches set to normal, run a flux trace.

c) With all 5-path selector switches set to Emergency, run a flux trace.

d) Determine the detector normalization constants from Data Sheet A.1.

e) Enter these detector normalization constants into the P-250 as shown in the table below.

Drive	P-250 Address	Constant
A		
B		
C		
D		
E		

POOR ORIGINAL

APPENDIX A (Continued)
Core Power Determination

PART 2: (Continued)

3. Verify that the P-250 parameters listed in the following table have the proper value and that the P-250 time and date are current. Update as required.

Address	Value	Function
K0901	1	Set the power normalization factor
K3525	1	Selects the modified "Flux Map Print" programs
K0900	0	Initiated Pass Number
K0864	Variable[1]	Calibration Constant for M/D Power Monitor

[1] Variable: The value entered is a ratio of the Primary Calorimetric Indicated Power (Item 8 on Data Sheet C.1) to the M/D calculated power (U0906) times the current value entered in (K0864). If no value has been entered into (K0864) enter 0.25.

$$\text{New (K0864)} = \text{Current (K0864)} \times \frac{\text{Item \#8 Data Sheet C.1}}{\text{(U0906)}}$$

4. For power determination, obtain a partial core flux map. The M/D's need not be withdrawn between passes, and passes may be repeated as often as a power determination is required.

NOTE: The calculated power (U0906) is printed after each pass and may be trended by the P-250 if desired. The individual detector normalized integrals are also printed.

POOR ORIGINAL

APPENDIX A (Continued)

TABLE A-1

Temp °F	Cp[1] BTU/lbm°F	$\dot{m}^{*}$ lbm/hr
556	1.260	3.6448×10^7
554	1.255	3.6553×10^7
552	1.250	3.6659×10^7
550	1.245	3.6765×10^7
548	1.240	3.6862×10^7
546	1.236	3.6959×10^7
544	1.231	3.7057×10^7
542	1.226	3.7155×10^7
540	1.221	3.7254×10^7
538	1.217	3.7343×10^7
536	1.213	3.7443×10^7
534	1.209	3.7538×10^7
532	1.206	3.7633×10^7
530	1.202	3.7729×10^7

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

POOR ORIGINAL

POOR ORIGINAL

APPENDIX A (Continued)

Data Sheet A.1

Date _____ Time _____ Unit _____ Power _____ Tavg _____

Item #	Calculation Procedure	Units	Loop 1	Loop 2	Loop 3
1	Loop Δ T - Inservice (at test point)	Volts			
2	Loop Δ T = (#1) x [1]	^{o}F			
3	Loop Δ H = (#2) x Cp (from Table A.1)	BTU/lbm			
4	Loop RCS Flow (from Table A.1)	10^6 lbm/hr			
5	Loop Reactor Power = (#3) x (#4)	10^6 BTU/hr			
6	Total Reactor Power = (#5) Loop 1 + Loop 2 + Loop 3	10^6 BTU/hr			
7	Reactor Power = (#6) x 0.29307	MWT			
8	% Reactor Power = (#7) x 0.02932	%			

[1] Conversion factor for Δ T obtained from scaling document.

Remarks:

Data By: _____

Date: _____

APPENDIX A (Continued)

DATA SHEET A.2

A_N = _____ B_N = _____ C_N = _____ D_N = _____ E_N = _____

A_E = _____ B_E = _____ C_E = _____ D_E = _____ E_E = _____

N_A = 1.00

$$N_B = \frac{A_N}{B_N} = \frac{N_A A_E}{B_N} = _____$$

$$N_C = \frac{A_N}{C_N} = \frac{N_B B_E}{C_N} = _____$$

$$N_D = \frac{A_N}{D_N} = \frac{N_C C_E}{D_N} = _____$$

$$N_E = \frac{A_N}{E_N} = \frac{N_D D_E}{E_N} = _____$$

POOR ORIGINAL

Definitions:

A_N, B_N, C_N, D_N, E_N = Normalized integral from summary map for each detector in a normal path in the first pass

A_E, B_E, C_E, D_E, E_E = Normalized integral from summary map for each detector in an emergency path in the second pass

N_A, N_B, N_C, N_D, N_E = Detector normalization factor for each detector

Remarks:

Data By: _____ _____ Date _____

APPENDIX A (Continued)

Part C: Using Thermocouples

The incore thermocouples can be used as an indication of both core flow distribution and power shifts during natural circulation.

Prior to running a thermocouple map or trending the eight quadrant tilts (four center line and four diagonal tilts) the following should be verified:

K0701-K0765 = 1, For the flow mixing factors

K5501 = 0, Indicates the measured core ΔT is unreliable

K0791 = 0.075, Core bypass flow fraction

K5010 = 8, Tells thermocouple program how many readings of thermocouples are required for averaging before calculation is done. This in turn sets the running frequency of the Thermocouple Averaging Program at 1, 2, ... N 8 seconds or 64 seconds for us.

The thermocouple programs breaks the core down into eight quadrants—four centerline and four diagonal quadrants (see Figure C-1). Quadrants 1-4 can be directly correlated with the excore detectors but quadrants 5-8 cannot.

The quadrant tilts are indicative of power shifts and should be trended at approximately a 2-minute frequency. The following addressable values are the quadrant tilts:

Quadrant	Addressable Value
1	U1159
2	U1160
3	U1161
4	U1162
5	U1151
6	U1152
7	U1153
8	U1154

POOR ORIGINAL

A Short Form Map should be run periodically or upon request from the test engineer as an indication of core flow distribution. It should be put on the Utility Typewriter if possible. The P-250 Operator's Console Reference Manual provides instructions for obtaining thermocouple maps.

The trend output and Short Form Maps should be attached to this procedure at the end of the test.

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	T0939A	RCL B T_{HOT}	°F
6	T0959A	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	

DATA SHEET 1

Record the following temperatures at the indicated intervals.

Time After Trip	Turbine Driven Auxiliary F.P. Room	Main Control Room
15 mins.	_____	_____
30 mins.	_____	_____
45 mins.	_____	_____
60 mins.	_____	_____
75 mins.	_____	_____
90 mins.	_____	_____
105 mins.	_____	_____
120 mins.	_____	_____

After test, record Outside Temperature _____ °F.

Completed By: _____

Date: _____

DATA SHEET 2

125-V Battery and 125 vac Vital Busses

(Voltage)

	125v DC Bus 2-I	125v DC Bus 2-II	125v DC Bus 2-III	125v DC Bus 2-IV	120vac Vital Bus 2-I	120vac Vital Bus 2-II	120vac Vital Bus 2-III	120vac Vital Bus 2-IV
Initial Conditions								
Immediately Following B.O.(T)								
T + 10 min.								
T + 20 min.								
T + 30 min.								
T + 40 min.								
T + 50 min.								
T + 60 min.								
T + 70 min.								
T + 80 min.								
T + 90 min.								
T + 100 min.								
T + 110 min.								
T + 120 min.								

Completed By: _____

Date: _____

DATA SHEET 2 (Continued)

125-V Vital Battery Room Temperatures & H_2 Level

Initial Conditions	125-V Battery Room I		125-V Battery Room II		125-V Battery Room III		125-V Battery Room IV	
	Temp.	H_2	Temp.	H_2	Temp.	H_2	Temp.	H_2
T + 10 min								
T + 20 min								
T + 30 min								
T + 40 min								
T + 50 min								
T + 60 min								
T + 70 min								
T + 80 min								
T + 90 min								
T + 100 min								
T + 110 min								
T + 120 min								

CAUTION: If H_2 approaches critical level, vertilate room.

Remarks:

Completed By: _____

Date: _____