BABCOCK & WILCOX
NUCLEAR POWER GENERATION DIVISION

TECHNICAL DOCUMENT

ATOG
ABNORMAL TRANSIENT OPERATING GUIDELINES

CAUTION

ATOG Part II Must Be Read and Understood
Prior to Review or Use of Part I.

74-1123297-00

Doc. ID – Serial No., Revision No.

for

DUKE POWER COMPANY
by
BABCOCK & WILCOX

1. RETURN TO REGULATORY CENTRAL FILES
ROOM 016

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PDR ADOCK 05000287
P PDR

BABCOCK & WILCOX
NUCLEAR POWER GENERATION DIVISION

RECORD OF REVISION

NUMBER
74-1123297-00

REV. NO.	CHANGE SECT/PARA.	DESCRIPTION/CHANGE AUTHORIZATION
00		Original Issue - J. J. Kelly Plant Engineering

Prepared by J. J. Kelly Project Engineer Date 3/25/82

Reviewed by W. H. Dell, Operations Support Svcs. Date 3/25/82

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Approved by S. Dowling, Mgr. Ops & Cont. Eng. Date 3-26-82

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ACRONYM GLOSSARY

ADV	Atmospheric Dump Valve
BAMT	Boric Acid Mix Tank
BWST	Borated Water Storage Tank
CFT	Core Flood Tank
CP	Cooldown Procedure
CRT	Cathode Ray Tube
DH	Decay Heat
DHR	Decay Heat Removal
EFWP	Emergency Feedwater Pump
EFPT	Emergency Feed Pump Turbine
EFW	Emergency Feedwater
PORV	Pilot Operated Relief Valve
ES	Engineered Safeguards
FW	Feedwater
H_2	Hydrogen
HPI	High Pressure Injection
ICS	Integrated Control System
IC T/C	Incore Thermocouple
LPI	Low Pressure Injection
MFW	Main Feedwater
MSRV	Main Steam Relief Valve
N_2	Nitrogen
NDT	Nil Ductility Temperature
NR	Narrow Range

NNI	Non-Nuclear Instrumentation
OP	Operating Procedure
OTSG	Once Through Steam Generator
PPS	Present Plant Status
P/T	Pressure vs. Temperature plot for water
Pzr.	Pressurizer
RB	Reactor Building
RBS	Reactor Building Spray
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RTD	Resistance Temperature Detector
SAD	System Auxiliary Diagram
SLB	Steam Line Break
STM-LK	Steam Leaking (Steam Generator)
SU	Startup
TBS	Turbine Bypass System
TBV	Turbine Bypass Valve
Tc	Tcold, reactor inlet
T/C	Thermocouple
Th	Thot, reactor outlet
TR	Tube Ruptured (Steam Generator)
WR	Wide Range

Section I

IMMEDIATE ACTIONS

Determine whether this is a reactor trip or a forced shutdown situation and proceed below.

Reactor Trip	Forced Shutdown
a. Manually trip the reactor.	a. If an OTSG tube rupture has occurred as indicated by main steam line and/or air ejector radiation monitor alarm, go to Section III D.
b. Manually trip the turbine.	b. If a forced shutdown is required by technical specifications or by other operating documents, shutdown plant to required conditions per normal procedures, starting with OP/3/A/1102/10 Controlling procedure for Unit shutdown.
c. Go to Section II.	

Section II

VITAL SYSTEM STATUS VERIFICATION

Verification Column VERIFY THE FOLLOWING:	Remedial Action Column IF VERIFICATION CANNOT BE MADE, PERFORM THE FOLLOWING:
1.0 REACTOR POWER DECREASING ON INTERMEDIATE RANGE.	Start HPI from BWST.
2.0 ALL RODS ON BOTTOM.	Begin emergency boration as necessary.
3.0 ALL MAIN TURBINE STOP VALVES SHUT.	Trip turbine from front standard.
4.0 LETDOWN FLOW THROUGH BLOCK ORIFICE ONLY	Close block orifice bypass valve (HP-7).
5.0 FEEDWATER HAS RUNBACK.	Trip running feedwater pumps and verify EFW pump starts.

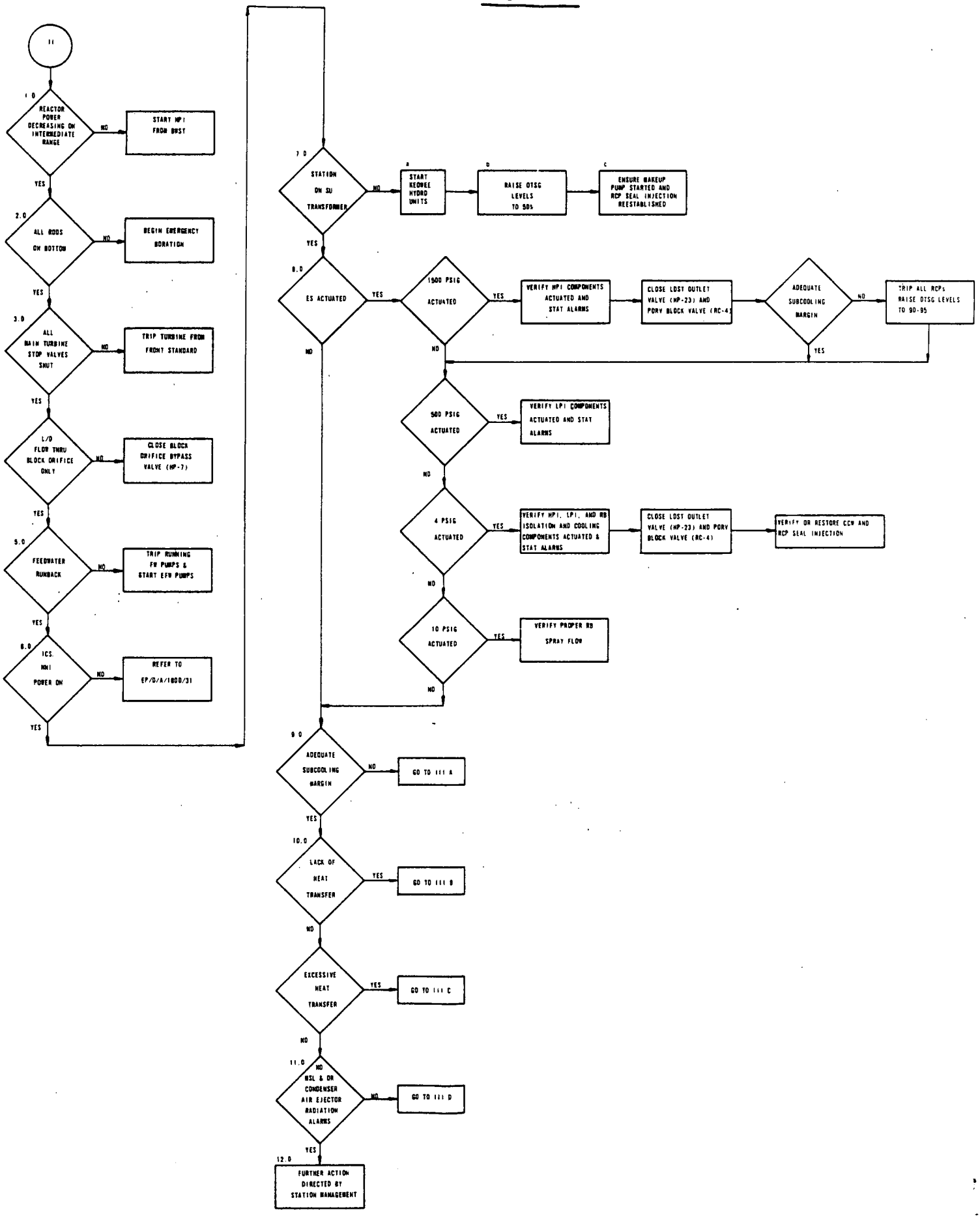
Verification Column	Remedial Action Column
VERIFY THE FOLLOWING:	
6.0 ICS/NNI POWER ON	(Refer to EP/0/A/1800/31).
7.0 STATION AUXILIARIES HAVE SHIFTED TO SU TRANSFORMER WITH VOLTAGE INDICATED ON ALL BUSES.	a) Start or verify auto start and loading of the Keowee Hydro units. b) With EFW properly throttled, raise OTSG levels to 50%. (See Specific Rule 3.0) c) Ensure a makeup pump is started and RCP seal injection is re-established. (If not, recover per EP/0/A/1800/20).
8.0 NO ES ALARMS	1500 PSIG Alarm a) Verify HPI channels 1 and 2 have actuated by noting that the colors of the components' indicating lamps have changed, and that the STAT alarms have actuated. (See Specific Rules 1.0 and 2.0). b) Close letdown storage tank outlet valve (HP-23) and PORV block valve (RC-4). c) IF subcooling margin is lost, THEN trip all RCPs. d) If subcooling margin is lost, THEN raise OTSG levels to 90-95% on the operate range while properly throttling feedwater. (if EFW is used see Specific Rule 3.0)

Verification Column	Remedial Action Column
VERIFY THE FOLLOWING:	
	e) IF the HPI system is not operating properly THEN refer to the SAD section.
	500 PSIG Alarm
	a) Verify LPI channels 3 and 4 have actuated by noting that the colors of the components' indicating lamps have changed, and that the STAT alarms have actuated.
	b) IF the LPI system is not operating properly, THEN refer to the SAD section.
	4 PSIG Alarm
	a) Verify HPI, LPI and reactor building isolation and cooling channels 1, 2, 3, 4, 5, and 6 have actuated by noting that the colors of the components' indicating lamps have changed, and that the STAT alarms have actuated.
	b) Close letdown storage tank outlet valve (HP-23) and PORV block valve (RC-4).
	c) Restore component cooling water verify RCP seal injection.
	d) IF the RB isolation OR RB cooling systems are not operating properly, THEN refer to the SAD section.
	10 PSIG Alarm
	a) Verify proper RB spray flow.
	b) IF the RB spray does not operate properly, THEN refer to the SAD section.

Verification Column	Remedial Action Column
VERIFY THE FOLLOWING:	
9.0 ADEQUATE SUBCOOLING MARGIN	Go to Lack of Adequate Subcooling, Section IIIA.
10.0 NORMAL PRIMARY TO SECONDARY HEAT TRANSFER EXISTS.	FOR LACK OF HEAT TRANSFER go to Section IIIB. FOR EXCESSIVE HEAT TRANSFER go to Section IIIC.
11.0 NO MAIN STEAM LINE AND/OR CONDENSER AIR EJECTOR RADIATION MONITOR ALARMS.	Go to SGTR, Section IIID.

12.0 THE PLANT IS STABLE IN A SAFE SUBCOOLED CONDITION WITH PROPER PRIMARY TO SECONDARY HEAT TRANSFER AND NO MAJOR PRIMARY BOUNDARY FAILURES. FURTHER ACTION AT THIS POINT WILL BE AT THE DISCRETION OF STATION MANAGEMENT.

Figure II VITAL SYSTEM STATUS VERIFICATION



Section III A

LACK OF ADEQUATE SUBCOOLING MARGIN

FOLLOWUP ACTIONS FOR TREATMENT OF LACK OF ADEQUATE SUBCOOLING MARGIN

1.0 TRIP ALL RCPs

2.0 RAISE SG LEVELS.

2.1 Raise SG levels to 90-95% on operate range while properly throttling FW (See specific Rule 3.0).

3.0 INITIATE HPI

3.1 See Specific Rule 1.0

4.0 ISOLATE POSSIBLE LEAKS

4.1 Close the PORV block valve (RC-4).

4.2 Close the letdown isolation valve (HP-5).

4.3 Close the pressurizer spray block valve (RC-3).

4.4 Close the RC pump seal return valves (HP-20).

4.5 Close pressurizer vent/sample valves.
GWD-27 (vent valve)
RC-5 AND RC-6 (sample valves)

5.0 IF SUBCOOLING MARGIN HAS BEEN ESTABLISHED, THEN GO TO STEP 11.0, OTHERWISE CONTINUE.

5.1 IF a loss of adequate subcooling margin is due to an overcooling and not a LOCA THEN wait 5-10 minutes for HPI to restore subcooling margin before continuing.

6.0 IF SUPERHEATED, THEN GO TO ICC SECTION.

6.1 IF, at any time during the transient T_{hot} RTD indicates superheated conditions, THEN compare T_{hot} RTD indication with incore T/C temperatures.

6.2 IF BOTH T_{hot} RTD and incore TC temperatures indicate superheat, THEN go to ICC Section, otherwise continue.

7.0 IF THERE IS PRIMARY TO SECONDARY HEAT TRANSFER IN BOTH SGs, THEN GO TO CP-103, OTHERWISE CONTINUE.

P The RCS is saturated. A small break is indicated.
P Cooldown with the SGs can be performed while HPI
S maintains RCS inventory.

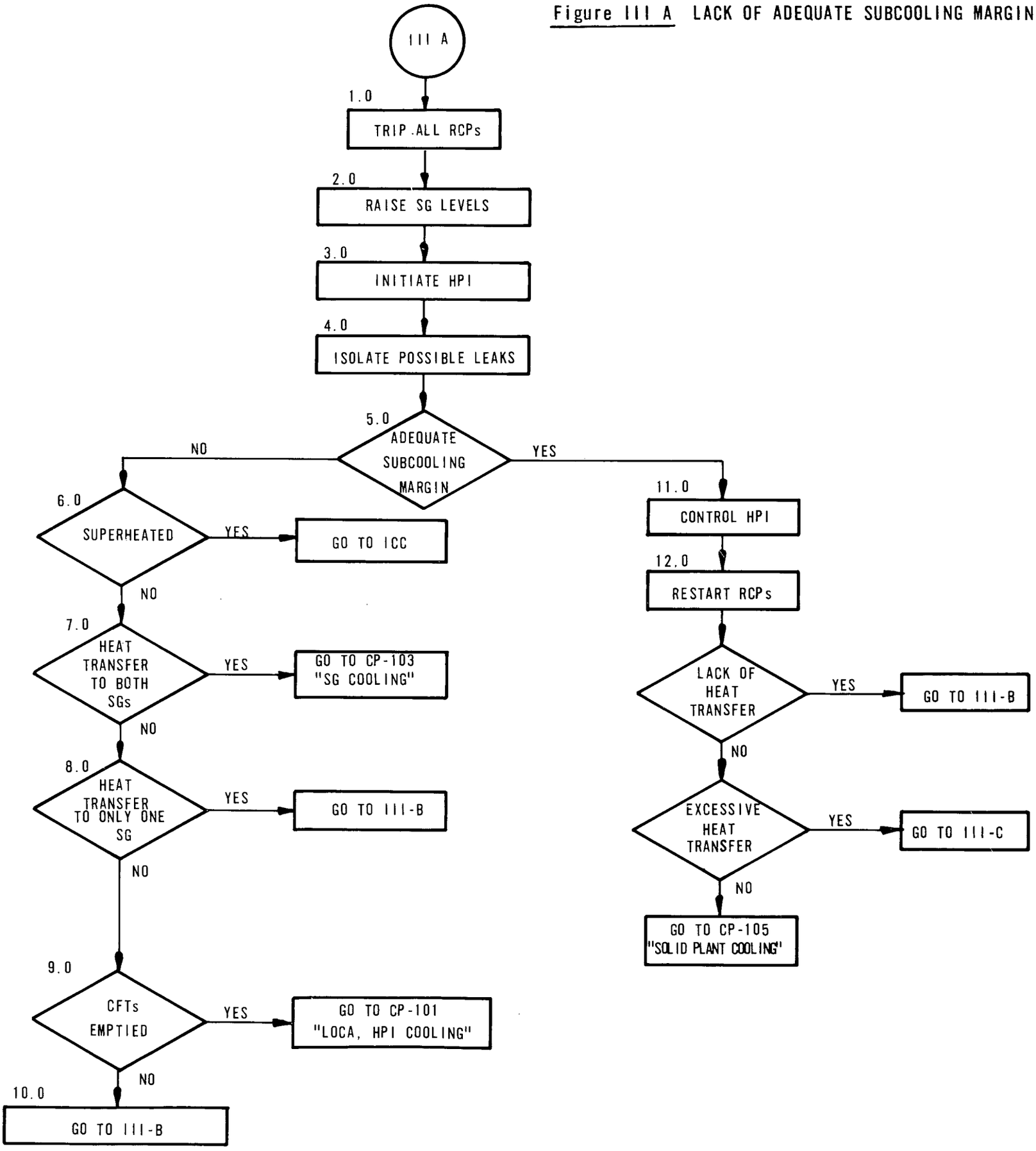
8.0 IF THERE IS PRIMARY TO SECONDARY HEAT TRANSFER IN ONLY ONE SG, THEN GO TO LACK OF HEAT TRANSFER SECTION III B, OTHERWISE CONTINUE.

9.0 IF The CFTs HAVE EMPTIED, THEN GO TO CP-101, OTHERWISE CONTINUE.

P | The Core Flood Tanks emptying is an indication of a major
LOCA, CP-101 provides instructions for long-term core
P | cooling following a major LOCA. Do not go to Section
III.B. Primary to secondary heat transfer will be lost
S | and cannot be regained.

10.0 IF THE CFTs HAVE NOT EMPTIED, GO TO LACK OF HEAT TRANSFER SECTION III B.

Figure III A LACK OF ADEQUATE SUBCOOLING MARGIN



III B

LACK OF HEAT TRANSFER

FOLLOWUP ACTIONS FOR TREATMENT OF LACK OF PRIMARY TO SECONDARY HEAT TRANSFER IN EITHER SG

1.0 IF THERE IS ADEQUATE SUBCOOLING MARGIN, THEN GO TO STEP 5.0, OTHERWISE CONTINUE.

LACK OF ADEQUATE SUBCOOLING MARGIN

2.0 TRIP ALL RCPs.

3.0 INITIATE HPI.

3.1 See Specific Rule 1.0.

4.0 IF SUPERHEATED, THEN GO TO ICC SECTION.

4.1 IF, at any time during the transient T_{hot} RTD indicates superheated conditions, THEN compare T_{hot} RTD indication with incore T/C temperatures.

4.2 IF BOTH T_{hot} RTD and incore T/C temperatures indicate superheat, THEN go to ICC Section, otherwise continue.

DETERMINE FEEDWATER AVAILABILITY

5.0 IF FEEDWATER IS AVAILABLE, THEN GO TO STEP 10.0, OTHERWISE CONTINUE WITH STEP 6.0.

LACK OF FEEDWATER EITHER SUBCOOLED OR SATURATED

6.0 INITATE EFW.

6.1 Feed both SGs, with EFW properly throttled to the appropriate SG level (See Specific Rules 3.0 and 4.0)

6.2 IF EFW is not available, THEN use main FW.

6.3 IF neither EFW nor MFW is available, THEN attempt to feed one SG from an alternate source (emergency feedwater cross connect to another unit, service water, etc.).

6.4 IF the EFW system is not operating properly, THEN refer to the SAD section.

7.0 WHEN FEEDWATER HAS BEEN REESTABLISHED, THEN GO TO STEP 10.0. UNTIL THEN, CONTINUE.

8.0 ESTABLISH HPI COOLING.

8.1 Initiate HPI (See Specific Rule 1.0)

8.2 Open PORV block valve (RC-4).

8.3 Open PORV (RC-66).

8.4 Run one RCP per loop as long as adequate subcooling margin is maintained.

9.0 IF NEITHER SG CAN BE FED, THEN GO TO CP-104.

P
P
S

There is no heat transfer to either SG. Natural circulation does not exist and cannot be induced due to a total loss of Feedwater. The SGs are dry and the core must be cooled by HPI.

FEEDWATER HAS BEEN REESTABLISHED BUT THERE IS NO HEAT TRANSFER

10.0 MAINTAIN APPROPRIATE SG LEVEL.

10.1 See Specific Rule 4.0

11.0 IF THE CFTs HAVE EMPTIED, THEN GO TO CP-101, OTHERWISE CONTINUE.

P
P
S | The Core Flood Tanks emptying is an indication of a major LOCA. CP-101 provides instructions for long-term cooling following a major LOCA. Primary to secondary heat transfer is lost and cannnot be regained.

12.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

12.1 Lower SG pressure by adjusting TBVs while maintaining level, until secondary Tsat is 40 to 60F lower than core exit thermocouple temperature. Maintain this SG pressure.

13.0 WHEN HEAT TRANSFER IS REESTABLISHED THEN GO TO STEP 19.0 UNTIL THEN, CONTINUE.

14.0 USE PUMP BUMPS TO INDUCE HEAT TRANSFER.

14.1 Determine RCP operability per OP/3/A/1103/6.

14.2 Bump a RCP, which is capable of being started, in the loop with the highest level in the SG.

14.3 Allow RCS pressure to stabilize within ±20 psig before determining if heat transfer is established.

14.4 WHEN heat transfer is established, THEN go to Step 19.0, until then, continue.

14.5 Repeat steps 14.2 through 14.4 for operable RCPs that have not been bumped. Allow 15 minutes between pump bumps. IF all operable RCPs have been bumped and heat transfer has NOT been reestablished, THEN continue with step 16.0.

15.0 IF RCPs CANNOT BE BUMPED, THEN GO TO CP-104.

P
P
S

There is not heat transfer to either SG. Natural Circulation does not exist and cannot be induced by bumping RCPs. The RCS is saturated and the core must be cooled by HPI.

16.0 FURTHER LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

16.1 Lower SG pressure by adjusting TBVs while maintaining the appropriate level, until secondary Tsat is 90 to 110F lower than core exit thermocouple temperature. Maintain this SG pressure.

17.0 START ONE RCP TO INDUCE HEAT TRANSFER.

17.1 If at least one hour has passed since reactor trip and any RCPs are capable of being started, start and run one RCP, preferably in a loop with SG level greater than 30".

18.0 IF HEAT TRANSFER HAS NOT BEEN REESTABLISHED, THEN GO TO CP-104, OTHERWISE CONTINUE.

P
P
S

There is no heat transfer to either SG. Attempts to establish heat transfer by natural circulation and forced flow have failed. The RCS is saturated and the core must be cooled by HPI.

HEAT TRANSFER HAS BEEN REESTABLISHED

19.0 RECOVER FROM HPI COOLING.

19.1 Close PORV block valve (RC-4).

19.1 Close PORV (RC-66).

19.3 Control HPI (See Specific Rule 2.0).

20.0 CONTROL HEAT TRANSFER RATE.

20.1 Adjust TBV position to maintain RC temperature at present value.

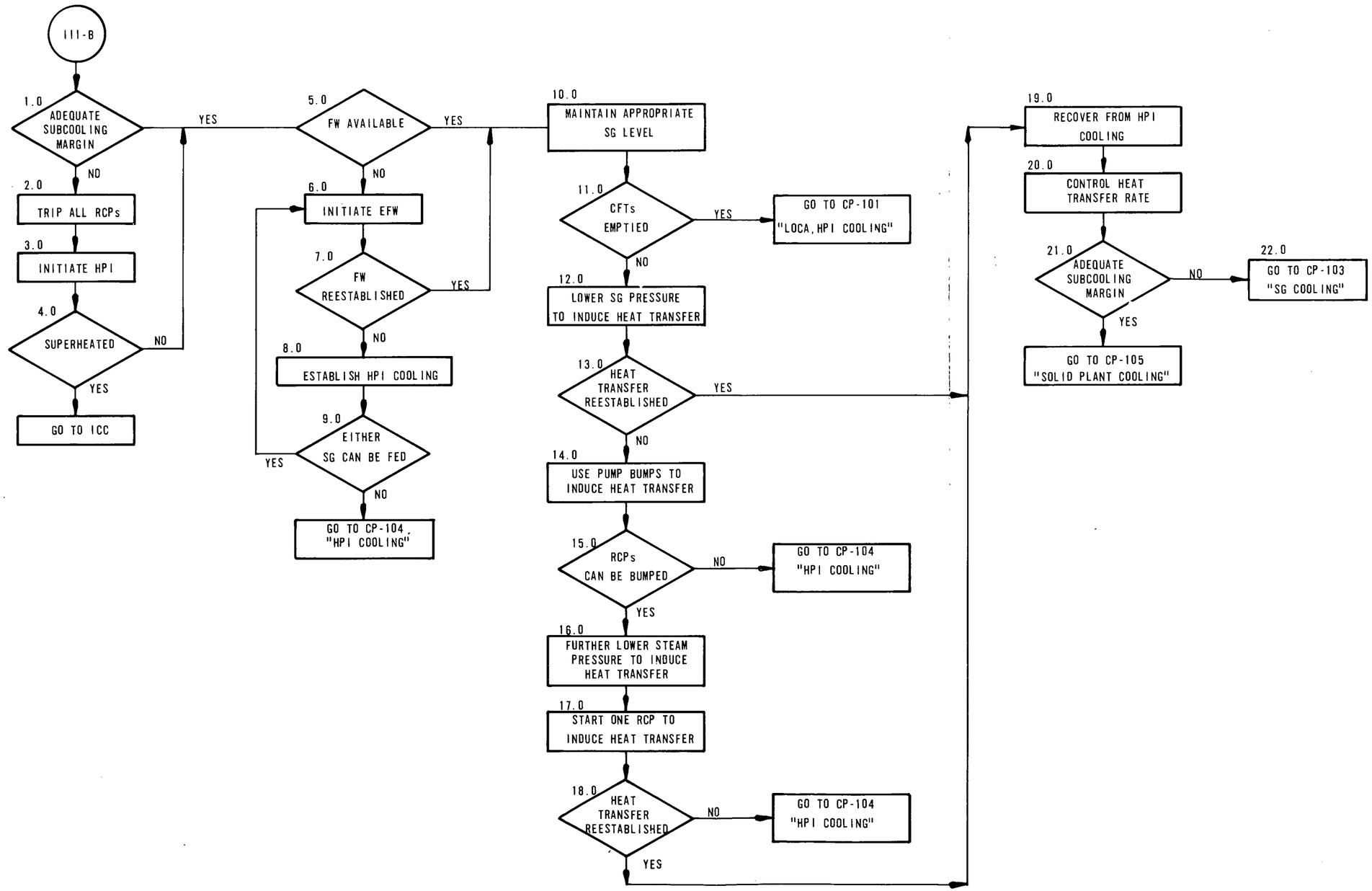
21.0 IF THERE IS ADEQUATE SUBCOOLING MARGIN, THEN GO TO CP-105.

P | The RCS is subcooled. There may or may not be a bubble in the
P | pressurizer. SG heat transfer is controlled. CP-105 provides
S | instructions either to draw a bubble if necessary then cooldown
  | normally or to cooldown solid if a bubble cannot be drawn.

22.0 IF THERE IS A LACK OF ADEQUATE SUBCOOLING MARGIN, THEN GO TO CP-103.

P | The RCS is saturated. A small break is indicated. Cooldown
P | with the SGs can be performed while HPI maintains RCS
S | inventory.

Figure III B LACK OF HEAT TRANSFER



III C

EXCESSIVE HEAT TRANSFER

FOLLOW-UP ACTIONS FOR TREATEMENT OF TOO MUCH PRIMARY TO SECONDARY HEAT TRANSFER

1.0 IF PRESSURIZER LEVEL IS BELOW 50" AND RCS PRESSURE IS DECREASING, THEN INITIATE HPI.

1.1 See Specific Rule 1.0.

2.0 IF IT IS APPARENT WHICH SG IS CAUSING THE OVERCOOLING, THEN GO TO STEP 14.0, OTHERWISE CONTINUE WITH STEP 3.0.

OVERCOOLING IS OCCURRING FROM UNDETERMINED SG

3.0 ISOLATE BOTH SGs.

3.1 IF pressurizer level is below 50" AND decreasing

OR

SG operating level is greater than 95% AND increasing

THEN

A. Close EFW control valves (FDW-315 and FDW-316).

B. Start the motor drive EFW pumps AND verify discharge pressure and recirculation flow.

C. Trip the running MFW pumps.

3.2 Close or verify closed MFW control valves (FDW-32 and FDW-41) AND startup FW control valves (FDW-35 and FDW-44).

3.3 Place the TBVs in manual, close and VERIFY.

3.4 Close the EFW control valves (FDW-315 AND FDW-316).

3.5 Complete isolation of SGs by closing the following valves:

Valve	SG 'A'	SG 'B'
MS Line to EFPT	MS-82	MS-84
MS Line to Aux Steam	MS-24	MS-33
MS Line to FW Turbine	MS-35	MS-36
MS Line to SSRH	MS-76	MS-79

4.0 IF SG LEVELS AND PRESSURES HAVE STABILIZED, THEN GO TO STEP 10.0.

5.0 IF EITHER SG HAS DECREASING LEVEL AND/OR PRESSURE, THEN CONTINUE WITH STEP 6.0.

PRESSURE AND LEVEL ARE STILL DECREASING ON ONE SG
(NON-ISOLABLE STEAM LEAK)

6.0 REESTABLISH HEAT TRANSFER TO SG WITHOUT THE STEAM LEAK.

6.1 SG with decreasing level and/or pressure has a steam leak.

6.2 Isolate the leaking SG by closing its respective valving as follows:

Valve	SG 'A'	SG 'B'
Main FW Block	FDW-31	FDW-40
Startup FW Block	FDW-33	FDW-44
Turbine Bypass Block	MS-17	MS-26

6.3 Allow the steam leaking SG to boil dry. Heat transfer is being intentionally stopped in the leaking SG. DO NOT go to Lack of Heat Transfer Section III B.

6.4 Establish MFW to only the SG without the steam leak. (see Specific Rule 4.0). Ensure steam supply to feed pump is from good OTSG.

6.5 IF MFW is not available, THEN use EFW (see Specific Rule 3.0).

6.6 Adjust TBVs on SG without the steam leak to maintain RC temperature at the present value.

6.7 IF the TBS is not operating properly, THEN refer to the SAD section.

6.8 Control HPI as necessary (see Specific Rule 2.0).

6.9 IF RB temperature increases above 130F, THEN start 3 RB coolers with maximum LPSW.

7.0 IF A SG TUBE RUPTURE IS INDICATED, GO TO SGTR SECTION III D STEP 5.2, OTHERWISE CONTINUE.

8.0 IF THERE IS LACK OF ADEQUATE SUBCOOLING MARGIN, GO TO LACK OF SUBCOOLING MARGIN SECTION III A, OTHERWISE CONTINUE.

9.0 GO TO CP-102.

P P S	RCS is subcooled with pressure and temperature stable. Only one SG is operable and steaming to the condenser.

SG PRESSURES AND LEVELS STABILIZED WITH BOTH SGs ISOLATED

10.0 REESTABLISH HEAT TRANSFER TO BOTH SGs.

10.1 Reestablish MFW to both SGs and maintain appropriate level (See Specific Rule 4.0).

10.2 IF MFW is NOT available, THEN use EFW.

10.3 Adjust TBV positions on each SG to maintain RC temperature at present value.

10.4 IF the TBS is not operating properly, THEN refer to the SAD section.

10.5 Control HPI as necessary (See Specific Rule 2.0).

11.0 IF A SG TUBE RUPTURE IS INDICATED, GO TO SGTR SECTION III D, STEP 5.2, OTHERWISE CONTINUE.

12.0 IF THERE IS LACK OF ADEQUATE SUBCOOLING MARGIN, GO TO LACK OF SUBCOOLING MARGIN SECTION III A, OTHERWISE CONTINUE.

13.0 AN OVERCOOLING HAS OCCURRED DUE TO EITHER EXCESSIVE FW OR A STEAM LEAK.

13.1 Station management needs to decide whether or not a cool-down is required. If there are other abnormal symptoms, treat them per the applicable section of this procedure. If there are not abnormal symptoms, this procedure is complete.

OVERCOOLING IS OCCURRING FROM ONE APPARENT SG

14.0 ISOLATE THE OVERCOOLING SG.

14.1 IF pressurizer level is below 50" AND decreasing
OR
SG operating level is greater than 95% AND increasing
THEN

A. Close EFW control valves (FDW-315 and FDW-316).

B. Start the motor driven EFW pumps AND verify discharge pressure and recirculation flow.

C. Trip the running MFW pumps

14.2 Close MFW control valve (FDW-32 or FDW-41) AND startup FW control valve (FDW-35 or FDW-44) on the overcooling SG.

14.3 Close and verify closed the TBVs on the overcooling SG.

14.4 Close the EFW control valve (FDW-315 or FDW-316) on the overcooling SG.

14.5 Close MS line valve to EFWPT (MS-82 or MS-84) on overcooling SG.

14.6 Close MS line valve to auxiliary steam (MS-24 or MS-33) on overcooling SG.

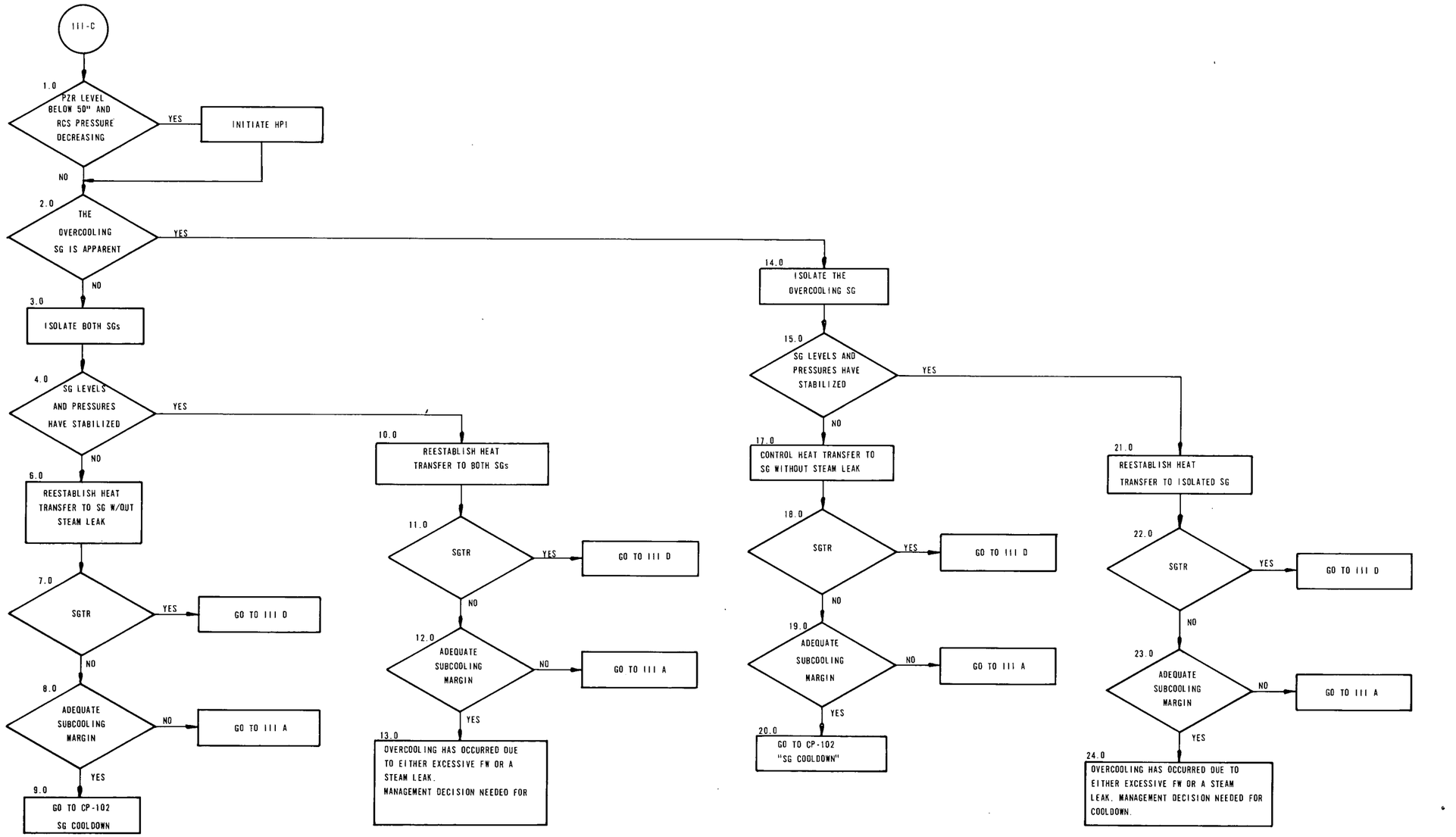
14.7 Close MS line valve to FW turbine (MS-35 or MS-36) on the overcooling SG.

14.8 Close MS line valve to SSRH (MS-76 or MS-79) on the overcooling SG.

15.0 IF PRESSURE AND LEVEL HAVE STABILIZED ON THE OVERCOOLING SG, THEN GO TO STEP 21.0. OTHERWISE CONTINUE.

16.0 IF PRESSURE AND LEVEL ARE STILL DECREASING ON THE OVERCOOLING SG, THEN CONTINUE WITH STEP 17.0.

Figure III C EXCESSIVE HEAT TRANSFER



III D

SGTR

FOLLOWUP ACTIONS FOR SG TUBE RUPTURE

1.0 IF THE REACTOR HAS TRIPPED, GO TO STEP 4.0, OTHERWISE CONTINUE.

REACTOR TRIP HAS NOT OCCURRED

2.0 INITIATE HPI IF REQUIRED.

2.1 IF pressurizer level is being maintained by the makeup system, THEN go to step 3.0, otherwise continue.

2.2 Manually initiate HPI as required to maintain pressurizer level greater than 100". (See Specific Rule 1.0)

2.3 IF pressurizer level cannot be maintained, THEN trip the reactor and go to step 4.0, otherwise continue.

3.0 SHUTDOWN REACTOR.

3.1 Isolate letdown (HP-5)

3.2 Immediately begin power reduction at greater than 5% per minute.

3.3 If reactor trip occurs during runback, go to Section I and perform Section II, VSSV.

3.4 Make local survey of main steam line to confirm high radiation alarms and identify the tube ruptured SG.

3.5 At less than 20% reactor power:

a. Place the TBVs in manual.

b. Open TBV's - Unload and "trip" turbine/generator.

c. Trip reactor.

d. Properly place TBVs back into auto.

REACTOR TRIP HAS OCCURRED

4.0 CONTROL HPI AS REQUIRED

4.1 Perform the reactor trip portion of Immediate Actions/VSSV Section if not already done.

4.2 IF pressurizer level is being maintained by the makeup system THEN go to Step 5.0, otherwise continue.

4.3 If adequate subcooling margin exists, THEN manually control HPI to maintain pressurizer level between 100" and 150".

4.4 IF adequate subcooling margin is lost, THEN TRIP ALL RC PUMPS.

4.5 IF adequate subcooling margin is lost, THEN initiate HPI. (See Specific Rule 1.0).

4.6 Initiate makeup to LDST. IF LDST level reaches 18 inches THEN open HP-24 to provide suction to the HPI pump from the BWST.

5.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS EXCESSIVE, THEN FOLLOW EXCESSIVE HEAT TRANSFER SECTION III C AS EXPEDITIOUSLY AS POSSIBLE AND RETURN TO THIS SECTION AT STEP 5.2 WHEN HEAT TRANSFER IS STABILIZED, OTHERWISE CONTINUE AT 6.0.

5.1 Do not go to CPs until directed to do so in this section.

5.2 If both SGs are operating with adequate primary to secondary heat transfer, go to Step 6.0, otherwise continue.

5.3 Feed the leaking SG as necessary (approximately 100 gpm) through the MFW nozzles to maintain tube to shell Δ T less than 150F.

6.0 PREPARE FOR COOLDOWN.

6.1 Isolate letdown (HP-5).

6.2 Turn off all pressurizer heaters.

6.3 Ensure that local survey of main steam line is being made to confirm high radiation alarms and verify the tube ruptured SG.

7.0 IF THE REACTOR COOLANT PUMPS ARE RUNNING, THEN GO TO STEP 16.0, OTHERWISE CONTINUE.

8.0 IF OFFSITE POWER IS AVAILABLE BUT RC PUMPS ARE NOT RUNNING. THEN GO TO STEP 13.0, OTHERWISE CONTINUE.

9.0 IF LOSS-OF-OFFSITE POWER HAS OCCURRED, THEN CONTINUE WITH STEP 10.0.

LOSS OF OFFSITE POWER HAS OCCURRED

10.0 WHEN OFFSITE POWER IS RESTORED, THEN GO TO STEP 13.0, OTHERWISE CONTINUE.

10.1 Restore offsite power as soon as possible.

11.0 BEGIN COOLDOWN AND DEPRESSURIZATION WITH LOSS-OF-OFFSITE POWER.

11.1 Verify that SG levels are increasing to the appropriate SG level (see Specific Rule 4.0) with EFW properly throttled (see Specific Rule 3.0).

11.2 AS SOON AS the tube ruptured SG is identified, DO NOT feed the tube ruptured SG unless needed to maintain the low level limit, to maintain natural circulation, to maintain adequate subcooling margin, or to maintain tube to shell ΔT requirements.

11.3 Regain IAS as quickly as possible. Refer to EP/O/A/1800/29, Loss of Instrument Air.

11.4 Depressurize the RCS to as close as possible to the adequate subcooling margin curve by opening the PORV.

11.5 As quickly as possible, begin cooldown of the RCS with the TBVs initially using both steam generators if they are both operable.

11.6 Perform a rapid cooldown to 500F (do not exceed a C/D rate of 240F/hr).

11.7 WHEN a 50F subcooling margin is obtained, THEN depressurize the RCS to as close as possible to the adequate subcooling margin curve by opening the PORV. (Increase the subcooling margin as necessary to obtain about 30F colder than the adequate subcooling margin curve before opening the PORV.)

11.8 During the depressurization and cooldown, control the TBVs as necessary to prevent the MSRVs from opening.

12.0 GO TO STEP 17.0

REACTOR COOLANT PUMPS NOT RUNNING

13.0 WHEN ADEQUATE SUBCOOLING MARGIN IS OBTAINED, THEN RESTART RCPs.

13.1 Start one RCP in each loop. IF successful, THEN go to Step 16.0, otherwise continue.

13.2 If unable to start a RCP in one loop, THEN attempt to start both RCPs in the other loop. IF successful, THEN go to Step 16.0, otherwise continue.

13.3 IF only one RCP was started AND the RCP is in Loop "B", THEN go to Step 16.0, otherwise continue.

14.0 BEGIN COOLDOWN AND DEPRESSURIZATION WITHOUT RCPs.

14.1 Verify that SG levels are increasing to the appropriate SG level (see Specific Rule 4.0) with feedwater properly throttled (See Specific Rule 3.0).

14.2 AS SOON AS the tube ruptured SG is identified, THEN stop feeding the tube ruptured SG unless needed to maintain the low level limit, to verify natural circulation, to maintain adequate subcooling margin, or to maintain tube to shell ΔT requirements.

14.3 As soon as possible, begin cooldown of the RCS with the TBVs initially on both steam generators, if possible.

14.4 Perform a rapid cooldown to 500F (do not exceed a C/D rate of 240 F/hr).

14.5 IF the RCPs cannot be restarted within 10 minutes after they tripped or were tripped, THEN:

a. Depressurize the RCS to as close as possible to the adequate subcooling margin curve by opening the PORV.

b. Continue cooldown of the RCS with the TBVs initially on both steam generators.

c. Whenever a 50F subcooling margin is obtained, depressurize the RCS to as close as possible to the adequate subcooling margin curve by opening the PORV. (Increase the subcooling margin as necessary to obtain about 30F colder than the adquate subcooling margin curve before opening the PORV).

d. Continue cooldown and depressurization in this manner until the RCPs can be restarted per Step 13.0.

15.0 GO TO STEP 17.0

REACTOR COOLANT PUMPS ARE RUNNING

16.0 BEGIN COOLDOWN AND DEPRESSURIZATION WITH RCPs.

16.1 Ensure appropriate steam generator level is maintained (See Specific Rule 4.0). Begin depressurizing the RCS to as close as possible to the adequate subcooling margin curve by opening the pressurizer spray valve (RC-1).

16.2 As quickly as possible, begin cooldown of the RCS with the TBVs initially on BOTH steam generators if possible.

16.3 IF the SGTR leak rate is greater than the capacity of one normal MU pump OR the condenser is NOT available, THEN perform a rapid cooldown to 500F (do not exceed a C/D rate of 240 F/hr).

16.4 Continue spraying the pressurizer as necessary to remain as close as possible to the adequate subcooling margin.

16.5 Continue with step 17.0.

COOLDOWN HAS BEGUN USING BOTH SGs

17.0 CONTROL THE TUBE RUPTURED SG TO PREVENT RADIATION RELEASE.

17.1 During the depressurization and cooldown control the TBVs as necessary to prevent the MSRVs from opening.

18.0 ISOLATE THE TUBE RUPTURE SG:

18.1 IF the SG without the tube rupture is not operable, THEN go to Step 19.0 and continue cooldown with the tube ruptured SG, otherwise continue.

18.2 AS SOON AS the tube ruptured SG is identified AND the RCS is below 540F, THEN isolate the tube ruptured SG by closing its respective valves as follows:

Valves	OTSG 'A'	OTSG'B'
Main FW Block	FDW-31	FEW-40
Startup FW Block	FDW-33	FDW-42
EFW Control	FDW-315	FDW-316
Turbine Bypass	MS-19 &-22	MS-28 &-31
MS Line to FW Turbine	MS-35	MS-36
MS Line to SSRH	MS-76	MS-79
MS Line to EFPT	MS-82	MS-84

18.3 Switch both the main and emergency feed pump steam supplies to the unaffected OTSG.

18.4 Initiate steaming as necessary to maintain the SG pressure below 1000 psig and SG level below 95% on the operate range on the tube rupture SG.

18.5 Transfer the supply of the auxiliary steam header from the unit with the TR OTSG to another unit and close MS-24 and MS-33 on the unit with the TR OTSG.

18.6 Open AS-8 AND then close SSH-1 on the unit with the TR OTSG in order to supply the steam seal header from auxiliary steam.

18.7 To minimize radioactive releases to the environment, refer to OP/O/A/1106/31, control of secondary contamination.

18.8 Continue with Step 19.0.

PLANT IS COOLING DOWN WITH ONE SG ISOLATED

19.0 CONTINUE COOLDOWN WITH APPLICABLE LIMITATIONS.

19.1 When RCS pressure and leak rate decrease and RCS inventory and subcooling can be maintained by the MU system, stop the HPI system and establish normal MU control.

19.2 Continue depressurization and cooldown at the maximum attainable C/D rate without exceeding 100 F/hr using the SG without the tube rupture.

19.3 Cooldown on the tube ruptured SG if the other SG is not operable.

19.4 Decrease the RCS pressure as required to remain as close as possible to the minimum subcooling margin line.

19.5 If an unisolable steam line break has occurred, upon reaching 400F determine the tube to shell ΔT. If ΔT is less than 150F, continue the cooldown.

19.6 If tube to shell ΔT exceeds 150F, stop cooldown. Feed the steam leaking SG as necessary (approximately 100 GPM) through the MFW nozzles to maintain tube to shell ΔT less than 150F. When ΔT is less than 150F, continue cooldown while maintaining ΔT less than 150F.

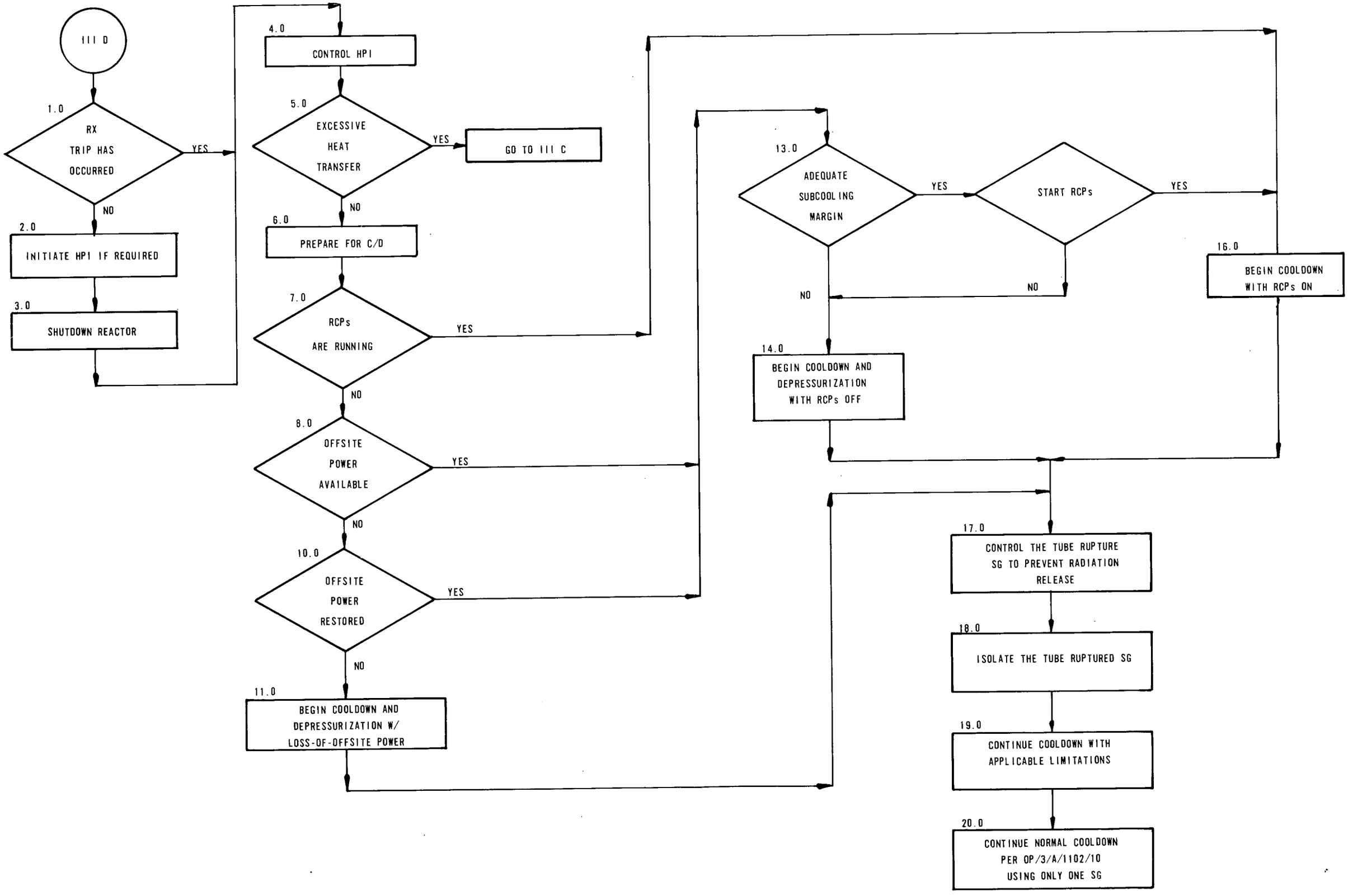
19.7 Notify Health Physics or Technical Support personnel to run PT/0/A/260/3, (Condenser Iodine Partition Factor Test).

19.8 For removal of activity from the condensate system, maintain in service the minimum number of powdex cells required for current condensate flow.

20.0 CONTINUE NORMAL COOLDOWN PER PROCEDURE OP/3/A/1102/10 USING ONLY ONE SG.

P P S | The tube rupture SG has been identified. The RCS is subcooled and the pressurizer is controlling RCS pressure.

Figure III D STEAM GENERATOR TUBE RUPTURE



CP-101

A LARGE LOCA HAS OCCURRED AND THE CORE FLOOD TANK IS EMPTYING

1.0 VERIFY AUTOMATIC ACTIONS.

1.1 Check ES actuation per Section II Step 9.0.

1.2 WHEN BWST level reaches ∿10 ft level, THEN begin makeup to BWST with borated water.

1.3 WHEN CFT levels decrease to Lo-Lo level, THEN close core flood tank isolation valves (CF-1 and CF-2) to prevent N_2 introduction into RCS.

2.0 NOTIFY PERSONNEL.

2.1 Notify the Duty Engineer.

3.0 CONTROL HPI.

3.1 (See Specific Rule 1.0).

3.2 WHEN BWST level drops to approximately 6 feet or BWST lo-lo-level alarms (minimum time 1/2 to 1 hr) THEN align HPI system to take suction from the reactor building sump using the LPI system to provide HPI pump suction.

A. Open LP-15 and LP-16, LPI discharge to MU pump suction.

B. Verify MU pump suction crossover valves, HP-98, HP-99, and HP-100 are open.

C. Verify RB sump suction valves outside containment, LP-19 and LP-20, are open (depress MANUAL OVERRIDE push buttons).

3.3 WHEN LPI suction is aligned to RB sump THEN close BWST outlet valves, LP-21 and LP-22, to prevent pumping BWST dry, (Depress MANUAL OVERRIDE push buttons).

3.4 IF LPI flow has been greater than 1000 gpm in each injection line for at least 20 minutes (RCS will not repressurize), THEN:

A. Stop HPI pumps.

B. Close or verify closed HP-26, HP-27, HP-409, HP-410, and HP-120.

C. Establish normal MU to maintain seal injection.

4.0 DETERMINE IF CORE FLOOD LINE BREAK HAS OCCURRED.

4.1 A CF line break is evident if only one CF tank blows down immediately and there is LPI flow to the affected CF nozzle. However, there is no LPI flow to the other loop with RCS pressure greater than 240 psig.

4.2 IF both DH Loops are operable AND unaffected LPI pumps are running and proper flow from BWST to the unaffected nozzle is established, THEN close the affected loop ES injection valve and CFT isolation valve (LP-17 and CF-2 OR LP-18 and CF-1) AND stop affected loop LPI pump.

4.3 IF unaffected LPI pump is not running THEN start additional LPI pump and establish LPI flow to unaffected loop through cross connect valves LP-9 and LP-10.

5.0 Throttle LPI valves LP-12 and LP-14 and building spray valves BS-1 and BS-2 as necessary to prevent pump cavitation.

6.0 ISOLATE MAJOR LINE CONTAINMENT PENETRATIONS:

6.1 IF core cooling is being maintained by the HPI/LPI/CFT systems, THEN stop the EFW pumps AND close the following valves to isolate the SGs.

Valves	OTSG'A'	OTSG 'B'
Main FW Block	FDW-31	FDW-40
Startup FW Block	FDW-33	FDW-42
EFW Control	FDW-315	FDW-316
Turbine Bypass Block	MS-17	MS-26
MS Line to Aux. Steam	MS-24	MS-33
MS Line to FW Turbine	MS-35	MS-36
MS Line to SSRH	MS-76	MS-79
MS Line to EFPT	MS-82	MS-84

6.2 WHEN A) RB pressure increases above 4 psig

OR

B) RCS pressure decreases below 1550 psig

OR

C) RB radiation increases above the high radiation limit

THEN Ensure the following valves are closed by ES actuation:

Penetration	ES Channel 1 Valves	ES Channel 2 Valves
RC Letdown	HP-3, HP-4	HP-5
RCP Seal Return	HP-20	HP-21
Quench Tank Vent	GWD-12	GWD-13
RB Normal Sump	LWD-1	LWD-2
Quench Tank Suction	CS-5	CS-6
RB Purge	PR-1	PR-2, PR-3, PR-4, PR-5
RB RIAS	PR-7, PR-9	PR-8, PR-10
PZR Sample	RC-5, RC-6	RC-7
SG Drain	FDW-105, FDW-107	FDW-106, FDW-109 FDW-103, FDW-104

6.3 WHEN RB pressure increases above 4 psig, THEN ensure the following valves are closed by ES actuation:

Penetration	ES Channel 5 Valves	ES Channel 6 Valves
Component Cooling - RC pumps - Letdown Cooler - Quench Tank Cooler - CRD Service Structure	CC-7	CC-8
- LPSW to RCP Motors	LPSW-6 LPSW-15	LPSW-6 LPSW-15

6.4 IF RCPs are running, THEN restore component cooling and LPSW to RCP motors.

7.0 ESTABLISH LONG - TERM COOLING.

7.1 Continue LPI cooling until further instructions are given.

7.2 Close PORV block valve, RC-4.

7.3 Continue with unit shutdown per OP/3/A/1102/10 while performing the following steps.

7.4 IF any of the following occur:

a) RB pressure is greater than or equal to 4 psig

OR

b) RB temperature is greater than or equal to 130 F.

OR

c) RB radiation is greater than the high radiation limit.

OR

d) RB H_2 concentration is greater than or equal to 3.5 wt. %.

THEN start 3 RB coolers with maximum LPSW.

7.5 Measure the pH and add appropriate caustic to coolant per CP/2002/05 within 30 minutes after switchover to recirculation mode of core cooling. Adjust the pH to a range of 7.0 to 8.0 within 24 hours.

7.6 Sample the RCS fluid for boron concentration to ensure that the RC is not being diluted. IF the RCS is being diluted, THEN check for leaks into RB (i.e. RB cooler cooling water, main or auxiliary feedwater, component cooling water, or steam lines).

7.7 Secure the RB Spray System when RB pressure decreases to atmospheric pressure or system has operated a minimum of 80 hours. Spray system may be run longer to aid in removing airborne iodine.

7.8 Monitor the Hydrogen level in the RB. Start the RB Hydrogen Purge System per OP/O/A/1104/29. Stop the hydrogen purge if RB radiation exceeds the high high limit.

7.9 Within 24 hours, rack in breakers on LP-103 and LP-104 and open these valves. IF unable to verify flow through LP-103 and LP-104, THEN open LP-3, LP-2, LP-1, LP-108, and LP-109 and verify flow through this line.

CP-102

NORMAL COOLDOWN

1.0 START RCP's

1.1 IF any RCPs are running, THEN go to Step 2.0, otherwise continue.

1.2 IF natural circulation is in progress, THEN start RCP's per OP/3/A/1103/06, RCP operation. One operating RCP per loop is desired.

2.0 IF a small break LOCA has occurred, THEN continue with Step 1.0 CP-103.

3.0 IF TWO SG's ARE IN SERVICE, THEN GO TO OP/3/A/1102/10, OTHERWISE CONTINUE.

4.0 PREPARE FOR COOLDOWN WITH A DRY SG.

4.1 Calculate the existing tube to shell ΔT for the dry SG.

$$\Delta T = \frac{\Sigma \text{ SG Shell T/C}}{5} - T_{cold}$$

ΔT = _____F. This value must not exceed $\pm 100^{o}F$.

4.2 When the ΔT, as determined in Step 4.1 above, is $<100^{o}F$, open the bypass valves on the operable SG and commence cooldown. DO NOT exceed $100^{o}F$ tube to shell ΔT on the dry SG.

4.3 If reactor coolant flow is by natural circulation, use the PORV to depressurize the RCS.

4.4 Continue with OP/3/A/1102/10.

CP-103

TRANSIENT TERMINATION FOLLOWING AN OCCURRENCE THAT LEAVES THE RCS SATURATED WITH SG(s) REMOVING HEAT

1.0 VERIFY THAT HEAT TRANSFER IS BEING CONTROLLED.

1.1 Verify maximum HPI flow (see Specific Rule 1.0).

1.2 Raise SG levels to 95% on the operate range.

2.0 IF THE CORE FLOOD TANKS ARE EMPTYING, THEN GO TO CP-101.

3.0 ENSURE THE CFT ISOLATION VALVES (CF-1 AND CF-2) REMAIN OPEN.

4.0 BEGIN COOLDOWN OF RCS.

4.1 Increase SG steaming by opening the TBVs.

4.2 Verify that SGs continue to provide heat sink for the RCS by:

a. Remaining pressurized

AND

b. core exit T/C's decrease as SG pressure is lowered.

4.3 Continue saturated cooldown by decreasing SG pressure.

4.4 If the RCS does not cooldown as the SGs are depressurized, bump a RCP to reestablish heat transfer via natural circulation.

4.5 WHEN the BWST level reaches 10 ft level, THEN begin makeup to the BWST with borated water.

5.0 IF NATURAL CIRCULATION CANNOT BE MAINTAINED, THEN GO TO CP-104.

6.0 WHEN THE RCS BECOMES SUBCOOLED, THEN START A RCP.

6.1 Determine if subcooled conditions exist by comparing exit T/C's and hot leg RTD's.

6.2 Preferably start RCP B1 or B2.

7.0 IF THE RCS REMAINS SUBCOOLED AFTER STARTING THE RC PUMP, THEN GO TO CP-105, OTHERWISE CONTINUE.

8.0 IF FOR ANY REASON THE RCS BECOMES SUPERHEATED, THEN GO TO SECTION ICC.

9.0 IF THE RCS REMAINS SUBCOOLED DURING THE NATURAL CIRCULATION COOLDOWN, THEN GO TO CP-105, OTHERWISE CONTINUE.

10.0 WHEN THE RCS DEPRESSURIZES TO LESS THAN 150 PSIG, THEN CLOSE ALL HIGH POINT VENT VALVES (RC-155, RC-156, RC-157, RC-158, RC-159, and RC-160).

11.0 WHEN LPI FLOW HAS BEEN IN EXCESS OF 1000 GPM IN EACH INJECTION LINE FOR AT LEAST 20 MINUTES, STOP HPI PUMPS AND CONTINUE, OTHERWISE GO TO STEP 14.

12.0 TRANSFER LPI SUCTION TO RB SUMP.

12.1 WHEN the BWST lo-lo-level alarms (minimum time 1/2 to 1 hour), THEN transfer LPI suction to RB sump. Manual override buttons must be depressed when making the following valve manipulations.

a) Verify RB sump suction valves, outside containment, LP-19 and LP-20 are open.

b) Close BWST outlet valves, LP-21 and LP-22, to prevent pumping BWST dry.

13.0 GO TO STEP 16.7.

14.0 IF THE CONDITIONS OF STEP 10 ARE NOT MET BEFORE THE BWST LEVEL DROPS TO 6 FEET OR BWST LO-LO-LEVEL ALARMS (MINIMUM TIME 1/2 TO 1 HOUR), THEN:

A. ALIGN ONE HPI PUMP TO TAKE SUCTION FROM THE RB SUMP USING THE LPI SYSTEM TO PROVIDE HPI PUMP SUCTION.

B. STOP SECOND HPI PUMP IF RUNNING.

14.1 Verify RB sump suction valves LP-19 and LP-20 are open.

14.2 Verify MU pump suction crossover valves, HP-98, HP-99, and HP-100 are open.

14.3 Verify running or start LPI pumps LP-3A and LP-3B.

14.4 Open LP-15 and LP-16, LPI discharge to MU pump suction.

14.5 Close BWST outlet valves, LP-21 and LP-22, to prevent pumping BWST dry.

15.0 ESTABLISH CONDITIONS FOR LPI COOLING

15.1 Continue HPI/LPI "piggyback" mode until RCS pressure is 250 psig.

15.2 Maintain 250 psig and continue cooldown until adequate subcooling margin is established.

16.0 WHEN ADEQUATE SUBCOOLING MARGIN IS ATTAINED, THEN ESTABLISH LPI COOLING.

16.1 IF two decay heat trains are operable, THEN go to Step 16.5. IF only one decay heat train is operable, THEN continue with step 16.2.

16.2 WHEN the HPI/LPI piggyback operation has been supplying at least 1000 gpm to each loop for 20 minutes AND, during this 20 minutes the RCS pressure has been less than the maximum pressure for LPI operation alone, THEN:

a. Verify that the LPI to RCS valve (LP-17 or LP-18) is open.

b. Establish normal MU to maintain seal injection.

c. Close LPI to HPI valves (LP-15 and LP-16).

16.3 WHEN two DHR systems are operable, THEN follow steps 16.5-16.7.

16.4 Until two DHR systems are operable, continue with step 16.7.

CAUTION

DO NOT ESTABLISH A FLOW PATH IN ANY SYSTEM ISOLATED BY THE ES WITHOUT REVIEW OF THE POTENTIAL RELEASE OF RADIOACTIVE GAS OR LIQUID.

16.5 When two LPI pumps are operable, align one pump in DHR mode and continue operating the other pump in "piggy-back" mode.

16.6 WHEN DH system flow has been greater than 1000 gpm in each line for at least 20 minutes, THEN:

a. Trip RCP's if running.

b. Terminate HPI.

c. Establish both LPI systems in DHR mode.

d. Establish over pressure protection.

16.7 Maintain seal water flow to all RCP's in anticipation of immediate restart should LPI flow be interrupted (one RCP/loop if required). Should RCP restart be required, use the jog start method.

17.0 ESTABLISH LONG TERM COOLING PER STEP 7.0 CP-101.

18.0 CONTINUE UNIT SHUTDOWN PER OP/3/A/1102/10

CP-104

TRANSIENT TERMINATION FOLLOWING AN OCCURRENCE THAT LEAVES THE RCS BEING COOLED BY HPI COOLING

1.0 IF RC PUMPS ARE RUNNING, THEN GO TO STEP 3, OTHERWISE CONTINUE.

2.0 IF NO RC PUMPS ARE OPERATING, THEN THE RC P/T COMBINATION SHALL BE KEPT WITHIN THE NO FORCED FLOW REGION OF FIGURE 2.

2.1 Determine the RC temperature by averaging the five HIGHEST incore thermocouple temperature readings.

2.2 WHEN adequate subcooling margin is obtained, THEN continually reduce the HPI flow rate to maintain the P/T limits of Figure 2.

2.3 WHEN RC P/T is below the maximum limit of the DHRS, THEN start the DHRS as soon as possible and maintain the RC P/T within the limits of the DHRS.

2.4 Continue at Step 3.0.

3.0 VERIFY PORV (RC-66) AND PORV BLOCK VALVE (RC-4) OPEN

4.0 IF THE RCS IS SATURATED, THEN ENSURE MAXIMUM HPI FLOW PER FIGURE 1.

4.1 (See Specific Rule 1.0).

4.2 WHEN the BWST level reaches 10 ft level
THEN begin makeup to the BWST with borated water.

5.0 WHEN THE RCS BECOMES SUBCOOLED, THEN REFER TO FIGURE 2 FOR NDT LIMITS.

6.0 IF COOLDOWN RATE AND RCS PRESSURE ARE BEING CONTROLLED AND THE RCS IS SUBCOOLED, THEN ISOLATE THE CORE FLOOD TANKS.

6.1 WHEN the RC system pressure reaches 675 to 700 psig, THEN close the core flood isolation valves (CF-1 and CF-2).

7.0 IF AT ANY TIME, FW IS RESTORED THEN FOLLOW STEPS 9.0 THROUGH 15.0.

8.0 GO TO CP-103 STEP 10.0

9.0 ESTABLISH CONDITIONS NEEDED TO RESTORE HEAT TRANSFER.

9.1 IF the RCS is NOT subcooled using core exit T/C's, THEN ensure maximum HPI flow per Figure 1.

9.2 IF NO RCPs are running, THEN try to get at least one RCP ready for bump.

9.3 Ensure that SG levels are being maintained at 95% operate range. If not, attempt to restore FW and increase levels to 95%.

10.0 IF AT ANY TIME, WHILE PERFORMING STEP 11.0 - 15.0, THE RCS BECOMES SUBCOOLED AND NATURAL CIRCULATION IS ESTABLISHED, THEN GO TO CP-105, OTHERWISE CONTINUE.

10.1 Natural circulation is verified by:

a. Thot and IC T/C's (average of 5 highest) indicate subcooling and decreasing.

b. Primary IC T/C temperature decreases when secondary pressure is decreased.

11.0 IF AT ANY TIME, NATURAL CIRCULATION IS ESTABLISHED BUT THE RCS REMAINS SATURATED, THEN GO TO CP-103.

12.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

12.1 Lower SG pressure by adjusting TBVs while maintaining level, until secondary Tsat is 40 to 60F lower than core exit thermocouple temperature. Maintain this SG pressure.

13.0 IF RCPs CANNOT BE BUMPED, THEN CONTINUE COOLDOWN WITH STEPS 1.0 - 8.0 OF THIS SECTION.

14.0 USE PUMP BUMPS TO INDUCE HEAT TRANSFER.

14.1 Determine RCP operability per OP/3/A/1103/6.

14.2 Bump a RCP, which is capable of being started, in a loop with SG level at the low level limit or greater.

14.3 Allow RCS pressure to stabilize within ±20 psig.

14.4 Repeat steps 14.2 through 14.3 for operable RCPs that have not been bumped. Allow 15 minutes between pump bumps. IF all operable RCPs have been bumped and heat transfer has NOT been reestablished, THEN continue with step 15.0.

15.0 FURTHER LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

15.1 Lower SG pressure by adjusting TBV's while maintaining level until secondary Tsat is 90 to 110 °F lower than core exit thermocouple temperature.

15.2 IF at least one hour has passed since reactor trip and any RCPs are capable of being started, THEN start and run one RCP, preferably in a loop with SG level greater than 30".

16.0 IF RCS REMAINS SUBCOOLED, GO TO CP-105. IF RCS REMAINS SATURATED, CONTINUE COOLDOWN PER STEPS 1.0 THROUGH 8.0.

CP-105

TRANSIENT TERMINATION FOLLOWING AN OCCURRENCE THAT MAY REQUIRE PRESSURIZER RECOVERY OR SOLID PLANT COOLDOWN WITH SGs REMOVING HEAT

1.0 IF THE HIGH POINT VENT VALVES HAVE BEEN OPENED, THEN CLOSE ALL HIGH POINT VENT VALVES (RC-155, RC-156, RC-157, RC-158, RC-159, AND RC-160).

2.0 IF THERE IS A BUBBLE IN THE PRESSURIZER, GO TO CP-102, OTHERWISE CONTINUE.

3.0 CONTROL HPI FLOW.

- 3.1 Adjust HPI flow to remain as close as possible to the adequate subcooling margin in the RCS.
- 3.2 Close or verify close PORV (RC-66) and PORV block valve (RC-4).
- 3.3 Establish letdown flow.
- 3.4 Control HPI and letdown flow to remain as close as possible to the adequate subcooling margin.

4.0 IF THE DECISION IS MADE NOT TO TRY TO ESTABLISH A BUBBLE IN THE PRESSURIZER, THEN PROCEED WITH A SOLID PLANT COOLDOWN, STEP 7.0.

5.0 ESTABLISH A BUBBLE IN THE PRESSURIZER.

- 5.1 Turn on all available pressurizer heaters. (IF pressurizer heaters are not available, THEN refer to SAD section.
- 5.2 Monitor the increase in presurizer water temperature until pressurizer temperature reaches saturation for the existing RC pressure. At this point, a bubble will be formed.
- 5.3 When a bubble is established in the pressurizer, lower pressurizer level to approximately 220 inches.

6.0 GO TO CP-102.

SOLID PLANT COOLDOWN

7.0 CONTROL HPI.

7.1 Maintain an approximate 50F subcooling margin by throttling HPI.

7.2 IF an approximate 50F subcooling margin cannot be obtained, THEN maintain maximum HPI flow per Figure 1.

7.3 Close letdown isolation valve (HP-5).

7.4 See Specific Rule 2.0.

8.0 CONTINUED COOLDOWN

8.1 Using small incremental steps, open the turbine bypass valves to attain a cooldown rate such that adequate subcooling margin is not violated.

8.2 Further adjustment of HPI flow and turbine bypass valve position should be accomplished so as to maintain the cooldown rate less than 100F/hr while maintaining adequate subcooling margin.

8.3 IF an approximate 50°F subcooling margin is obtained, THEN start RCPs per OP/3/A/1103/6. One per loop is desired.

8.4 Continue cooldown while attending to overall plant cooldown per OP/3/A/1102/10.

SPECIFIC RULES

1.0 INITIATE HPI.

1.1 Verify indicated HPI flow is equal to or greater than the dotted line in Figure 1.

1.2 If HPI flow cannot be verified in both loops, open the cross connect valves for the HPI header, HP-409 and HP-410.

1.3 IF one HPI pump fails to start, THEN perform the following actions:

a. Verify the makeup pump is lined up to receive power from the operating diesel generator.

b. Establish a pump suction flow path from the BWST.

c. Verify the letdown storage tank outlet valve is closed, HP-23.

d. Adjust loads as necessary on the operating diesel generator to supply power to the makeup pump (about 530 KW).

e. Place the makeup pump in service.

1.4 IF HPI flow cannot be increased to at least the value of dotted line in Figure 1, THEN maintain the maximum attainable HPI flow while investigating the HPI system.

1.5 IF the HPI system is not operating properly, THEN refer to the SAD section.

SPECIFIC RULES

2.0 CONTROL HPI.

2.1 WHEN RCS subcooling is equal to or greater than the minimum subcooling margin, THEN control HPI per the following:

a. IF any RCPs are operating, THEN reduce HPI flow to maintain the RC P/T within Region I AND II of Figure 2.

b. IF NO RCPs are operating, THEN reduce HPI flow to maintain the RC P/T within Region II only.

c. IF HPI cooling is in progress, THEN do not reduce HPI flow based on pressurizer level. Go to Step 2.2

d. IF pressurizer level is greater than 100", AND the appropriate region of Figure 2 is being maintained, THEN reduce HPI flow to maintain pressurizer level between 100" and 150".

OR

HPI may be stopped and normal MU restarted.

2.2 Adjust HPI flow with HPI valve HP-26 (Loop A) and HP-27 (Loop B), as necessary.

2.3 Limit each HPI pump flow to between 530 and 100 gpm to prevent runout and deadhead conditions.

SPECIFIC RULES

3.0 PROPERLY THROTTLING EFW.

3.1 IF natural circulation has stopped AND SG level is below appropriate level, THEN ensure full EFW flow. Do not throttle EFW until natural circulation is verified.

3.2 IF RC temperature is to be stabilized, THEN throttle EFW to maintain SG pressure at less than 100 psig below the turbine header pressure setpoint. (e.g. throttle EFW to maintain SG pressure above 910 psig after a reactor trip when the turbine header setpoint has been biased to 1010 psig).

3.3 IF a cooldown is required, THEN throttle EFW as necessary to limit the cooldown rate to less than the maximum allowed 100F/hr.

3.4 Maintain continuous EFW flow until the appropriate level setpoint is reached (see Specific Rule Number 4.0). Do not allow the SG level to decrease if level is still below the appropriate level.

3.5 IF the EFW system is not operating properly, THEN refer to the SAD section.

SPECIFIC RULES

4.0 MAINTAIN APPROPRIATE SG LEVEL.

4.1 IF any RCPs are running, THEN maintain the low level limit (30" on the startup range).

4.2 IF NO RCPs are running, THEN maintain 50% on the operate range.

4.3 IF there is a lack of adequate subcooling margin, THEN maintain 90-95% on the operate range.

SAD SECTION

RCS Pressure & Inventory Control

System	SAD Dwg. No.	Components Required to Support System
Pzr Heaters Pzr & Spray	EDS-0114-011-115	600V MCC buses for heater banks, 208V buses for spray valves.
HPI	EDS-0114-011-103	BWST, LPSW for HPI pump cooling, HPSW for backup HPI pump cooling, HPI pump room coolers, 4160V buses for HPI pumps, 208V buses for valve control, 125V DC panel boards for switchgear breakers, 125V DC panel board for ES switchgear breakers and valves.
LPI	EDS-0114-011-107	BWST, LPSW for LPI coolers, RB sump for LPI supply in recirculation mode, LPI pump room coolers, 4160V bus for LPI and LPSW pumps, 600V buses for valve operators, 208V buses for ES valve operators, 125V DC panel board for switchgrear breakers, 125V DC panel board for ES switchgear breakers, 600V AC buses for unit coolers, 208V buses for valve operators

System	SAD Dwg. No.	Components Required to Support System
Chemical Addition	EDS-0114-011-106	Boric acid mix tank for storage of concentrated boric acid, caustic mix tank for NaOH (Sodium Hydroxide) storage, hydrazine drum for hydrazine supply when required, lithium hydroxide mix tank for LiOH storage, 208V bus for pump motors and valve operators.

Secondary Heat Transfer Control

System	SAD Dwg. No.	Components Required to Support System
EHC	EDS-0114-011-13	125V DC power supply for EHC control, recirculating cooling water system supplies cooling water to EHC oil coolers, 600V AC bus powers EHC pumps, permanent magnet generator provides backup AC power to EHC cabinet, 120V AC bus for power to EHC control,
Turbine Bypass System	EDS-0114-011-114	208V AC bus powers turbine bypass valves, air system supplies air operated valves
Emergency Feedwater	EDS-0114-011-105	4160V bus supplies power to motor driven EFW pumps, 600V bus powers motor operated valves, 208V bus powers motor operated valves, 125V DC panel board powers switchgear breakers, 125V DC panel board powers ES switchgear breakers, OTSG's supply steam for turbine driven EFW pump, auxiliary steam header supplies steam to turbine driven EFW pumps, instrument air system supplies air to control valves, condenser

System	SAD Dwg. No.	Components Required to Support System
		hotwell supplies water for EFW system, upper surge tank supplies water to EFW system, EFW pump turbine lube oil cooler cools EFWP turbine bearing lube oil, HP service water for TDEFWP bearing cooling, LP service water for motor driven EFWP cooling, EFWP turbine oil pump pumps lube oil for TDEFWP bearings (starts as shutoff valve leaves the closed position)

Reactor Building Control

System	SAD Dwg. No.	Components Required to Support System
Reactor Building Spray	EDS-0114-011-104	BWST supplies RB spray pumps, reactor building emergency sump collects spray and may be manually aligned to supply spray pumps during low pressure recirculation mode, auxiliary building unit coolers for RBSS pump room area cooling, LPSW provides cooling for unit coolers, 125V DC panel board for control power to ES switchgear breakers, 125V DC panel board for control power to switchgear breakers, 208V bus for power to ES valve operators, 600V bus for power to ES valve operators, 4160V bus for power supply to pumps, 600V bus supplies power to unit coolers
Reactor Building Emergency Cooling	EDS-0114-011-111	4160V bus supplies power to ES pumps, 600V bus supplies power to fans, 208V bus supplies power to valve operators (3), 125V DC panel board provides control power to ES breakers, 125V DC panel board provides control power to switchgear breakers, LPSW for RB cooling coils

System	SAD Dwg. No.	Components Required to Support System
Reactor Building Isolation	EDS-0114-011-112	600V bus power supply to motors and valve operators, 208V bus for power to valve operators, 125V DC panel board for power to solenoid valves and ES switchgear breakers, 125V DC panel board for control power to switchgear breakers

SECTION ICC

FOLLOWUP ACTIONS FOR INADEQUATE CORE COOLING

1.0 INITIATE HPI & LPI.

1.1 See Specific Rule 1.0.

1.2 IF LPI is delivering flow, THEN increase LPI flow to maximum.

2.0 INCREASE SG LEVELS TO 90-95%.

3.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

3.1 Depressurize SG(s) while maintaining level(s) to achieve secondary T-sat 90 to 110F lower than incore T/C temperature and maintain this T.

4.0 ENSURE CORE FLOOD TANK ISOLATION VALVES (CF-1 and CF-2) ARE OPEN.

5.0 TAKE ACTION BASED ON FIGURE 3.

5.1 Average the five highest reading incore T/C temperatures.

5.2 Determine which region of Figure 3 that the RCS is in based on Step 5.1.

5.3 Using the region determined in Step 5.2, take action according to the following table.

REGION	ACTION
1	Go to CP-103
2	Continue Step 1.0 - 4.0 above
3	Go to Step 6.0
4	Go to Step 11.0

INCORE THERMOCOUPLE TEMPERATURE IS IN REGION 3

6.0 START ONE RCP PER LOOP IF POSSIBLE.

6.1 Do not override normal RCP interlocks.

7.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER

7.1 Depressurize operating steam generator(s) as rapidly as possible to 400 psig or further if necessary to achieve a 100F decrease in secondary T-sat.

8.0 OPEN ALL HIGH POINT VENT VALVES, RC-155, RC-156, RC-157, RC-158, RC-159 and RC-160.

9.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS NOT ESTABLISHED, THEN OPEN THE PORV (RC-66).

9.1 Allow RCS to depressurize until HPI/LPI/CFTs return incore thermocouple temperatures to saturation.

9.2 Go to CP-104.

10.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS ESTABLISHED THEN GO TO CP-103

10.1 Maintain the primary to secondary heat transfer by cycling the PORV to keep RCS pressure 25-60 psi greater than SG pressure.

INCORE THERMOCOUPLE TEMPERATURE IS IN REGION 4

11.0 START ALL RCPs

11.1 Starting interlocks should be defeated if necessary.

11.2 Do not defeat the overload trip circuit.

11.3 IF low pressure service water is lost AND not restored to the motor within 30 minutes, THEN trip the RC pump.

12.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER

12.1 Depressurize the operative SG(s) as quickly as possible. Do not go below the minimum steam pressure necessary to power the steam driven EFW pump unless one of the following is available:

a) Steam from another unit.

b) Steam from aux. boiler.

c) Both motor driven EFWPs.

13.0 DEPRESSURIZE THE RCS

13.1 Open the PORV (RC-66) and PORV block valve (RC-4) and leave open.

13.2 Depressurize the RCS until LPI restores core cooling.

14.0 WHEN incore thermocouple temperature returns to the saturation temperature for the existing RCS pressure, THEN continue with Step 15.0.

COOLDOWN FOLLOWING ICC (INCORE TEMPERATURES HAVE BEEN IN REGION 4, NOW SATURATED)

15.0 DECREASE RUNNING RCPs TO ONE PER LOOP.

16.0 CLOSE THE CORE FLOOD TANK ISOLATION VALVES (CF-1) AND CF-2).

17.0 MAINTAIN EFW FLOW.

17.1 If using turbine driven EFWP, do not reduce SG pressure below the minimum steam pressure necessary to power the steam driven EFW pump until one of the following is available:

a) Steam from another unit.

b) Steam from aux. boiler.

c) Both motor driven EFWP's.

18.0. WHEN LPI FLOW HAS BEEN IN EXCESS OF 1000 GPM IN EACH INJECTION LINE FOR AT LEAST 20 MINUTES, THEN STOP HPI PUMPS IF RUNNING AND CONTINUE WITH 19.0, OTHERWISE, GO TO STEP 21.0.

CAUTION

DO NOT ESTABLISH A FLOW PATH IN ANY SYSTEM ISOLATED BY THE ES WITHOUT REVIEW OF THE POTENTIAL RELEASE OF RADIOACTIVE GAS OR LIQUID.

19.0 TRANSFER LPI SUCTION TO RB SUMP.

19.1 WHEN the BWST level drops to approximately 6 feet or lo-lo-level alarms (minimum time 1/2 to 1 hour), THEN transfer LPI suction to the RB sump. When the following valve manipulations are made, manual override push buttons must be depressed.

a) Verify RB sump suction valves, outside containment, LP-19 and LP-20 are open.

b) Close BWST outlet valves, LP-21 and LP-22, to prevent pumping BWST dry.

20.0 CONTINUE LPI COOLING UNTIL FURTHER INSTRUCTIONS ARE GIVEN.

21.0 IF THE CONDITIONS OF STEP 18 ARE NOT MET BEFORE THE BWST LEVEL DROPS TO 6 FEET OR BWST ALARMS (MINIMUM TIME 1/2 TO 1 HOUR), THEN:

A) ALIGN ONE HPI PUMP TO TAKE SUCTION FROM THE RB SUMP USING THE LPI SYSTEM TO PROVIDE HPI PUMP SUCTION.

B) STOP SECOND HPI PUMP IF RUNNING.

21.1 Verify RB sump suction valves LP-19 and LP-20 are open.

21.2 Verify MU pump suction cross over valves, HP-98, HP-99, and HP-100 are open.

21.3 Verify running or start LPI pumps LP-3A and LP-3B.

21.4 Open LP-15 and LP-16, LPI discharge to MU pump suction.

21.5 Close BWST outlet valves, LP-21 and LP-22 to prevent pumping BWST dry.

22.0 ESTABLISH CONDITIONS FOR LPI COOLING

22.1 IF primary temperature can be controlled by steaming the SG(s), THEN go to Step 22.4, otherwise continue.

22.2 Continue HPI/LPI "piggyback" mode until RCS pressure is 250 psig.

22.3 Go to Step 22.7.

22.4 Cooldown the RCS by steaming the operable SGs while maintaining HPI/LPI flow until RCS pressure is 250 psig.

22.5 Throttle HPI flow to prevent exceeding limits of Figure 2.

22.6 Close the PORV (RC-66) and cycle as necessary to maintain 250 psig RCS pressure.

22.7 Maintain 250 psig and continue cooldown until adequate subcooling margin is established.

23.0 WHEN ADEQUATE SUBCOOLING MARGIN IS ATTAINED, THEN ESTABLISH LPI COOLING.

23.1 IF two decay heat trains are operable, THEN go to Step 23.5. IF only one decay heat train is operable, THEN continue with Step 23.2.

23.2 WHEN the HPI/LPI piggyback operation has been supplying at least 1000 gpm to each loop for 20 minutes AND, during this 20 minutes the RCS pressure has been less than the maximum pressure for LPI operation alone, THEN:

a) Verify that the LPI to RCS valve (LP-17 or LP-18) is open.

b) Establish normal MU to maintain seal injection.

c) Close LPI to HPI valves (LP-15 and LP-16)

23.3 WHEN two DHR systems are operable, THEN follow steps 23.5 - 23.7.

23.4 Until two DHR systems are operable, continue with Step 23.7.

CAUTION

DO NOT ESTABLISH A FLOW PATH IN ANY SYSTEM ISOLATED BY THE SFAS WITHOUT REVIEW OF THE POTENTIAL RELEASE OF RADIOACTIVE GAS OR LIQUID.

23.5 When two LPI pumps are operable, align one pump in DHR mode and continue operating the other pump in "piggyback" mode.

23.6 WHEN DH system flow has been greater than 1000 gpm in each line for at least 20 minutes, THEN:

a) Trip RCP's, if running.

b) Terminate HPI.

c) Establish both LPI systems in DHR mode.

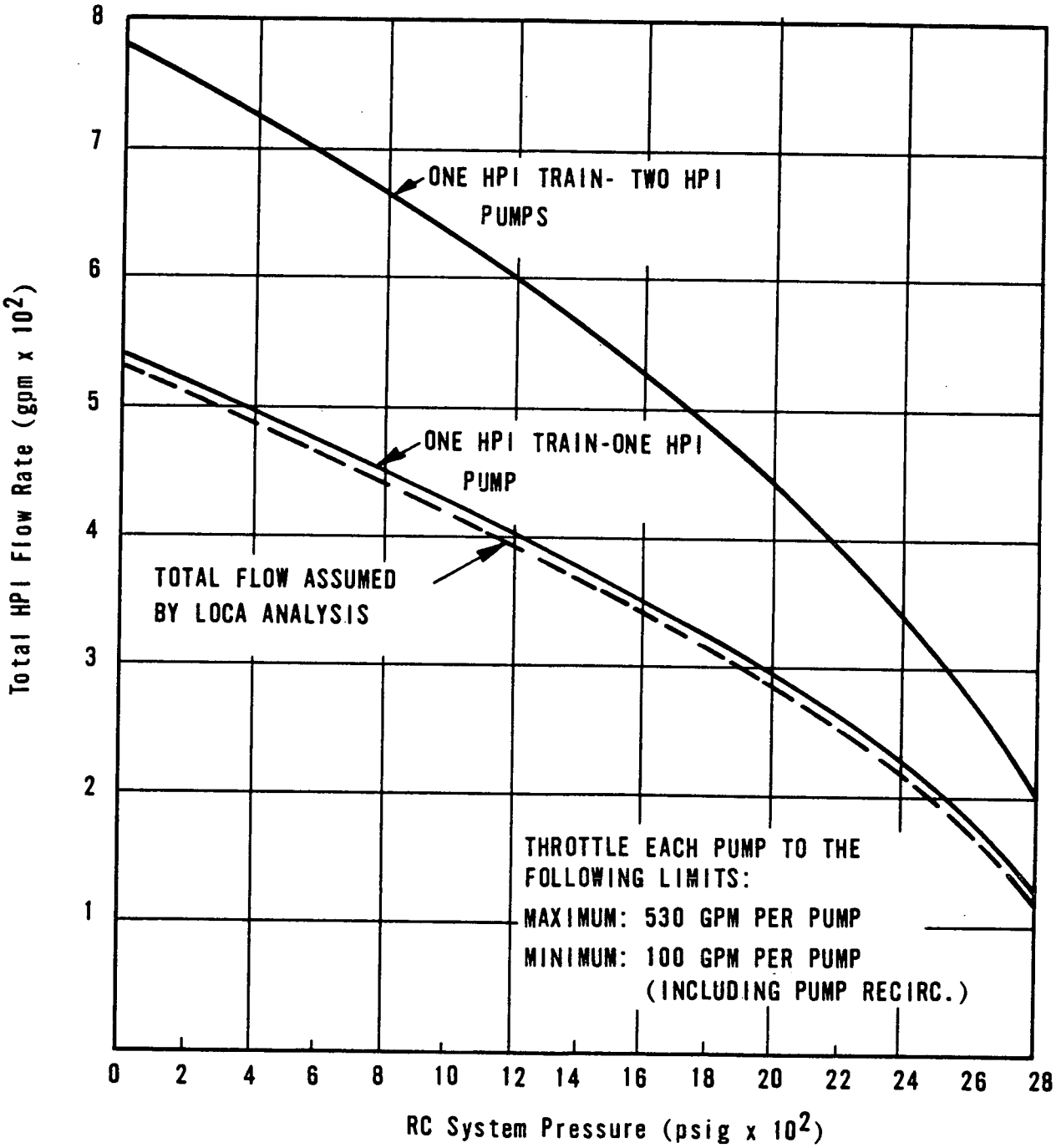
d) Establish over pressure protection by resetting the PORV setpoint.

23.7 Maintain seal water flow to all RCP's in anticipation of immediate restart should LPI flow be interrupted (one RCP/loop if required). Should RCP restart be required, start RCPs per OP/3/A/1103/6..

24.0 ESTABLISH LONG TERM COOLING PER STEP 7.0 CP-101.

25.0 CONTINUE UNIT SHUTDOWN PER OP/3/A/1102/10.

Figure 1 UNTHROTTLED HPI FLOW VS. RC PRESSURE



NOTE: TO ENSURE ADEQUATE LOCA PROTECTION, UNTHROTTLED TOTAL HPI FLOW SHOULD BE ABOVE THE DOTTED LINE. SOLID LINES ARE NOMINAL, EXPECTED FLOWS. DOTTED LINE IS THE TOTAL FLOW ASSUMED BY LOCA ANALYSIS.

FIGURE 2 RC PRESSURE/TEMPERATURE LIMITS

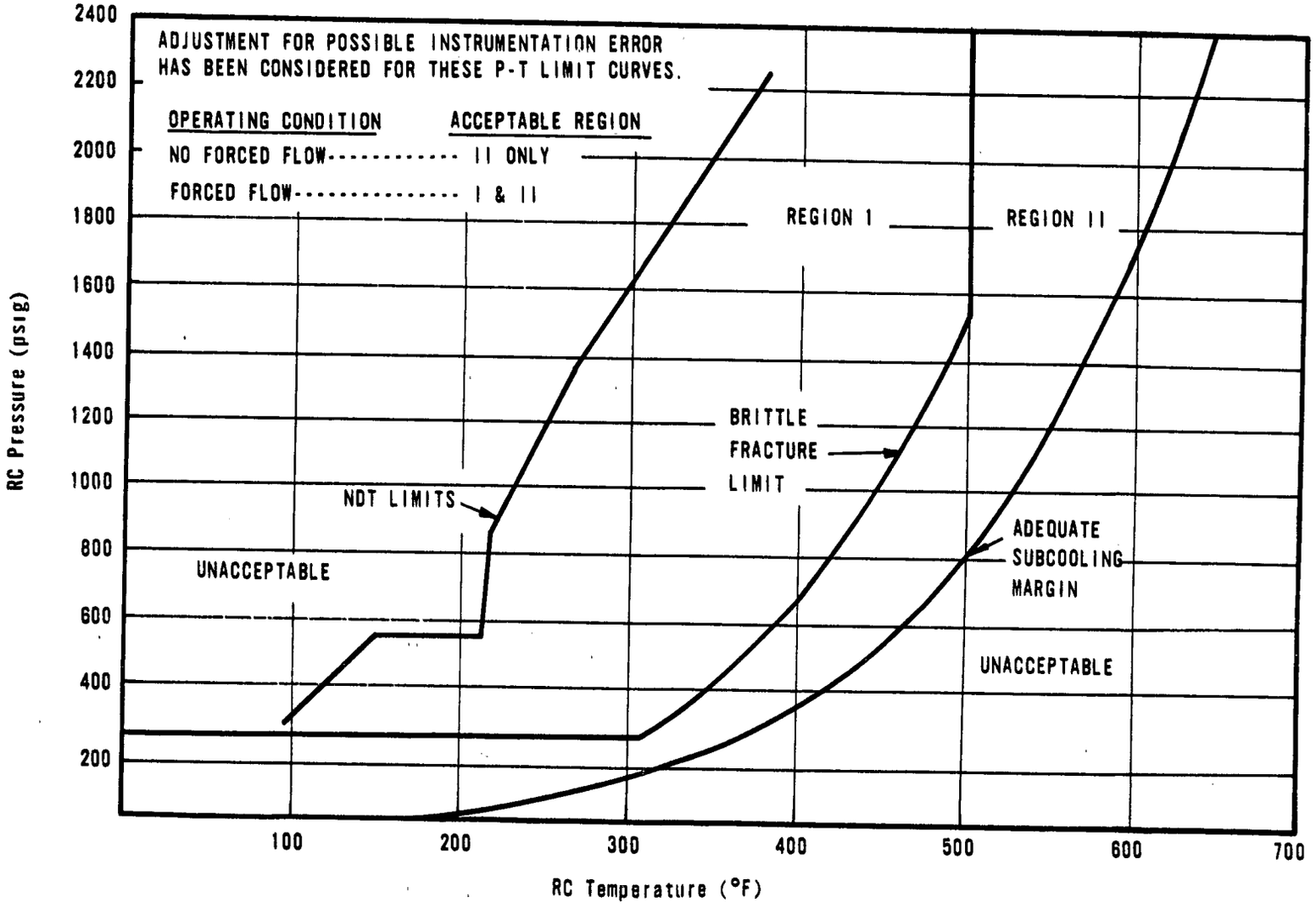


Figure 3 CORE EXIT FLUID TEMPERATURE FOR INADEQUATE CORE COOLING