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Sequoyah Nuclear Plant

SPECIAL TEST NO. 4

EFFECT OF STEAM GENERATOR SECONDARY SIDE ISOLATION ON NATURAL CIRCULATION

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Rev. No.	Date	Revised Pages	Rev. No.	Date	Revised Pages
0	5/6/80	All			

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SPECIAL TEST NO. 4

EFFECT OF STEAM GENERATOR SECONDARY

SIDE ISOLATION ON NATURAL CIRCULATION

EFFECT OF STEAM GENERATOR SECONDARY SIDE ISOLATION ON NATURAL CIRCULATION

Table of Contents

TEST DESCRIPTION

With natural circulation established at ~ 1% rated thermal power and reduced reactor coolant temperature, steam generators will be isolated sequentially to determine the effect on natural circulation conditions. Isolation of up to 2 steam generators will be tested if limitations permit. Steam generators will then be sequentially returned to service to verify that natural circulation can be reestablished.

SPECIAL OPERATOR INSTRUCTION

*An operator initiated safety injection should be performed only for one or more of the following conditions:

Reactor Coolant System Subcooling	≦ 10°
Sudden Unexplained Decrease in Pressurizer Level of or to an Indicated Level of	10% ≦ 10%
Sudden Unexplained Decrease in Any S/G Level to	≦ 76% Wide Range ≦ 0% Narrow Range
Unexplained Pressurizer Pressure Drop	≧ 200 PSI
Containment Pressure Hi - (1.54 psig)	Annunciator XA-55-6B Window 6 initiates

An operator initiated reactor trip should be performed for any of the following conditions:

Reactor Coolant System Subcooling	≦ 15°
Sudden Unexplained Decrease in Pressurizer Level of or to an Indicated Level of	 5% ≦ 17%
1/3 Excores	≧ 10%
Any Loop Δ T	> 65°F
Tavg	> 578°F
Core Exit Temperature (Highest)	> 610°F
Any Uncontrolled Rod Movement	

*SI termination should be in accordance with plant EMERGENCY OPERATING PROCEDURES.

1.0 OBJECTIVES

1.1 Determine the effect of steam generator isolation on natural circulation conditions.

1.2 Verify that natural circulation can provide sufficient flow to remove decay heat after partial loss of heat sink.

1.3 Verify that natural circulation can be reestablished in primary loops after steam generators are returned to service.

1.4 To provide operator training. All operating shifts will perform this test.

2.0 PREREQUISITES

2.1 Reactor is critical and manually controlled at approximately 1% power. (Power level determined as indicated in Appendix C).

_____ /

2.2 All four reactor coolant pumps in operation.

_____ /

2.3 Reactor coolant system pressure is being maintained automatically at approximately 2000 psig (PIC-68-340A setpoint = 37.5%) and average coolant temperature is being maintained at approximately 515°F.

_____ /

2.4 Steam generator pressure is being maintained at approximately 763 psig using steam dumps in automatic under pressure control.

_____ /

2.5 Feedwater to the steam generators will be supplied by the auxiliary feedwater system with flow control in auto. Steam generator levels should be maintained at approximately 33% on narrow range indicators.

_____ /

2.6 Steam generator chemistry is in a condition that the absolute minimum steam generator blowdown can be maintained through the test.

_____ /

2.7 The 100 psi steamline differential pressure safety injection bistables have been blocked through temporary conditions as specified in Appendix E.

_____ /

2.8 Verify the automatic actuation of safety injection has been blocked in accordance with Appendix E.

_____ /

2.9 Verify the input logic of safety injection on high steam line ΔP has been blocked in accordance with Appendix E.

_____ /

2.0 (Continued)

2.10 Verify the high steam flow coincident with low S/G pressure or low-low T_{avg} input to safety injection has been modified in accordance with Appendix E.

_____ /

2.11 Verify the following UHI isolation valves are gagged.

FCV - 87-21 _____ /

FCV - 87-22 _____ /

FCV - 87-23 _____ /

FCV - 87-24 _____ /

2.12 Verify the bistables supplying the low pressure signal to the high steam flow S.I. logic have been recalibrated in accordance with Appendix E.

_____ /

NOTE: This allows cooling down to 450°F without getting a reactor trip.

2.13 Brush recorders have been set up to monitor test points at the following locations:

2.13.1 Recorder No. 1 (6 Channel)

Channel	Parameter	Test Point	Rack
1	RCS Flow-Loop 1	FP/414B	1-R-1
2	RCS Flow-Loop 2	FP/424B	1-R-1
3	RCS Flow-Loop 3	FP/434B	1-R-1
4	RCS Flow-Loop 4	FP/444B	1-R-1
5	Pressurizer Pressure	PP/455B	1-R-1
6	Pressurizer Level	LP/459B	1-R-1

2.13.2 Recorder No. 2 (6 Channel)

Channel	Parameter	Test Point	Rack
1	SG 1 Pressure	PP/416B	1-R-3
2	SG 1 Level	LP/501	1-R-23
3	SG 1 Steam Flow	FP/512B	1-R-3
4	SG 2 Pressure	PP/426B	1-R-3
5	SG 2 Level	LP/502	1-R-23
6	SG 2 Steam Flow	FP/522B	1-R-3

2.0 (Continued)

2.13.3 Recorder No. 3 (6 Channel)

Channel	Parameter	Test Point	Rack
1	SG 3 Pressure	PP/436B	1-R-4
2	SG 3 Level	LP/503	1-R-23
3	SG 3 Steam Flow	FP/532B	1-R-4
4	SG 4 Pressure	PP/446B	1-R-4
5	SG 4 Level	LP/504	1-R-23
6	SG 4 Steam Flow	FP/542B	1-R-4

2.13.4 Recorder No. 4 (4 Channel)

Channel	Parameter	Test Point	Rack
1	SG 1 Aux Feed Flow	L-3-163, TP 13	1-L-11B
2	SG 2 Aux Feed Flow	L-3-155, TP 13	1-L-11A
3	SG 3 Aux Feed Flow	L-3-147, TP 12	1-L-11B
4	SG 4 Aux Feed Flow	L-3-170, TP 12	1-L-11A

/

NOTE: Record the following on all strip charts:

a) Unit No.
b) Date
c) Procedure No.
d) Parameter scale and range
e) Chart speed
f) Name of person recording data
g) Recorder I.D. No.

2.14 Record the following parameters on the reactivity computer recorders.

a. Flux
b. Average wide range Tcold
c. Average wide range Thot
d. Average steam generator pressure
e. Reactivity

/

2.0 (Continued)

2.15 Set up the P-250 computer trend printer to monitor the following parameters at 1-minute intervals, as specified in Appendix D.

a. Pressurizer pressure
b. Pressurizer level
c. Wide range Tcold (all loops)
d. Wide range Thot (all loops)
e. Steam generator pressure (all loops)
f. Steam generator level (all loops)
g. Power range channels
h. Additional parameters as determined by the test engineer

_____ / _____

2.16 Trend 4 incore thermocouples as determined by the test engineer on the analog trend recorders in the main control room. It is suggested that these thermocouples be the hottest responding thermocouple in each core quadrant.

_____ / _____

2.17 Control Bank D is at approximately 160 steps or as specified by the test engineer to permit reactor power increase up to approximately 1% (required control bank D position may be determined during the hot zero power test program).

_____ / _____

2.18 Pressurizer level control is in automatic, maintaining pressurizer level at approximately 25%.

_____ / _____

2.19 Normal charging and letdown are in service under automatic control.

_____ / _____

2.20 A determination of the sensitivity of the NIS to changes in T_{cold} has been completed. (Special Test 9A.)

_____ / _____

2.21 Intermediate and power range (low setpoint) high level reactor trip setpoints have been set to 7% in accordance with Appendix C and D of SU-8.5.2.

Power Range _____ / _____

Intermediate Range _____ / _____

3.0 PRECAUTIONS

3.1 Do not exceed 5% rated thermal power at any time while the test is in progress.

3.2 Abort test if any of the following temperature limits are exceeded.

3.2.1 Core exit temperature of 610°F

3.2.2 ΔT as indicated by $T_H - T_C$ of 65°F

3.2.3 T_{avg} of 578°F for any loop

3.3 Maintain reactor coolant pump seal and thermal barrier differential pressure requirements as specified in SOI-68.2.

3.4 Avoid any sudden changes in feedwater flow or steam generator level.

3.5 Ensure seal flow to each reactor coolant pump is maintained at or slightly above 4 gpm during the test.

3.6 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 temperature indications respectively.

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

3.8 Maintain reactor coolant system cold leg temperatures as stable as possible during system transients. This is required to determine changes in core power level on the NIS channels.

3.9 When testing with the reactor coolant in the low temperature range of 450°F to 500°F, maintain the lithic concentration at 2.0 to 2.2 ppm, the upper part of the specified lithic range. This is especially necessary if high boric acid concentrations (~ 1000 ppm) are also being used.

3.10 Ensure control bank D position remains at $\geq$ 100 steps. Should this limit be reached during the cooldown, boron concentration will have to be increased.

3.11 Ensure auxiliary spray is in service prior to tripping the reactor coolant pumps. Spray flow to the pressurizer can be controlled by adjusting charging flow, closing the normal charging path, or opening the normal spray valves after the RCP's are tripped.

3.12 Should a reactor trip occur during the conduct of this test, at least one reactor coolant pump (#2) should be started prior to closing the reactor trip breaker.

4.0 Special Test Equipment

Instrument	Specification	Identification Number	Calibration Verification
Reactivity Computer	Westinghouse		
Brush 260 Recorders (3)	Brush 260 or Equivalent		
Brush 400 Recorder (1)	Brush 400 or Equivalent		
Recorder (1)	HP7100B or Equivalent		

If test instruments are changed during this test, the instrument information must be recorded here and an entry made in the chronological log book explaining this change.

5.0 INSTRUCTIONS

5.1 Start brush recorders, analog trend recorders, reactivity computer and P-250 trend blocks.

_____ /

5.1.1 Establish auxiliary spray flow to the pressurizer.

_____ /

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

5.2 Simultaneously trip all reactor coolant pumps. Reduce seal water flow to each pump to approximately 4 gpm.

_____ /

5.3 Maintain steam generator level at approximately 33%.

_____ /

NOTE: At initiation of natural circulation the following initial response is expected:

1. Wide range T_{hot}, increase
2. Wide range T_{cold}, slight increase or constant
3. Core exit thermocouples, increase
4. Pressurizer level, increase

Natural circulation will be stable when:

1. ΔT between wide range T_{hot} and T_{cold} is constant
2. ΔT between wide range T_{cold} and core exit thermocouple average temperature is constant
3. Wide range $T_{hot} \cong$ core exit thermocouple average temperature (See Table 1)

5.4 Adjust setpoint on steam dump pressure controller PIC-1-33 as needed to maintain cold leg temperatures at the initial values.

_____ /

5.5 Adjust setpoints on atmospheric relief valve pressure controllers for each loop to maintain steam pressure below 1025 psig before isolating any steam generators. This should prevent opening of main steam safety valves.

_____ /

5.0 (Continued)

5.5.1 Establish maximum maintainable flow through normal letdown path, and manually increase charging flow to maintain a constant RCS water mass. Start an additional centrifugal charging pump if necessary. (Maintain pressurizer level ~ constant after equilibrium has been reached on natural circulation).

_____ /

CAUTION: Monitor primary to secondary differential pressure very closely during the transient and do not allow it to exceed 1500 psi.

NOTE: Allow the pressurizer level to increase when T_{avg} is increased. (Expected increase is approximately 1% per °F increase in T_{avg}).

5.6 Close MSIV FCV-1-22. Isolate feedwater flow and steam generator blowdown (if in service) for steam generator #3. Carefully control feedwater additions to the remaining steam generators to hold the levels at approximately 33%. It may be necessary to adjust the steam dump pressure controller setpoint to reduce T_{cold} in the unisolated loops so that the steam generator pressure in the isolated loop remains below the setpoint of the atmospheric relief valve.

_____ /

NOTE: During this transient the following responses can be expected.

1. Wide range T_{hot}, increase
2. Wide range T_{cold} for Loop 3, increase
3. Wide range T_{cold} for other loops, held constant using steam dump
4. Core exit thermocouples, increase (See Table 1)
5. Pressurizer pressure and level, increase

5.7 Allow natural circulation conditions to stabilize. Steady state should be achieved when the calculated loop 3 ΔT is approximately zero.

_____ /

5.8 Verify that the calculated value for Tavg for the remaining 3 loops has stabilized. If Tavg continues to increase and cannot be stabilized the test director should determine whether further testing can be conducted.

_____ /

5.0 (Continued)

NOTE: Verify T_{avg} is stable prior to conducting the next step.

CAUTION: Monitor primary to secondary pressure very closely during the transient and do not allow it to exceed 1600 psi.

5.9 Close MSIV FCV-1-29. Isolate feedwater flow and steam generator blowdown (if in service) for steam generator #4. Carefully control feedwater additions to the remaining steam generators to hold the levels at approximately 33%. It may be necessary to adjust the steam dump pressure controller setpoint to reduce T_{cold} in the unisolated loops so that the steam generator pressure in the isolated loops remain below the setpoint of the atmospheric relief valves.

_____/_____

NOTE: During this transient, the following responses can be expected:

1. Wide range Thot, increase
2. Wide range Tcold for loops 3 and 4, increase
3. Wide range Tcold for loops 1 and 2, held constant using steam dump
4. Core exit thermocouples, increase

5.10 Allow natural circulation conditions to stabilize. Steady state should be achieved when the calculated loop 4 ΔT is approximately zero.

_____/_____

5.11 Verify that the calculated value for Tavg for the remaining 2 loops has stabilized. If Tavg continues to increase and cannot be stabilized, the test director should determine whether further testing can be conducted.

_____/_____

CAUTION: Monitor primary to secondary pressure very closely during the transient and do not allow it to exceed 1600 psi. If equilibrium has not been reached within one-half hour proceed immediately to the next step.

5.12 Slowly reduce the setpoint on atmospheric relief valve controller PIC 1-31A and allow steam generator #4 pressure to reach approximate equilibrium with steam header pressure. Restore feedwater slowly to maintain ~ 33% level.

_____/_____

5.0 (Continued)

5.13 Open first FCV-1-150 and then MSIV FCV-1-29 and close atmospheric relief valve PCV-1-30. Carefully control feedwater addition to steam generators 1, 2, and 4 to maintain steam generator levels at approximately 33%.

_____ /

NOTE: During the transient, the following responses can be expected.

1. Wide range T_{hot}, decreases
2. Wide range T_{cold} for Loop 4, decrease
3. Wide range T_{cold} for Loop 3, no change
4. Wide range T_{cold} for Loops 1 and 2, increase by using steam dump

5.14 Allow natural circulation to stabilize. Steady state should be achieved when the calculated loop ΔT's for loops 1, 2, and 4 are approximately equal.

_____ /

5.15 Slowly reduce the setpoint on atmospheric relief valve controller PIC-1-24A and reduce steam dump to condenser, allowing steam generator #3 to reach approximate equilibrium with steam header pressure of 1005 psig. Restore feedwater slowly to maintain ~ 33% level.

_____ /

5.16 Open first FCV-1-149 and then MSIV FCV-1-22 and close atmospheric relief valve PCV-1-23.

_____ /

NOTE: During the transient the following responses can be expected.

1. Wide range T_{hot}, decrease
2. Wide range T_{cold} for loop 3, decrease
3. Wide range T_{cold} for loops, 1, 2, and 4, Increase using steam dump

5.17 Allow natural circulation conditions to stabilize. Steady state should be achieved when the calculated loop ΔT's are approximately equal.

_____ /

5.18 Stop recording test data.

_____ /

5.0 (Continued)

5.19 Insert control bank D until the reactor is in the hot zero power test range.

_____ /

CAUTION: Ensure pressurizer spray controllers are at zero output prior to starting the first reactor coolant pump.

5.20 Restart all four reactor coolant pumps in accordance with SOI-68.2 starting with #2 then 1, 3, and 4.

_____ /

5.21 Return control of the system to operations.

_____ /

5.22 Return the bistables supplying the low pressure signal to the high steam flow S.I. logic to their original setpoints in accordance with Appendix E unless the next test 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.

_____ /

5.23 Restore the high steam flow coincident with low S/G pressure or low-low T_{avg} input to safety injection in accordance with Appendix E unless the next test 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.

_____ /

5.24 Remove the block of the input logic of safety injection on high steam line ΔP in accordance with Appendix E unless the next test to be performed requires the block to be intalled. If this is the case, disregard this step, place N/A in the signature line, and initial.

_____ /

5.25 Remove the block of automatic actuation of safety injection in accordance with Appendix E unless the next test to be performed requires the block to be installed. If this is the case, disregard this step, place N/A in the signature line, and initial.

_____ /

5.0 (Continued)

5.26 Remove the gags from the following UHI isolation valves unless the valves are required to be gagged for the next test. If this is the case, disregard this step, place N/A in the signature line, and initial.

FCV - 87-21	_____ / _____
FCV - 87-22	_____ / _____
FCV - 87-23	_____ / _____
FCV - 87-24	_____ / _____

5.27 Reset the intermediate and power range high level reactor trip setpoints as indicated by the test director in accordance with Appendix C and D of SU-8.5.2 unless the next test to be performed requires this adjustment. If this is the case, disregard this step, place N/A in the signature line, and initial.

Power Range	_____ / _____
Intermediate Range	_____ / _____

6.0 ACCEPTANCE CRITERIA

6.1 Core exit thermocouple temperature does not exceed 610 degrees Fahrenheit.

_____ /

6.2 ΔT for any loop does not exceed 65 degrees Fahrenheit.

_____ /

6.3 T_{avg} for any loop does not exceed 578 degrees Fahrenheit.

_____ /

6.4 Sufficient natural circulation could be maintained in active primary loops to maintain stable temperatures following partial loss of heat sink.

_____ /

6.5 Natural circulation could be restored to inactive loops when associated steam generators were returned to service.

_____ /

APPENDIX A

References

1. FSAR
2. Technical Specifications
3. Plant Operating Instructions SOI 68.2
   EOI 5

APPENDIX B

Test Deficiencies # _____

Test Deficiency

Recommended Resolution

Final Resolution

Originator _____ / _____
Signature Date

PORC Review of Final Resolution _____
Date

Approval of Final Resolution _____ / _____
Plant Superintendent Date

APPENDIX C

Procedure for Determining Core Power Level

APPENDIX C (Continued)

Outline

I. Core Power Determination

A. Primary Side Calorimetric (Forced Circulation Only)

1. Reference (~ 550°F) Calorimetric (Before NC test)

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 percent 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 5 or 6 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 C

CORE POWER DETERMINATION

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

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

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

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

APPENDIX C (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 as per TI-53. Select flux thimbles as per the table below for the flux map.

Drive	10-Path Position	Core Location
A	10	L-5
B	10	L-11
C	10	E-5
D	10	E-11
E	6	J-8
F	8	P-9

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 second flux trace.

   d) Determine the detector normalization constants from Data Sheet C.2.

APPENDIX C (Continued)

Core Power Determination

PART B: (Continued)

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

Drive	P-250 Address
A	K0908
B	K0909
C	K0910
D	K0911
E	K0912
F	K0913

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
K5525	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 B 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.

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

APPENDIX C (Continued)

PART B: (Continued)

4. For power determination, obtain a partial core flux map as per TI-53. 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.

TABLE C-1

Temp ^{o}F	C_p (1) BTU/lbm ^{o}F	m^{o} 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	3.7348×10^7
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.

APPENDIX C (Continued)

Data Sheet C.1

Date _____ Time _____ Unit _____ Power _____ Tavg _____ ^{o}F

Item #	Calculation Procedure	Units	Loop 1 R2/TP-411J	Loop 2 R6/TP-421J	Loop 3 R10/RP-431J	Loop 4 R13/RP-441J
1	Loop ΔT - Inservice (at test point)	Volts				
2	Loop ΔT = (#1) x (1)	^{o}F				
3	Loop ΔH = (#2) x Cp (from Table C.1)	BTU/lbm				
4	Loop RCS Flow (from Table C.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 + Loop 4	10^{6} BTU/hr				
7	Reactor Power = (#6) x 0.29307	MWT				
8	% Reactor Power = (#7) x 0.02932	%				

(1) Conversion factor for ΔT obtained from scaling document.

Remarks:

Date By: _____

Checked By: _____

APPENDIX C (Continued)

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

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

$N_A = 1.00$

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

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

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

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

$$N_F = \frac{A_N}{F_N} = \frac{N_E E_E}{F_N} = \text{_____}$$

Definitions:

A_N, B_N, C_N, D_N, E_N, F_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, F_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, N_F = Detector normalization factor for each detector

Remarks:

Data By: _____ Date _____

APPENDIX C (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 Thermcouple Averaging Program at 1, 2, ... X 8 seconds or 64 seconds for us.

The thermcouple 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:

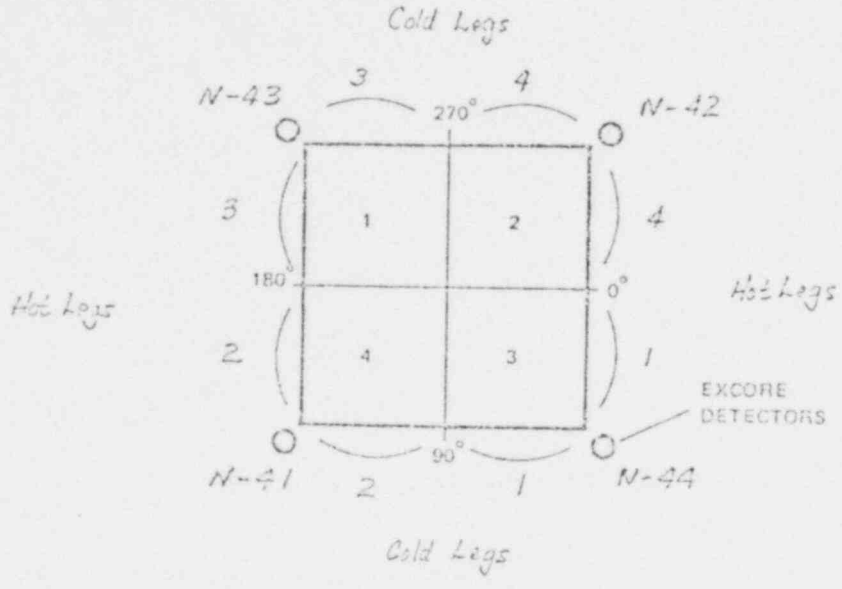
Quadrant	Addressable Value
1	U1159
2	U1160
3	U1161
4	U1162
5	U1151
6	U1152
7	U1153
8	U1154

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.

APPENDIX C (Continued)

CENTER LINE QUARTER-CORE SYMMETRY



DIAGONAL QUARTER-CORE SYMMETRY

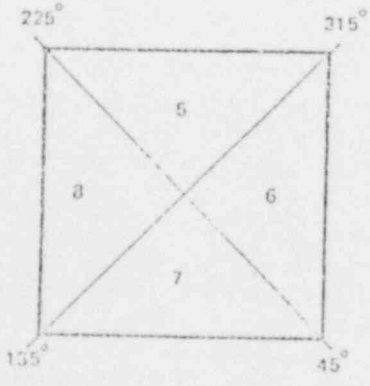


Figure C-1

APPENDIX D

Procedure For Use Of Computer System For Data Collection

The following parameters will be monitored during this test using the plant computer system.

Parameter	Computer Point
Pressurizer Pressure	P0480A
Pressurizer Level	L0480A
RCS Loop 1 Hot Leg Temperature	T0419A
RCS Loop 1 Cold Leg Temperature	T0406A
RCS Loop 2 Hot Leg Temperature	T0439A
RCS Loop 2 Cold Leg Temperature	T0426A
RCS Loop 3 Hot Leg Temperature	T0459A
RCS Loop 3 Cold Leg Temperature	T0446A
RCS Loop 4 Hot Leg Temperature	T0479A
RCS Loop 4 Cold Leg Temperature	T0466A
Steam Generator 1 Pressure	P0400A
Steam Generator 1 Narrow Range Level	L0400A
Steam Generator 2 Pressure	P0420A
Steam Generator 2 Narrow Range Level	L0420A
Steam Generator 3 Pressure	P0440A
Steam Generator 3 Narrow Range Level	L0440A
Steam Generator 4 Pressure	P0460A
Steam Generator 4 Narrow Range Level	L0460A
Power Range Channel 1 (Quadrant 4)	N0049A
Power Range Channel 2 (Quadrant 2)	N0050A
Power Range Channel 3 (Quadrant 1)	N0051A
Power Range Channel 4 (Quadrant 3)	N0052A
Incore Thermocouples	T0001A through T0065A

APPENDIX D (Continued)

The computer trend typewriter will be used to monitor the following computer points. (Additional points may be added as required by the test director).

BLOCK 1

Column	Point	Column	Point	Column	Point
1	P0480A	7	T0459A	13	P0420A
2	L0480A	8	T0446A	14	L0420A
3	T0419A	9	T0479A	15	P0440A
4	T0406A	10	T0466A	16	L0440A
5	T0439A	11	P0400A	17	P0460A
6	T0426A	12	L0400A	18	L0460A

BLOCK 2

Column	Point	Column	Point
1	N0049A	7	T0017A
2	N0050A	8	T0043A
3	N0051A	9	T0059A
4	N0052A	10-13	Hottest T/C from each core Quadrant
5	T0002A	14-18	As Required
6	T0013A		

To initially clear each data block perform the following step for each block to be used.

1. Push DIGITAL TREND button
2. Select block number (1 to 6) on keyboard
3. Push VALUE 1 button
4. Select 0 on keyboard
5. Push VALUE 2 button
6. Push STOP button

Repeat the above 6 steps for each data block to be used.

NOTE: A Block Trend Error message will occur if the data block is initially clear.

APPENDIX D (Continued)

To set up the data blocks, perform the following series of steps for each point to be monitored.

1. Push the DIGITAL TREND button
2. Select the point address (i.e. P0480A) on the alphanumeric keyboard
3. Push ADDRESS button
4. Select block number (1 to 6) on keyboard.
5. Push VALUE 1 button
6. Select column number (1 to 18) on keyboard
7. Push VALUE 2 button
8. Push START button

Once the blocks are set up they can be initiated by performing the following steps for each block.

1. Push DIGITAL TREND button.
2. Select block number (1 to 6) on keyboard
3. Push VALUE 1 button
4. Select internal number 0 = 30 sec., 1 = 1 minute, 2 = 2 minute, etc.) The 30-second interval is recommended for the duration of the test transient
5. Push VALUE 3 button
6. Push START button

If it is necessary to change the trend interval of a block or trend, perform the following.

1. Push DIGITAL TREND button
2. Select block number (1 to 6) on keyboard
3. Push VALUE 1 button
4. Select new interval number (0 = 30 sec., 1 = 1 min., 2 = 2 min., etc) on keyboard
5. Push VALUE 3 button
6. Push START button

To stop trending or block perform the following:

1. Push DIGITAL TREND button
2. Select block number (1 to 6) on keyboard
3. Push VALUE 1 button
4. Select C on keyboard
5. Push VALUE 3 button
6. Push STOP button

In addition to the data recorded on the trend typewriter, the following points will be monitored on analog trend recorded.

T0056A (Core exit temp).
Others as needed (Recommend pressurizer pressure, steam generator level (WR) and steam generator pressure).

APPENDIX D (Continued)

After selecting the per to be used to record a value, ensure that it is cleared by performing the following steps.

1. Push ANALOG TREND function button
2. Select per number (1 to 12) on keyboard
3. Push VALUE 1 button
4. Push STOP button

To start an analog trend perform the following steps.

1. Push ANALOG TREND function button
2. Select the computer point address (i.e. T0043A) on the alphanumeric keyboard
3. Push ADDRESS button
4. Select per number (1 to 12) on keyboard
5. Push VALUE 1 button
6. Select per position on keyboard. This is the minimum value of the parameter to be monitored
7. Select range on the keyboard
8. Push VALUE 3 button
9. Push START button

Repeat these steps until all of the desired analog points are being recorded.

Prior to initiation of the transient, and required thereafter, incore thermocouple maps will be recorded at the programmers console in the computer room. To initiate an incore thermocouple map at that location, perform the following steps.

1. Push IN-CORE T/C MAP function button
2. Select 25 on keyboard for short-form current map
3. Push VALUE 1 button
4. Select output device code number 20 for programmers console on keyboard.
5. Push VALUE 2 button
6. Select 1 on keyboard for a short-form map
7. Push VALUE 3 button
8. Push START button

APPENDIX E

Safeguard Blocking Procedure

The first step blocks automatic initiation of a safety injection. The safety injection alarm, manual S.I handswitch, and the reactor trip portion of the protection logic will remain in operation. If conditions exist that would normally initiate a safety injection; (1) the safety injection alarm will initiate telling the operator that the condition exists and what the problem is. (2) a reactor trip will take place automatically. (3) a safety injection can be initiated manually from the switch in the control room if conditions warrant.

1. Install temporary jumpers and temporary alteration control tags to logic cards A216, test point 1, to the logic ground on the logic test panels in R-47 and R-50.

   NOTE: These jumpers will be specially made for this purpose and installed by an instrument mechanic.

   R-47 Panel Performed by: _____ / _____

   Verified by: _____ / _____

   R-50 Panel Performed by: _____ / _____

   Verified by: _____ / _____

Procedure for blocking automatic actuation of a safety injection on high steamline Delta-P. This block will prevent a reactor trip from occuring during the natural circulation tests from high ΔP caused by degraded test conditions. (This block will also defeat all ΔP S.I. alarms.)

2. Verify status lights 1-XX-55-6B/1, 2, 3, 4, 25, 26, 27, 28, 50, 51, 73, 76 are all clear prior to starting blocking procedure.

3. Move test trip switch PS-515A in 1-R-7 to the trip position and verify the amber light above the switch comes on.

   Performed by: _____ / _____

   Verified by: _____ / _____

CAUTION: In the next step, and all following steps in which a voltage is being applied to the indicated terminals, ensure the applied voltage is of the same polarity as the terminals. This check should be done for every step that a voltage source is applied. Failure to apply the correct polarity will ground the rack power supply. (This problem can be avoided if only the hot wire from the voltage source in the rack is applied to the first terminal indicated in each step [the lower numbered terminal]. The

APPENDIX E

ground will already be made up through the trip switch). The wire on the rack side of the terminal block must be lifted and taped for the terminal point where the jumper wire is connected. The TACF tag will be attached to the bistable switch and the TACF must note the jumper and the lifted wire.

NOTE: Orange "out of service" stickers should be placed on all status/ alarm windows as the 120V source is connected.

4. Lift and tape the wire on the rack side of terminal L-9 in the rear of 1-R-7. Apply a 120-VAC source to terminals L-9 and L-10 and verify 1-XX-55-6B/25 is clear.

Performed by: _____ / _____

Verified by: _____ / _____

5. Move test trip switch PS-515B in 1-R-7 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ / _____

Verified by: _____ / _____

6. Lift and tape the wire on the rack side of terminal L-7 in the rear of 1-R-7. Apply a 120-VAC source to terminals L-7 and L-8 and verify 1-XX-55-6B/27 is clear.

Performed by: _____ / _____

Verified by: _____ / _____

7. Move test trip switch PS-516C in 1-R-12 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ / _____

Verified by: _____ / _____

8. Lift and tape the wire on the rack side of terminal L-5 in the rear of 1-R-12. Apply 120-VAC source to terminals L-5 and L-6 and verify 1-XX-55-6B/73 is clear.

Performed by: _____ / _____

Verified by: _____ / _____

APPENDIX E

9. Move test trip switch PS-516D in 1-R-12 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

10. Lift and tape the wire on the rack side of terminal L-7 in the rear of 1-R-12. Apply 120-VAC source to terminals L-7 and L-8 and verify 1-XX-55-6B/76.

Performed by: _____ /_____

Verified by: _____ /_____

11. Move test trip switch PS-525B in 1-R-8 to trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

12. Lift and tape the wire on the rack side of terminal L-7 in the rear of 1-R-8. Apply 120-VAC source to terminals L-7 and L-8 and verify 1-XX-55-6B/28 is clear.

Performed by: _____ /_____

Verified by: _____ /_____

13. Move test trip switch PS-525A in 1-R-8 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

14. Lift and tape the wire on the rack side of terminal L-9 in the rear of 1-R-8. Apply 120-VAC source to terminals L-9 and L-10 in the rear of 1-R-8 and verify that XX-55-6B/26 is clear.

Performed by: _____ /_____

Verified by: _____ /_____

APPENDIX E

15. Move test trip switch PS-526D in 1-R-11 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

16. Lift and tape the wire on the rack side of terminal L-7 in the rear of 1-R-11. Apply 120-VAC source to terminals L-7 and L-8 in the rear of 1-R-11 and verify that XX-55-6B/51 is clear.

Performed by: _____ /_____

Verified by: _____ /_____

17. Move test trip switch PS-526C in 1-R-11 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

18. Lift and tape the wire on the rack side of terminal L-5 in the rear of 1-R-11. Apply a 120-VAC source to terminals L-5 and L-6 and verify 1-XX-55-6B/50 is clear.

Performed by: _____ /_____

Verified by: _____ /_____

Temporary Modification to High Steam Flow Coincident with Low S.G. Pressure or Low-Low T_{avg} Safety Injection

19. Verify annunciators XA-55-6A/30 and XA-55-6A/31 are clear or can be cleared.

Performed by: _____ /_____

Verified by: _____ /_____

NOTE: If the alarms will not clear, do not proceed with this modification as a reactor trip may result. The input bistables should be checked and the source of the problem corrected.

APPENDIX E

20. Move test trip switch TS412D in R-2 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

21. Lift and tape the wire on the rack side of terminal M-3 in the rear of 1-R-2. Apply a 120-VAC source to terminals M-3 and M-4 and verify XA-55-6A/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

22. Move test trip switch TS-422D in R-6 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

23. Lift and tape the wire on the rack side of terminal M-3 in the rear of 1-R-6. Apply a 120-VAC source to terminals M-3 and M-4 and verify XA-55-6A/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

24. Move test trip switch TS432D in R-10 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

25. Lift and tape the wire on the rack side of terminal M-3 in the rear of 1-R-10. Apply a 120-VAC source to terminals M-3 and M-4 in R-10 and verify XA-55-6A/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

APPENDIX E

26. Move test trip switch TS-442D in R-13 to the trip position and verify the amber light above the switch comes on.

Performed by: _____ /_____

Verified by: _____ /_____

27. Lift and tape the wire on the rack side of terminal M-3 in the rear of 1-R-13. Apply a 120-VAC source to terminals M-3 and M-4 in R-13 and verify XA-55-6A/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

NOTE: The T_{avg} inputs to the high steam flow S.I and steam dump interlock are now blocked. The next steps will trip the steam flow inputs to the high steam flow Safety Injection signal so that an S.I. signal will be initiated on low steam generator pressure alone (600 psig). (This would result in a reactor trip, an S.I. alarm, but no S.I. initiation).

28. Move test trip switch FS512B in R-3 to the trip position and verify the amber light and annunciator XA-55-6B/2 come on.

Performed by: _____ /_____

Verified by: _____ /_____

29. Move test trip switch FS522B in R-3 to the trip position and verify the amber light and annunciator XA-55-6B/9 come on.

Performed by: _____ /_____

Verified by: _____ /_____

NOTE: These two trips will supply the 2 out of 4 logic required to get a Safety Injection Signal.

APPENDIX E

30. Apply Temporary Alteration Control Tags forms to all the above test trip switches to ensure that they remain in the trip position. Damage to the bistable could occur if the switch is moved back to the normal position. Record the temporary alteration numbers below:

RACK	TEST SWITCH	TEMP ALT. NO.
R-7	PS515A	_____/_____
R-7	PS515B	_____/_____
R-12	PS516C	_____/_____
R-12	PS516D	_____/_____
R-8	PS525B	_____/_____
R-8	PS525A	_____/_____
R-11	PS526D	_____/_____
R-11	RS526C	_____/_____
R-2	TS412D	_____/_____
R-6	TS422D	_____/_____
R-10	TS432D	_____/_____
R-13	TS442D	_____/_____
R-3	FS512B	_____/_____
R-3	FS522B	_____/_____

The following step reduces the setpoint of the S/G pressure input to S.I. to trip at 350 psig allowing T_{avg} to be reduced to 450°F.

31. Recalibrate the following bistables to the indicated setpoints and attach Temporary Alteration Control Tags.

Panel	Bistable	Setpoint
R-12	PS-1-5A (PB516A)	350 psig Decreasing (21.66 MA Loop Current)
	Performed by:	_____/_____
	Verified by:	_____/_____
R-11	PS-1-12A (PB526A)	350 psig Decreasing (21.66 MA Loop Current)
	Performed by:	_____/_____
	Verified by:	_____/_____

APPENDIX E

R-11 PS-1-23A (PB536A) 350 psig Decreasing
(21.66 MA Loop Current)

Performed by: _____ /_____

Verified by: _____ /_____

R-12 PS-1-30A (PB546A) 350 psig Decreasing
(21.66 MA Loop Current)

Performed by: _____ /_____

Verified by: _____ /_____

NOTE: When calibrating bistables, approach the setpoint very slowly to reduce the effect of the lead/lag module in the loop. Calibrate one loop at a time and have all loop bistables tripped while calibrating. The same individuals may only calibrate 2 of these instruments. The remaining 2 instruments must be calibrated by 2 other individuals.

To return the steamline Delta-P S.I. to normal condition, the following steps should be followed.

NOTE: The orange "out of service" stickers should be removed from the alarm/status window as each bistable is put back in service.

32. Remove the 120-VAC source from L-5 and L-6 in 1-R-11. Reterminate wire on L-5.

Performed by: _____ /_____

Verified by: _____ /_____

33. Move test trip switch PS-526C in 1-R-11 to the normal position and verify the amber light above the switch and 1-XX-55-6B/50 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

34. Remove the 120-VAC source from L-7 and L-8 in 1-R-11. Reterminate wire on L-7.

Performed by: _____ /_____

Verified by: _____ /_____

APPENDIX E

35. Move test trip switch PS-526D in 1-R-11 to the normal position and verify the amber light above the switch and 1-XX-55-6B/51 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

36. Remove the 120-VAC source from L-9 and L-10 in 1-R-8. Reterminate wire on L-9.

Performed by: _____ /_____

Verified by: _____ /_____

37. Move test trip switch PS-525A in 1-R-8 to the normal position and verify the amber light and 1-XX-55-6B/26 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

38. Remove the 120-VAC source from L-7 and L-8 in 1-R-8. Reterminate wire on L-7.

Performed by: _____ /_____

Verified by: _____ /_____

39. Move test trip switch PS-525B in 1-R-8 to the normal position and verify the amber light above the switch and 1-XX-5-6B/28 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

40. Remove the 120-VAC source from terminals L-7 and L-8 in 1-R-12. Reterminate wire on L-7.

Performed by: _____ /_____

Verified by: _____ /_____

41. Move test trip switch PS-516D in 1-R-12 to the normal position and verify the amber light above the switch and 1-XX-55-6B/76 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

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42. Remove the 120-VAC source from terminals L-5 and L-6 in 1-R-12. Retermi-nate wire on L-5.

Performed by: _____ /_____

Verified by: _____ /_____

43. Move test trip switch PS-516C in 1-R-12 to the normal position and verify the amber light above the switch and 1-XX-55-6B/73 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

44. Remove the 120-VAC source from terminals L-7 and L-8 in 1-R-7. Retermi-nate wire on L-7.

Performed by: _____ /_____

Verified by: _____ /_____

45. Move test trip switch PS-515B in 1-R-7 to the normal position and verify the amber light and 1-XX-55-6B/27 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

46. Remove the 120-VAC source from terminals L-9 and L-10 in 1-R-7. Retermi-nate wire on L-9.

Performed by: _____ /_____

Verified by: _____ /_____

47. Move test trip switch PS-515A to the normal position and verify the amber light above the switch and 1-XX-55-6B/25 are clear.

Performed by: _____ /_____

Verified by: _____ /_____

NOTE: At this point the steamline Delta-P safety injection is in a normal operating mode.

To return the high steam flow coincident with low steam generator pressure or low-low T_{avg} to normal, perform the following steps.

APPENDIX E

48. Move test trip switch FS522B in R-3 to the normal position and verify the amber light goes out and XA-55-6B/9 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

49. Move test trip switch FS512B in R-3 to the normal position and verify the amber light goes out and XA-55-6B/2 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

50. Remove the 120-VAC source from terminals M-3 and M-4 in R-13. Reterminate wire on M-3.

Performed by: _____ /_____

Verified by: _____ /_____

51. Move test trip switch TS442D in R-13 to the normal position and verify the amber light goes out and XA-55-6A/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

52. Remove the 120-VAC source from terminals M-3 and M-4 in R-10. Reterminate wire on M-3.

Performed by: _____ /_____

Verified by: _____ /_____

53. Move test trip switch TS432D in R 0 to the normal position and verify the amber light goes out and XA-55-oA/30 will clear.

Performed by: _____ /_____

Verified by: _____ /_____

54. Remove the 120-VAC source from terminals M-3 and M-4 in R-6. Reterminate wire on M-3.

Performed by: _____ /_____

Verified by: _____ /_____

APPENDIX E

55. Move test trip switch TS442D in R-6 to the normal position and verify the amber light goes out and XA-55-6A/30 will clear.

Performed by: _____ / _____

Verified by: _____ / _____

56. Remove the 120-VAC source from terminals M-3 and M-4 in R-2. Retermi-nate wire on M-3.

Performed by: _____ / _____

Verified by: _____ / _____

57. Move test trip switch TS412D in R-2 to the trip position and verify the amber light comes on and XA-55-6A/30 will clear.

Performed by: _____ / _____

Verified by: _____ / _____

58. Remove the Temporary Alteration Tage on the following test trip switches:

RACK	TEST SWITCH	TEMP ALT. NO.
R-7	PS515A	_____ / _____
R-7	PS515B	_____ / _____
R-12	PS516C	_____ / _____
R-12	PS516D	_____ / _____
R-8	PS525B	_____ / _____
R-8	PS525A	_____ / _____
R-11	PS526D	_____ / _____
R-11	RS526C	_____ / _____
R-2	TS412D	_____ / _____
R-6	TS422D	_____ / _____
R-10	TS432D	_____ / _____
R-13	TS442D	_____ / _____
R-3	FS512B	_____ / _____
R-3	FS522B	_____ / _____

APPENDIX E

59. Remove the jumpers and the Temporary Alteration Tags from logic cards A216, test point 1, to the logic ground on the logic test panels in R-47 and R-50.

R-47 Panel Performed by: _____ / _____
Verified by: _____ / _____

R-50 Panel Performed by: _____ / _____
Verified by: _____ / _____

The following step should be carried out to return the calibration of the S/G low pressure S.I. bistables to normal.

60. The following bistables should be returned to their normal setpoints indicated on the calibration card for the particular bistable. (30.0 ± .2MA) Remove the temporary alteration control tags after the recalibration.

NOTE: These calibrations require 2 IM's per calibration. The same individuals may only calibrate 2 of the instruments. The other instruments must be calibrated by other individuals.

Panel	Bistable	Performed By/Verified By
R-12	PS-1-5A (PB516A)	_____ / _____
		_____ / _____
R-11	PS-1-12A (PB526A)	_____ / _____
		_____ / _____
R-11	PS-1-23A (PB536A)	_____ / _____
		_____ / _____
R-12	PS-1-30A (PB546A)	_____ / _____
		_____ / _____

NOTE: All reactor safeguard systems modified for the special startup tests are back in a normal configuration at this time.

APPENDIX F

Technical Specifications Exceptions

The table below identifies those technical specification items which are temporarily bypassed or require special test exceptions to the limiting conditions for operation during the performance of this and all other special tests.

TECHNICAL SPECIFICATION	1 Natural Circulation	2 Loss of Offsite Power	3 Natural Circ. w/o Przr Htrs.	4 Natural Circ. Isolate SG	5 Natural Circ. Reduced Pressure	6 Charging and Letdown Cooldown	7 Blackout	8 Stagnant Start	9A Forced Flow Cooldown	9B Boron Mixing Cooldown
Containment HI Pressure SI (3.3.2.1)	X	X	X	X	X	X	X	X	X	X
Safety Limits (2.1.1)	X	X	X	X	X	X	X	X		X
OPΔT (3.3.1) Inoperable because of low flow	X	X	X	X	X		X	X	X	X
OTΔT (3.3.1) Inoperable because of low flow	X	X	X	X	X		X	X	X	X
Minimum temperature (3.1.1.4)				X				X	X	X
Moderator temperature coefficient (3.1.1.3)				X				X	X	X
Steamline ΔP SI (3.3.2.1) bypassed	X	X	X	X	X	X	X	X	X	X
High Steamflow coincidental w/low steamline pressure or low-low T_{avg} SI										
Reset flow to 0% and T_{avg} blocked	X	X	X	X	X	X	X	X	X	X
Reset low steamline pressure				X					X	X
Low pressurizer pressure SI (3.3.2.1)	X	X	X	X	X	X	X	X	X	X
SG level low AFW start reset (3.3.2.1)		X					X			
Pressurizer (3.4.[illegible]			X		X		X			
UHI (3.5.1.2)	X	X	X	X	X	X	X	X	X	X
AFW (3.7.1.2)		X					X			
Diesel Gens. (3.8.1.1)		X					X			
A.C. Electrical Boards (3.8.2.1)		X					X			
Batteries (3.8.2.3)		X					X			
RCS Flowrate (3.2.3)	X	X	X	X	X		X	X		X
Control Rod Insertion Limits (3.1.3.6)	X	X	X	X	X		X	X		
Reactor Coolant Flow Normal Operation (3.4.1.2)	X	X	X	X	X		X	X		X

TABLE 1

Loop Flow and Core ΔT for
Various Power Levels and
Isolation Configurations

(Computer Estimates)

	No. of Loops Operating (Nat. Circ.)			
Power Level	4	3	2	1
.5%	W_L = 3.7 ΔT = 10.3	W_L = 3.6 ΔT = 12.5	W_L = 4.1 ΔT = 16.4	W_L = 5.2 ΔT = 26
.75%	W_L = 3.7 ΔT = 13.5	W_L = 4.1 ΔT = 16.3	W_L = 4.7 ΔT = 21.4	W_L = 5.9 ΔT = 34
1%	W_L = 4.1 ΔT = 16.3	W_L = 4.5 ΔT = 19.8	W_L = 5.2 ΔT = 26	W_L = 6.5 ΔT = 41
1.5%	W_L = 4.7 ΔT = 21.4	W_L = 5.2 ΔT = 26	W_L = 5.9 ΔT = 34	W_L = 7.5 ΔT = 54
2%	W_L = 5.2 ΔT = 26	W_L = 5.7 ΔT = 31.4	W_L = 6.5 ΔT = 41	W_L = 8.2 ΔT = 65.4
2.5%	W_L = 5.6 ΔT = 30.1	W_L = 6.2 ΔT = 36.5	W_L = 7.1 ΔT = 47.1	W_L = 8.9 ΔT = 75.9
3%	W_L = 5.9 ΔT = 34	W_L = 6.5 ΔT = 41.2	W_L = 7.5 ΔT = 54	W_L = 9.7 ΔT = 85.7

NOTE: W_L is % of 97,000 gpm flow through operable loop.

ΔT = Loop ΔT in °F.