STARTUP PROCEDURE 90.5 Rev. 2

NATURAL CIRCULATION AT REDUCED PRESSURE

1.0 OBJECTIVES

1.1 Verify the capability to maintain Natural Circulation at reduced RCS pressures.

1.2 Verify the accuracy of the saturation meter indication as provided by the P-250.

1.3 Provide operational experience with control of saturation margin at reduced margins by use of primary charging flow and secondary steam flow.

1.4 To provide operator training in control of saturation margin under Natural Circulation.

2.0 REFERENCES

2.1 Westinghouse precautions limitations and setpoints, Rev. 7, August 1979.

2.2 SUP 90.0, Special Tests Sequence Document

2.3 Operating Instructions

2.3.1 OI II-1.3.1 "RCP Operation"

2.3.2 EI I-4.9 "Blackout"

3.0 PREREQUISITES

___ 3.1 The low power physics measurement program (SUP's 80.3, 80.4, 80.5, and 80.6) is complete.

___ 3.2 Brush recorders are connected per section 8.0.

___ 3.3 The P-250 computer T/W trend is monitoring the parameters listed in Appendix A.

___ 3.4 The reactivity computer/recorder is operating recording flux reactivity, and loop wide range temperatures per para. 8.3 of this procedure.

___ 3.5 Automatic actuation of Safety Injection has been blocked per SUP 90.0, App. A (ref. 2.2)

___ 3.6 The input logic of steam line ΔP S.I. actuation has been blocked per SUP 90.0, App. A (ref. 2.2)

___ 3.7 The input logic of high steam flow, coincident with low steam line pressure or low-low T_{av} is modified per SUP 90.0 App. A (ref. 2.2)

___ 3.8 The test engineer has conducted briefings for all personnel involved in the conduct of the test.

___ 3.9 Station QA has been nofified of the start of this test.

___ 3.10 The special operator instructions given in SUP 90.0, section 9.1.4 have been posted conspicuously in the control room.

___ 3.11 The S/G lo-lo and lo level reactor trip setpoints have been reset to 5%.

___ 3.12 The NIS power range hi-level, low range trip setpoint (normally 25%) has been reset to .583 volts and the intermediate range high flux setpoint has been reset to 28 μa (equivalent to 7% reactor power).

4.0 INITIAL CONDITIONS

____ 4.1 The reactor is critical at approximately 3% power as determined by the incore flux mapping system.

____ 4.2 The rod control system is in Manual Control with Control Bank D at approximately 160 steps or as specified by Reactor Test Engineer (in Bank D select).

____ 4.3 All four RCP's are in operation, unless branching option from SUP 90.1 is utilized.

____ 4.4 Steam Generator Level is maintained at approximately 33% (N.R.) using Auxiliary Feedwater Pumps.

____ 4.5 Pressurizer pressure is maintained at about 2235 psig with heaters and spray in Automatic.

____ 4.6 Pressurizer Level is maintained about 26% with charging flow controlled manually. (34% if branching from SUP 90.1 is utilized.)

____ 4.7 RCS average temperature T_{av} is 547°F $\pm$ 1°F
(if branching from SUP 90.1 on natural circulation, T_{av} will be at about 570°F)

____ 4.8 Steam Generator pressure is being maintained at about 1005 psig by steam dump to the condenser in the steam pressure mode of control (preferable) or by atmospheric steam dump (alternate).

5.0 ENVIRONMENTAL CONDITIONS

5.1 Atmospheric steam dump may be required during the performance of this procedure.

6.0 ACCEPTANCE CRITERIA

6.1 Natural Circulation can be maintained at reduced RCS pressure in all four reactor coolant loops.

6.2 Operator action points of SUP 90.0, section 9.1.4.1 is maintained throughout the test.

6.3 The saturation recorder is in agreement with margins calculated from recorded plant parameters using steam tables to within 3%.

6.4 As many SRO's and RO's (licensed on Unit #2) as practical participate in or observe this test.

7.0 SPECIAL TEST EQUIPMENT

7.1 Three Brush 260 (or equivalent) chart recorders, connected per section 8.0.

Recorder No.	S/N	Cal. Date
1		
2		
3		

7.2 Westinghouse reactivity computer

Recorder No.	S/N	Cal. Date
1		
2		
3		
4		
5		

7.3 Chronometer or stopwatch _____ _____

8.0 DATA COLLECTION

8.1 All data acquired as a result of performance of this procedure shall be recorded at the appropriate step, or attached data sheets, or affixed as appropriate.

8.2 Recorder data points. Mark each chart with test No., Date, Time, Recorder Number, Chart Speed.

8.2.1

Recorder No. 1	Inst.	Parameter	Range
Channel No. 1	FT-414	RCS Loop Flow 21	0-10% flow
Channel No. 2	FT-424	RCS Loop Flow 22	0-10% flow
Channel No. 3	FT-434	RCS Loop Flow 23	0-10% flow
Channel No. 4	FT-444	RCS Loop Flow 24	0-10% flow
Channel No. 5	PT-474	Pressurizer Pressure	1600-2400 psig
Channel No. 6	LT-461	Pressurizer Level	0-100%

8.2.2

Recorder No. 2	Inst.	Parameter	Range
Channel No. 1	FA-1087	Aux. Feed Flow to S/G 21	0-300 gpm
Channel No. 2	LT-517	S/G 21 Level	0-100%
Channel No. 3	PT-516	S/G 21 Pressure	700-1200 psig
Channel No. 4	FA-1091	Aux. Feed Flow to S/G 22	0-300 gpm
Channel No. 5	LT-527	S/G 22 Level	0-100%
Channel No. 6	PT-526	S/G 22 Pressure	700-1200 psig

8.2.3

Recorder No. 3	Inst.	Parameter	Range
Channel No. 1	FA-1095	Aux. Feed Flow to S/G 23	0-300 gpm
Channel No. 2	LT-537	S/G 23 Level	0-100%
Channel No. 3	PT-536	S/G 23 Pressure	700-1200 psig
Channel No. 4	FA-1097	Aux. Feed Flow to S/G 23	0-300 gpm
Channel No. 5	LT-547	S/G 24 Level	0-100%
Channel No. 6	PT-546	S/G 24 Pressure	700-1200 psig

8.3 Reactivity Computer Chart Recorders

8.3.1 Recorder #1 Channel A ρ-computer output
Channel B N-41 excore detector current

8.3.2 Recorder #2 Channel A Loop 21 T_c TE 413 B 510-610°F
Channel B Loop 21 T_h TE 413 A 510-610°F

8.3.3 Recorder #3 Channel A Loop 22 T_c TE 423 B 510-610°F
Channel B Loop 22 T_h TE 423 A 510-610°F

8.3.4 Recorder #4 Channel A Loop 23 T_c TE 433 B 510-610°F
Channel B Loop 23 T_h TE 433 A 510-610°F

8.3.5 Recorder #5 Channel A Loop 24 T_c TE 443 B 510-610°F
Channel B Loop 24 T_h TE 443 A 510-610°F

8.4 Copies of the reactivity computer trace and saturation meter recorder will be marked and attached as data.

8.5 P-250 trend typewriter data covering the duration of this test will be attached. (see Appendix A for data points)

8.6 P-250 computer printouts of the incore thermocouple maps taken during the performance of the test will be attached.

8.7 P-250 computer printouts of the single pass partial core maps used during the test for core power determination will be attached as data.

8.8 A record licensed operators participating and observing this test is documented on Appendix B.

8.9 Data acquisition steps need not be repeated for multiple test performances done for training proposes. Place NA on the initial lines for these steps. However, flux map and incore T/C map printouts shall be taken during training runs, and shall be marked as training runs. It is recommended that the test engineer leave all other data acquisition systems (e.g. reactivity computer recorder) operating during the training runs as well.

9.0 PRECAUTIONS

9.1 Observe the precautions, limitations, and special operator instructions given SUP 90.0, sections 9.3 and 10.3. (ref. 2.2)

9.2 When RCS pressure drops below P-11, (1915 psig) manually block SI or the reactor will trip when the setpoint (1765 psig) is reached. Also, close the PORV block valves.

9.3 When RCS temperature is reduced to maintain the saturation margin, maintain T_C above 531°F.

9.4 This test should be performed concurrently with SUP 90.3 (natural circulation with loss of pressurizer heaters) and they should be performed as few times as practical. This limitation is imposed because of the reduced saturation temperature margin experienced during these tests.

9.5 The Operator Action points of SUP 90.0, paragraph 9.1.4.1 are maintained throughout the test.

10.0 INSTRUCTIONS

___ 10.1 Secure the pressurizer back-up heater groups 21 and 22 by pressing the MAN pushbuttons and OFF pushbuttons on their respective bezels at the main control console.

___ 10.2 Start the P-250 T/W trend printing the points specified in Appendix A.

___ 10.3 Start the Brush recorders on high speed (125 mm/min.)

___ 10.4 Turn off the pressurizer heater control group, by depressing the OFF pushbutton on its bezel at the main control console.

___ 10.5 Stop all four reactor coolant pumps simultaneously.

___ 10.6 Verify Natural Circulation is established.

NOTE: Expected plant response is as follows:

Wide range T_H - increase to approximate 590°F
Wide range T_C - approximately constant
Incore T/C's - increase to approximate 590°F
Pressurizer Level - increase to approximate 35%
Natural Circulation will be stable when:

Incore thermocouples and loop wide range T_H are stable and approximately equal.

ΔT between wide range T_H and T_C is constant

Steam Generator levels are steady or varying slowly with constant feed.

___ 10.7 Maintain pressurizer level approximately constant after equilibrium conditions are reached by adjusting charging flow to match letdown and seal leak off.

NOTE: Maintain RCP Seal Injection flow per operating instruction OI II-1.3.1 "RCP Operation".

___ 10.8 Once equilibrium is established adjust Brush Chart Recorder speeds as directed by the Test Engineer.

___ 10.9 Obtain incore T/C map and determine power using one pass flux map.

NOTE

If branching from SUP 90.1 on continued natural circulation, steps 10.1 and 10.3 above must be performed at this point to continue the test.

NOTE: If desired, depressurization rate can be increased using auxiliary spray. However, if this test is being run concurrently with SUP 90.3, do not use auxiliary spray, as this would disturb that SUP's performance.

___ 10.10 Continue to monitor the incore T/C temperature and record the highest valid reading every two minutes in data sheet 1 from the digital trend also record the lowest pressurizer pressure reading from among the four pressure channels, from digital trend. Record the hottest wide range loop RTD temperature from the digital trend in data sheet 1.

NOTE: Block low pressure SI and close PORV block valve when pressure decreases to the P-11 setpoint (1915 psig)

NOTE: Use wide range pressure PI-405 if pressure is decreased below the range of the narrow range instrument (1700 psig)

___ 10.11 Use the steam tables to determine the saturation margin expressed in degrees Fahrenheit, and record in data sheet 1. Also record in the space provided the saturation margin as calculated by the P-250 at the time data is recorded for step 10.10. Tsat - Hi T/C = SAT Meter $\pm$ 3°F
Reading

___ 10.12 When the Test Engineer is satisfied that enough data has been obtained to meet the objective of this test, increase the saturation margin to 50°F using steam dump and/or charging flow.

NOTE: Do not exceed 70% pressurizer level.

___ 10.13 At this time, a preliminary evaluation of the accuracy of the saturation meter should be done to determine if the display is within 3% of the margin as calculated from steam tables. Reprogramming of the P-250 may be required if this criterion is not met.

___ 10.14 Restore RCS pressure to 2235 psig by energizing pressurizer backup heater groups. Place pressurizer pressure heater control group back to AUTO.

NOTE: Open the PORV block valve closed in step 10.10 above. Avoid overpressurizing, use auxiliary spray if necessary.

___ 10.15 Shutdown the reactor by inserting control bank D to zero steps (rod control in Bank D select).

___ 10.16 Restart all four reactor coolant pumps per OI 1.3.1, "RCP Operation" (reference 2.3.1) beginning with loop 23.

___ 10.17 Restore pressurizer level to approximately 22% and return pressurizer level control to automatic.

___ 10.18 Restore to normal the reactor protection system modified per prerequisit 3.5, 3.6, and 3.7 unless further testing is required. In this case, N/A the step and proceed establish initial conditions for the next test.

____ 10.19 Record the names of licensed operators (RO's and SRO's) participating in or observing the test in Appendix B, as appropriate.

____ 10.20 Retrieve and attach recorder traces, P-250 printouts per paragraph 8.2-8.8 (see also para. 8.8)

11.0 TEST COMPLETION

11.1 Comments

11.2 Changes to SPM

11.3 Signature

Test Engineer	Date
Senior Shift Supervisor/Shift Supervisor	Date
Quality Assurance	Date
Shift Technical Advisor	Date

Date

T/C

DATA SHEET 1

TIME	Hi W.R RTD	Hi T/C	LO PRESS	MARGIN (per steam tables)	MARGIN (per SAT. meter)

APPENDIX A

P-250 Digital Trend Parameters

Parameter	Computer Point
Pressurizer Pressure Channel 1	P0480A
Pressurizer Level Channel 1	L0480A
RCS Loop 21 Hot Leg Temperature	T0419A
RCS Loop 21 Cold Leg Temperature	T0406A
RCS Loop 22 Hot Leg Temperature	T0439A
RCS Loop 22 Cold Leg Temperature	T0426A
RCS Loop 23 Hot Leg Temperature	T0459A
RCS Loop 23 Cold Leg Temperature	T0446A
RCS Loop 24 Hot Leg Temperature	T0479A
RCS Loop 24 Cold Leg Temperature	T0466A
Steam Generator 21 Pressure	P0400A
Steam Generator 21 Narrow Range Level	L0400A
Steam Generator 22 Pressure	P0420A
Steam Generator 22 Narrow Range Level	L0420A
Steam Generator 23 Pressure	P0440A
Steam Generator 23 Narrow Range Level	L0440A
Steam Generator 24 Pressure	P0460A
Steam Generator 24 Narrow Range Level	L0460A
Power Range Channel 1 (Quadrant 1)	N0049A
Power Range Channel 2 (Quadrant 2)	N0050A
Power Range Channel 3 (Quadrant 3)	N0051A
Power Range Channel 4 (Quadrant 4)	N0052A
Hottest Incore Thermocouple	U0090A
Pressurizer Surge Line Temperature	T0482A
Pressurizer Pressure Channel II	
Pressurizer Pressure Channel III	
Calculated Margin to Saturation Conditions	

NOTE: At the discretion of the Test Engineer, a redundant computer point may be substituted where available.

APPENDIX B

SRO's Participating In Test

SRO's Observing Test

APPENDIX B

(cont.)

RO's Participating In Test

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

RO's Observing Test

_____	_____
_____	_____
_____	_____
_____	_____
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_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

QA Review _____