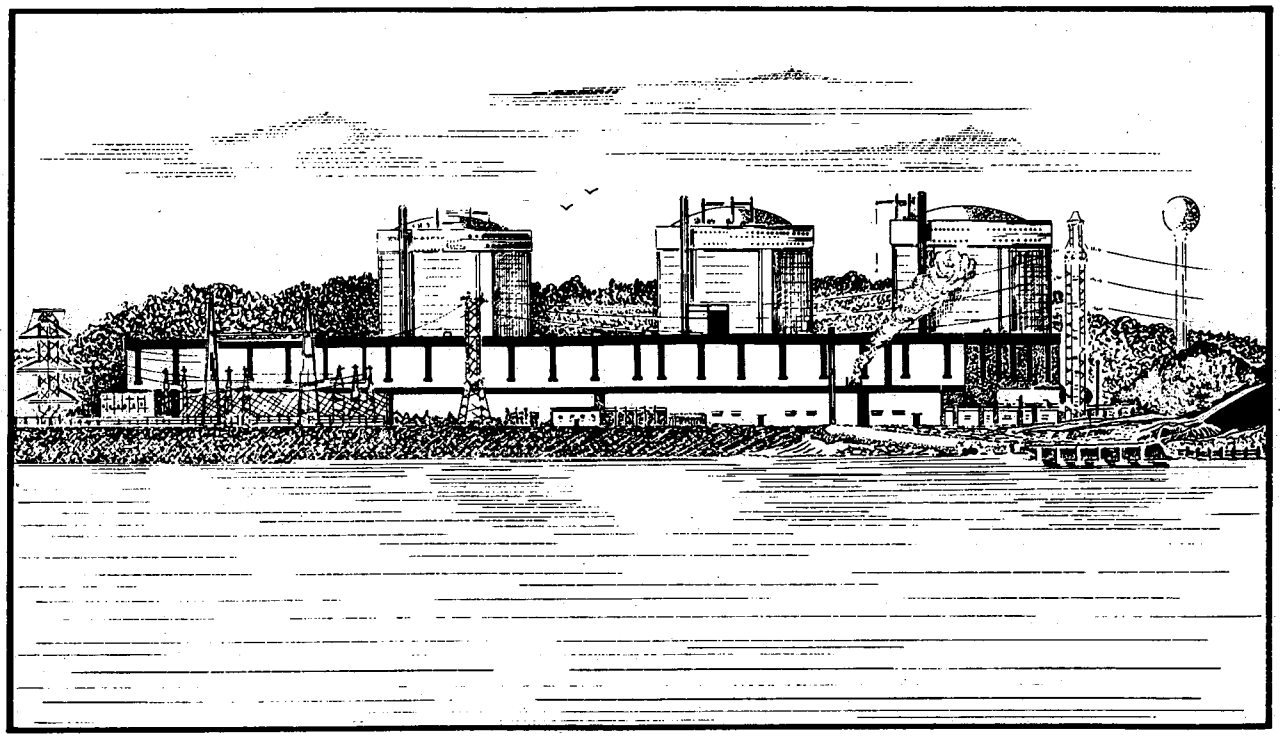
Oconee Nuclear Station

Unit 3



Abnormal Transient Operating Guidelines

(ATOG)

Part I

Procedural Guidelines

8104090578

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.

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74 - 1123297 - 00

Doc. ID — Serial No., Revision No.

for

DUKE POWER COMPANY

by

BABCOCK & WILCOX

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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 M M Hornby & E Faulkner DATE 3/16/81

Reviewed by E Faulkner J Kelly DATE 3/16/81

Reviewed by L H Ell DATE 3/16/81

Approved by J Hallman DATE 3/16/81

DRAFT

TABLE OF CONTENTS

		Tab Name
Acronym Glossary		
Section I - Immediate Actions		
Section II - Vital System Status Verification		
Section III A -	Follow-up Actions for Treatment of Lack of Adequate Subcooling Margin	Tab III A
Section III B -	Follow-up Actions for Treatment of Lack of Primary to Secondary Heat Transfer in Either OTSG	Tab III B
Section III C -	Follow-up Actions for Treatment of Too Much Primary to Secondary Heat Transfer	Tab III C
Section III D -	Follow-up Actions for OTSG Tube Rupture	Tab III D
Cooldown Procedures (CPs)		CPs
CP-101	Transient Termination Following Large LOCA When CF Tank has Emptied	
CP-102	Normal Cooldown	
CP-103	Transient Termination Following an Occurrence that Leaves the RCS Saturated with OTSGs Removing Heat	
CP-104	Transient Termination Following an Occurrence that Leaves the RCS being Cooled by HPI Cooling	
CP-105	Transient Termination Following an Occurrence That May Require Pressurizer Recovery of Solid Plant Cooldown	
CP-106	Cooldown Following ICC	
Section ICC	Follow-up Actions for Inadequate Core Cooling	

D·R·A·F·T

LIST OF FIGURES

Figure	
1	HPI Flow Vs RC Pressure
2	RC Pressure/Temperature Limits
3	Core Exit Fluid Temperature for Inadequate Core Cooling

D·R·A·F·T

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NUCLEAR POWER GENERATION DIVISION

TABLE OF CONTENTS/EFFECTIVE PAGE LIST

NUMBER 74-1123297-00

SECTION	TITLE	PAGE	DOC. NO.
	Acronym Glossary	4	74-1123297-00
		5	74-1123297-00
I	Immediate Actions	6	74-1123297-00
II	Vital System Status Verification	7	74-1123297-00
		8	74-1123297-00
		9	74-1123297-00
		10	74-1123297-00
III A	Follow-Up Actions for Treatment of Lack of Adequate Subcooling Margin	11	74-1123297-00
		12	74-1123297-00
		13	74-1123297-00
		14	74-1123297-00
		15	74-1123297-00
III B	Follow-Up Actions for Treatment of Lack of Primary to Secondary Heat Transfer in Either OTSG	16	74-1123297-00
		17	74-1123297-00
		18	74-1123297-00
		19	74-1123297-00
		20	74-1123297-00
		21	74-1123297-00
		22	74-1123297-00
		23	74-1123297-00
III C	Follow-Up Actions for Treatment of Too Much Primary to Secondary Heat Transfer	24	74-1123297-00
		25	74-1123297-00
		26	74-1123297-00
		27	74-1123297-00
		28	74-1123297-00
		29	74-1123297-00
III D	Follow-up Actions for Tube Rupture	30	74-1123297-00
		31	74-1123297-00
		32	74-1123297-00
		33	74-1123297-00
		34	74-1123297-00
		35	74-1123297-00
		36	74-1123297-00
		37	74-1123297-00

D·R·A·F·T

BABCOCK & WILCOX
NUCLEAR POWER GENERATION DIVISION

TABLE OF CONTENTS/EFFECTIVE PAGE LIST

NUMBER 74-1123297-00

SECTION	TITLE	PAGE	DOC. NO.
CP-101	Transient Termination Following Large LOCA When CF Tank has Emptied	38	74-1123297-00
		39	74-1123297-00
		40	74-1123297-00
CP-102	Normal Cooldown	41	74-1123297-00
CP-103	Transient Termination Following an Occurrence that Leaves the RCS Saturated with OTSGs Removing Heat	42	74-1123297-00
		43	74-1123297-00
		44	74-1123297-00
CP-104	Transient Termination Following an Occurrence that Leaves the RCS Being Cooled by HPI Cooling	45	74-1123297-00
		46	74-1123297-00
		47	74-1123297-00
		48	74-1123297-00
CP-105	Transient Termination Following an Occurrence That May Require Pressurizer Recovery or Solid Plant Cooldown	49	74-1123297-00
		50	74-1123297-00
CP-106	Cooldown Following ICC	51	74-1123297-00
		52	74-1123297-00
		53	74-1123297-00
ICC	Follow-Up Actions for Inadequate Core Cooling	54	74-1123297-00
		55	74-1123297-00

D·R·A·F·T

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
CCW	Component Cooling Water
LPI	Low Pressure Injection
MFW	Main Feedwater
MSRV	Main Steam Relief Valve
N_2	Nitrogen
NDT	Nil Ductility Temperature
NR	Narrow Range

D·R·A·F·T

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
SLB	Steam Line Break
STM-LK	Steam Leaking (Steam Generator)
SU	Startup
TBV	Turbine Bypass Valve
Tc	Tcold, reactor inlet
T/C	Thermocouple
Th	Thot, reactor outlet
TR	Tube Ruptured (Steam Generator)
WR	Wide Range

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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.	

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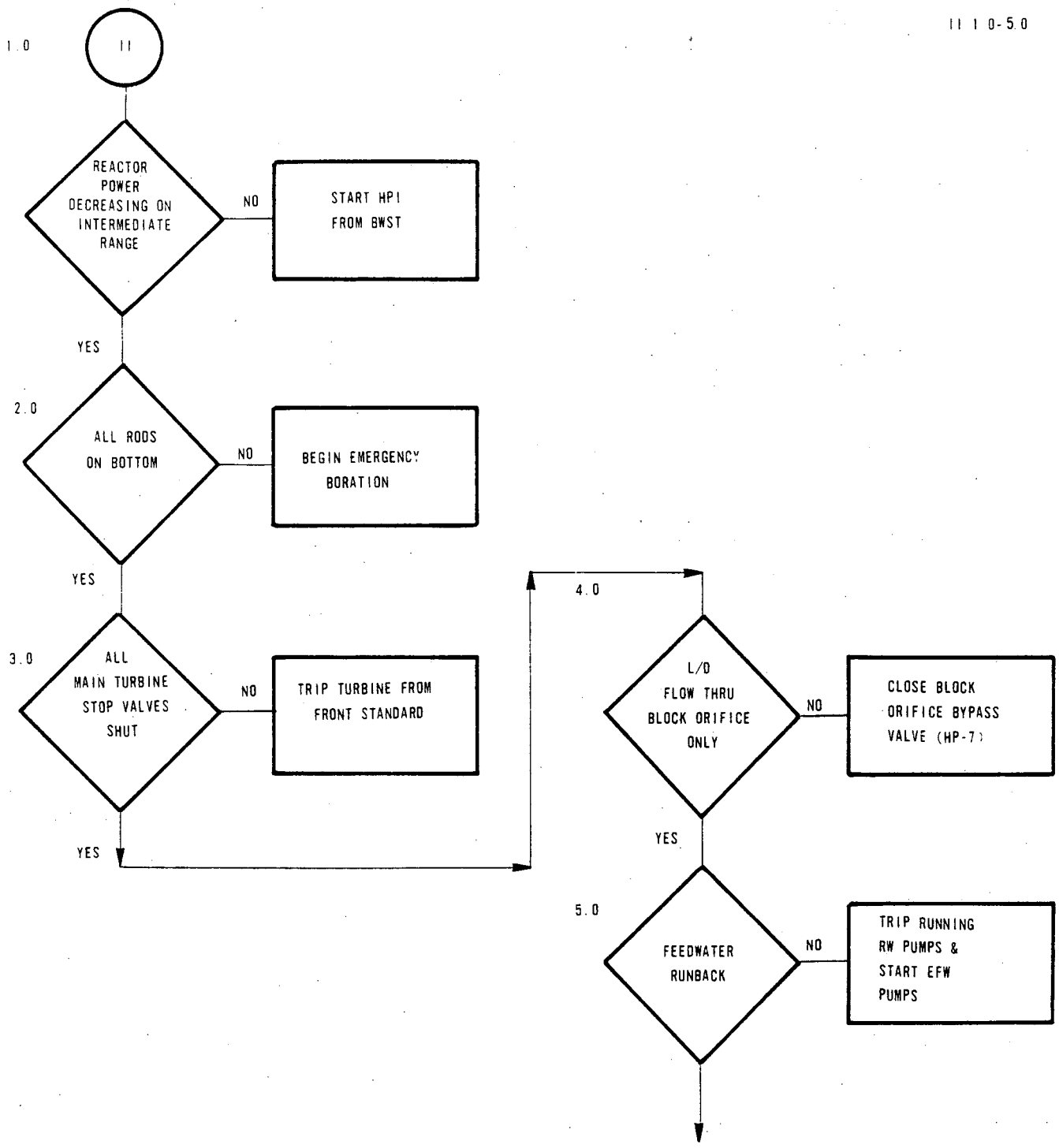
1.0
II
REACTOR POWER DECREASING ON INTERMEDIATE RANGE
NO
START HPI FROM BWST
YES
2.0
ALL RODS ON BOTTOM
NO
BEGIN EMERGENCY BORATION
YES
3.0
ALL MAIN TURBINE STOP VALVES SHUT
NO
TRIP TURBINE FROM FRONT STANDARD
YES
4.0
L/D FLOW THRU BLOCK ORIFICE ONLY
NO
CLOSE BLOCK ORIFICE BYPASS VALVE (HP-7)
YES
5.0
FEEDWATER RUNBACK
NO
TRIP RUNNING RW PUMPS & START EFW PUMPS

Section II

Vital System Status Verification

Verification Column	Remedial Action Column
Verify the following:	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.

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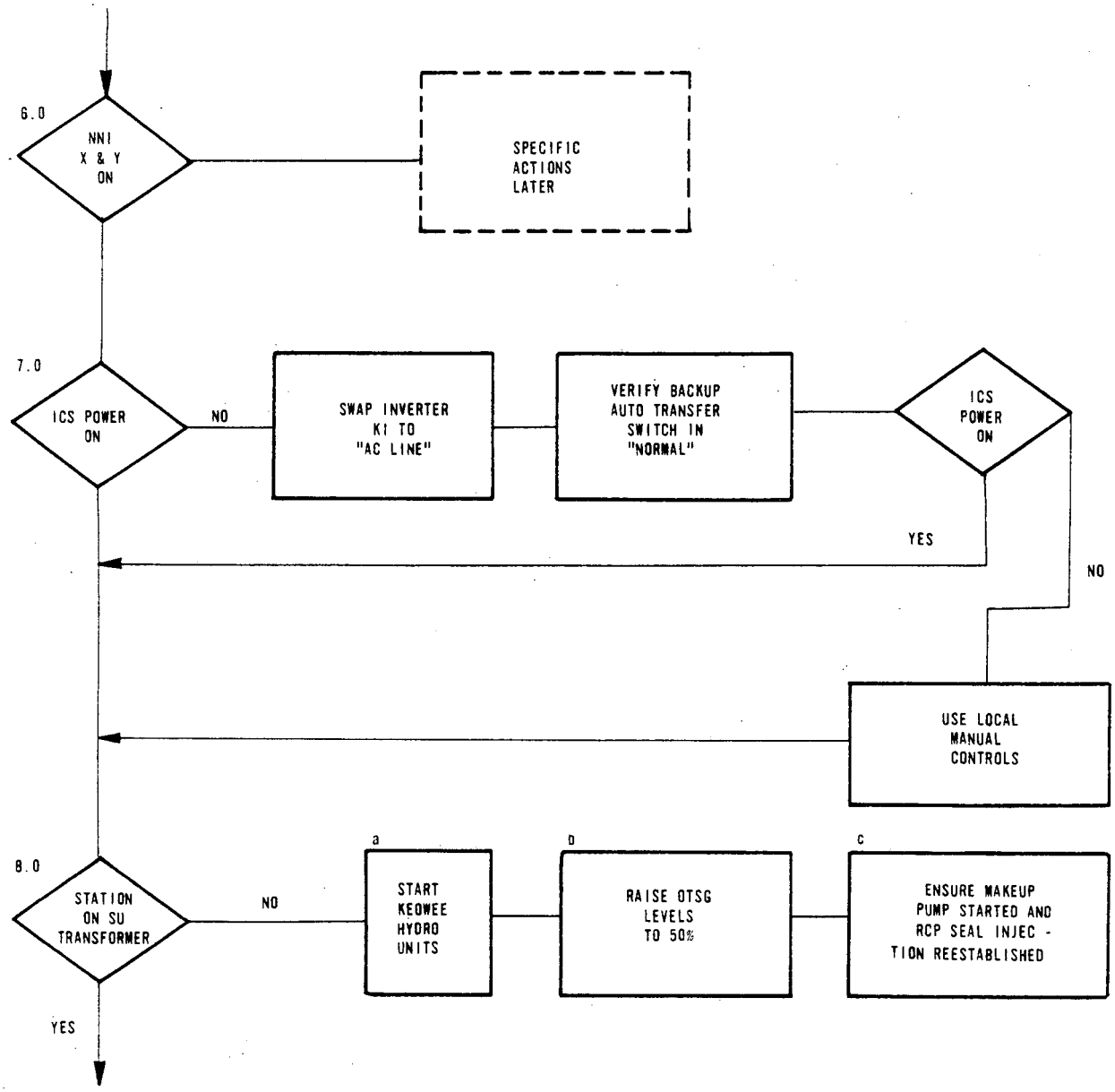
6.0
NNI
X & Y
ON
SPECIFIC
ACTIONS
LATER
7.0
ICS POWER
ON
NO
SWAP INVERTER
KI TO
"AC LINE"
VERIFY BACKUP
AUTO TRANSFER
SWITCH IN
"NORMAL"
ICS
POWER
ON
YES
NO
USE LOCAL
MANUAL
CONTROLS
8.0
STATION
ON SU
TRANSFORMER
NO
a
START
KEOWEE
HYDRO
UNITS
b
RAISE OTSG
LEVELS
TO 50%
c
ENSURE MAKEUP
PUMP STARTED AND
RCP SEAL INJEC -
TION REESTABLISHED
YES

Verification Column	Remedial Action Column
Verify the following:	
6.0 NNI X and Y Power On	(Specific actions to be determined later.)
7.0 ICS power on as indicated by hand-auto lights lit on ICS stations.	a) Manually swap inverter KI to "AC Line". b) Verify that the Backup Auto Transfer switch is in the "Normal" position. c) If ICS power is still not restored, use local manual controls. (Refer to OP/3/A/1107/04 for additional information.)
8.0 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%. c) Ensure a makeup pump is started and RCP seal injection is re-established.

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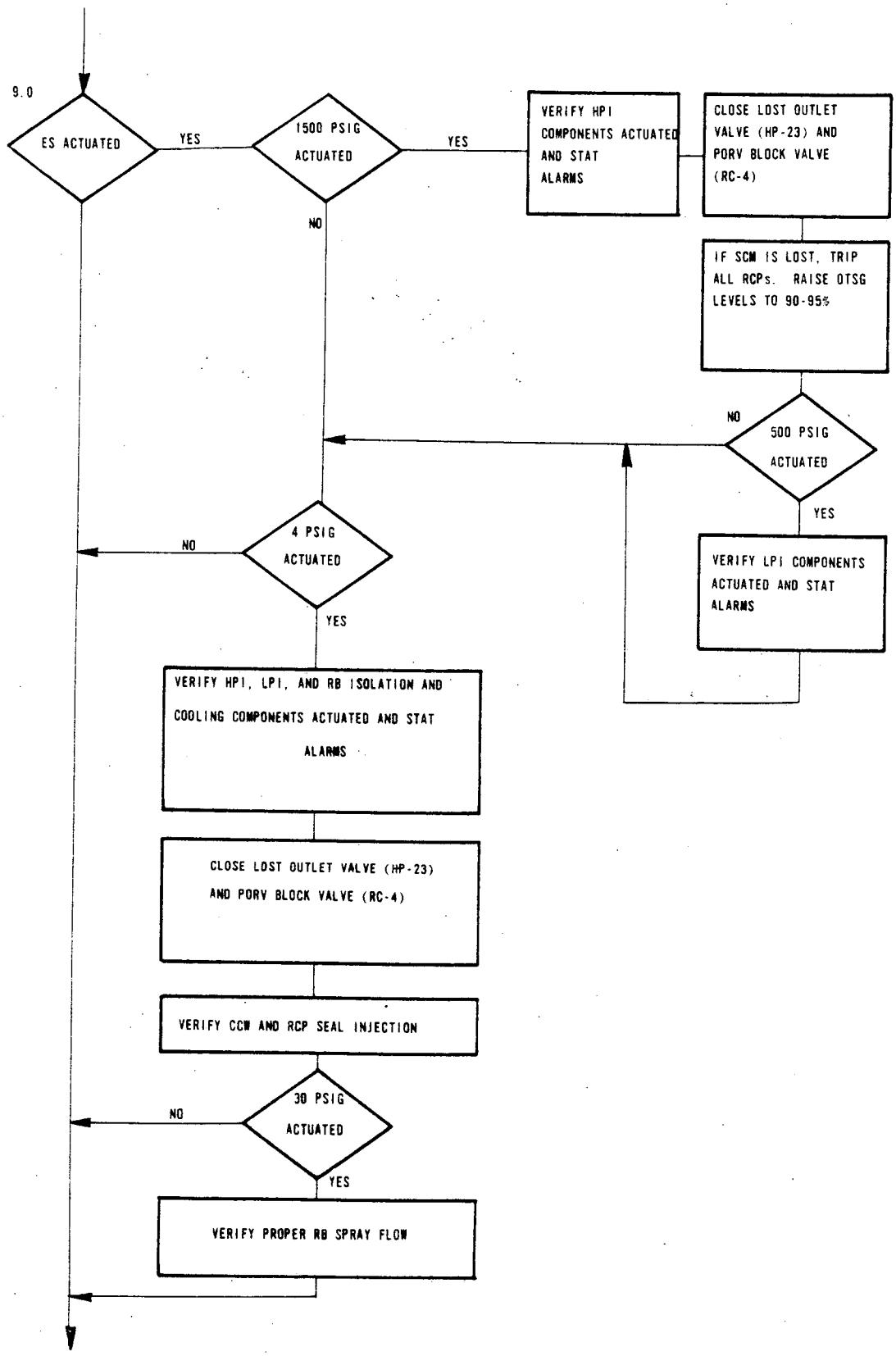
9.0
ES ACTUATED
YES
1500 PSIG ACTUATED
YES
NO
VERIFY HPI COMPONENTS ACTUATED AND STAT ALARMS
CLOSE LOST OUTLET VALVE (HP-23) AND PORV BLOCK VALVE (RC-4)
IF SCM IS LOST, TRIP ALL RCPs. RAISE OTSG LEVELS TO 90-95%
NO
500 PSIG ACTUATED
YES
VERIFY LPI COMPONENTS ACTUATED AND STAT ALARMS
NO
4 PSIG ACTUATED
YES
VERIFY HPI, LPI, AND RB ISOLATION AND COOLING COMPONENTS ACTUATED AND STAT ALARMS
CLOSE LOST OUTLET VALVE (HP-23) AND PORV BLOCK VALVE (RC-4)
VERIFY CCW AND RCP SEAL INJECTION
NO
30 PSIG ACTUATED
YES
VERIFY PROPER RB SPRAY FLOW

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TECHNICAL DOCUMENT

NUMBER 74-1123297-00

Verification Column	Remedial Action Column
Verify the following:	
9.0 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. b) Close letdown storage tank outlet valve (HP-23) and PORV block valve (RC-4). c) If subcooling margin is lost, trip all RCPs. While properly throttling feedwater, raise OTSG levels to 90-95%. 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. 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) Verify component cooling water and RCP seal injection. 10 PSIG Alarm a) Verify proper RB spray flow.

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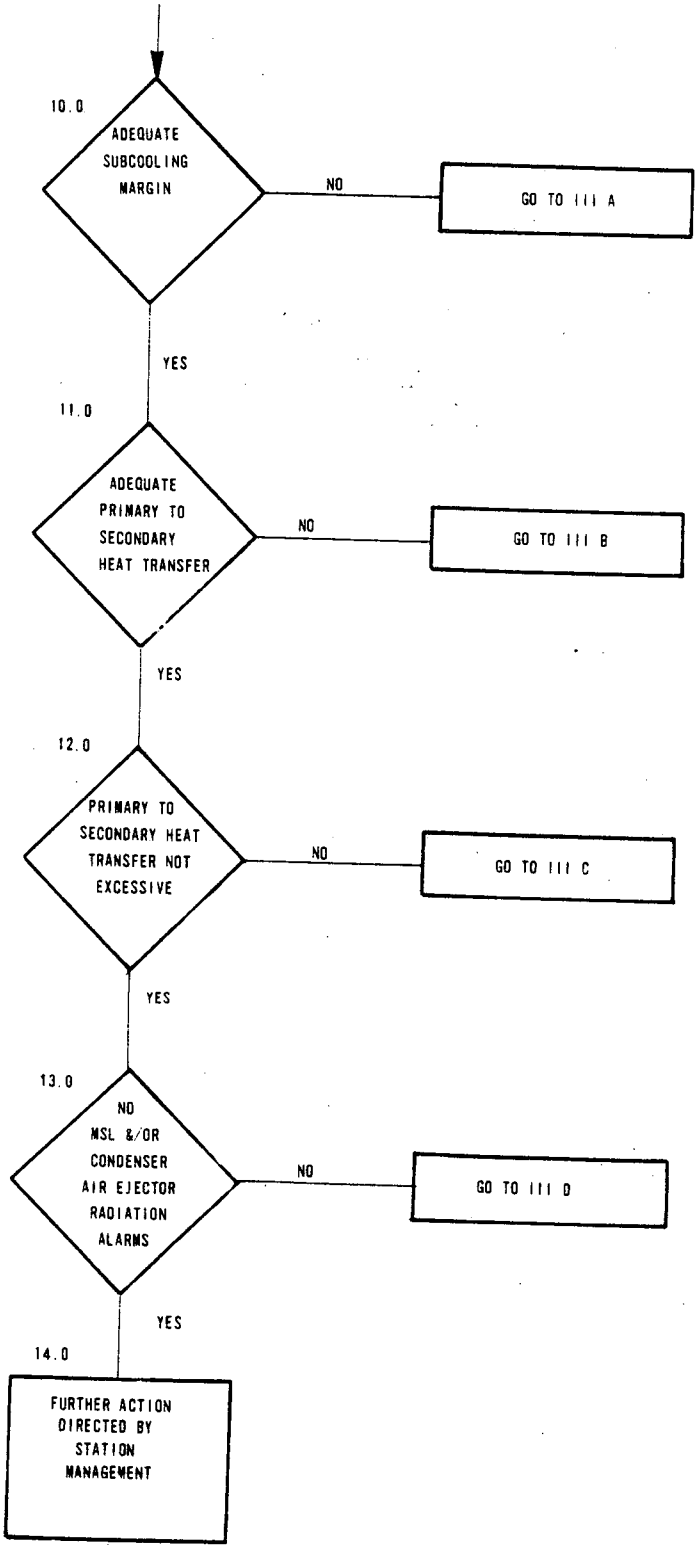
10.0
ADEQUATE SUBCOOLING MARGIN
NO
GO TO III A
YES
11.0
ADEQUATE PRIMARY TO SECONDARY HEAT TRANSFER
NO
GO TO III B
YES
12.0
PRIMARY TO SECONDARY HEAT TRANSFER NOT EXCESSIVE
NO
GO TO III C
YES
13.0
NO MSL &/OR CONDENSER AIR EJECTOR RADIATION ALARMS
NO
GO TO III D
YES
14.0
FURTHER ACTION DIRECTED BY STATION MANAGEMENT

Verification Column	Remedial Action Column
Verify the following:	
10.0 Adequate subcooling margin exists	Go to Section IIIA - Follow-up Actions for Treatment of Lack of Adequate Subcooling Margin.
11.0 Adequate primary to secondary heat transfer exists.	Go to Section IIIB - Follow-up Actions for Treatment of Lack of Primary to Secondary Heat Transfer.
12.0 Primary to secondary heat transfer is not excessive.	Go to Section IIIC - Follow-up Actions for Treatment of Too Much Primary to Secondary Heat Transfer.
13.0 No main steam line and/or condenser air ejector radiation monitor alarms.	Go to Section IIID - Follow-up Actions for OTSG Tube Rupture.

14.0 The plant is stable in a safe subcooled condition with proper primary to secondary heat transfer and no primary boundary failures. Further action at this point will be the discretion of station management.

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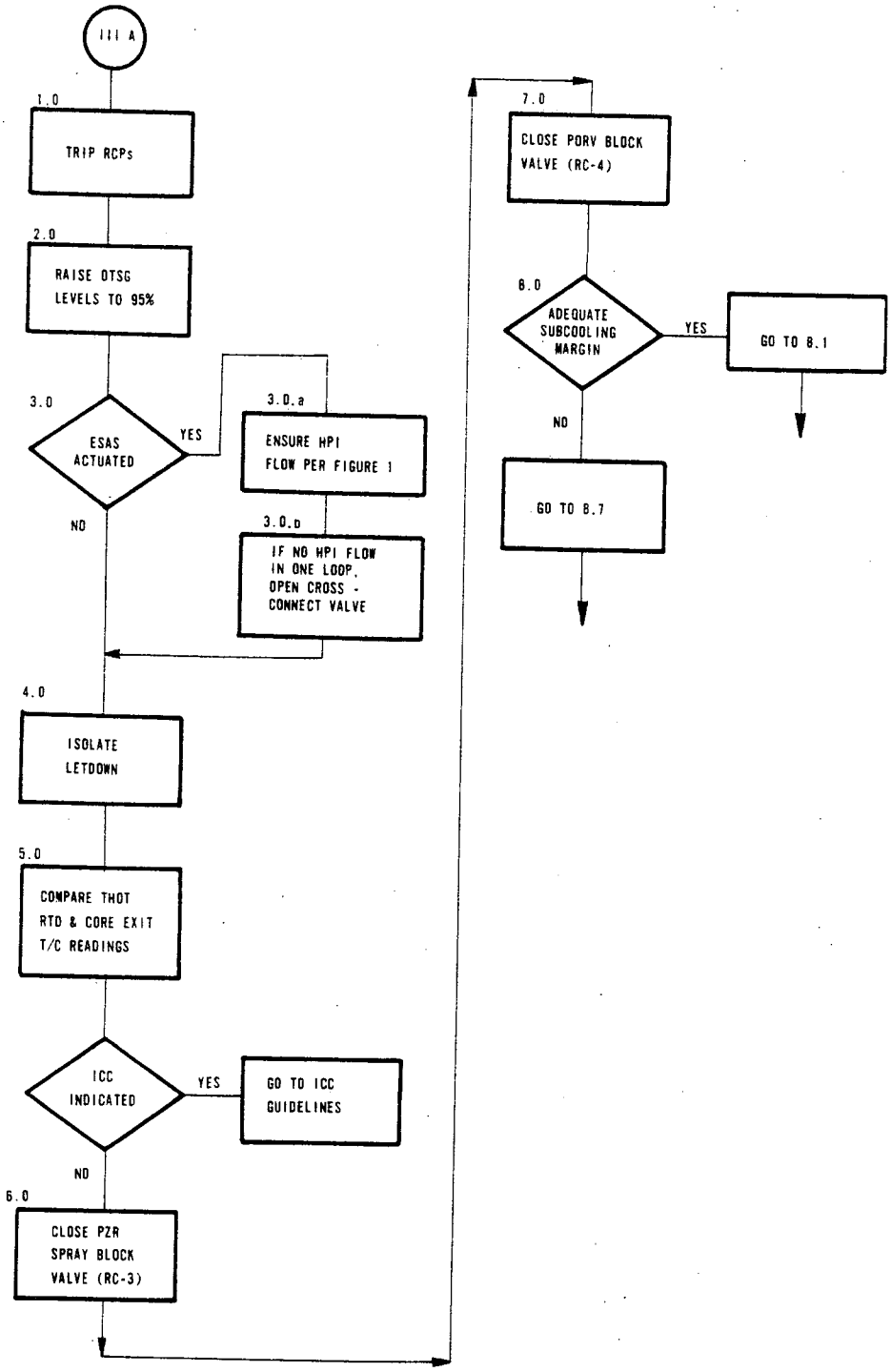
III A
1.0
TRIP RCPs
2.0
RAISE OTSG LEVELS TO 95%
3.0
ESAS ACTUATED
YES
NO
3.0.a
ENSURE HPI FLOW PER FIGURE 1
3.0.b
IF NO HPI FLOW IN ONE LOOP, OPEN CROSS - CONNECT VALVE
4.0
ISOLATE LETDOWN
5.0
COMPARE THOT RTD & CORE EXIT T/C READINGS
ICC INDICATED
YES
GO TO ICC GUIDELINES
NO
6.0
CLOSE PZR SPRAY BLOCK VALVE (RC-3)
7.0
CLOSE PORV BLOCK VALVE (RC-4)
8.0
ADEQUATE SUBCOOLING MARGIN
YES
GO TO 8.1
NO
GO TO 8.7

Section III A

Follow-up Actions for Treatment of Lack of Adequate Subcooling Margin

1.0 Trip all RCPs.

2.0 If possible, raise OTSG levels to 90-95% on operate range while properly throttling feedwater.

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3.0 If ES actuates:

a) Ensure maximum HPI flow per Figure 1

b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header

4.0 Isolate all letdown.

5.0 Compare Thot RTD and core exit thermocouple temperatures frequently for indications of:

5.1 Natural Circulation - RTD and T/C readings track together

5.2 Inadequate Core Cooling - RTD and T/C readings show superheated conditions

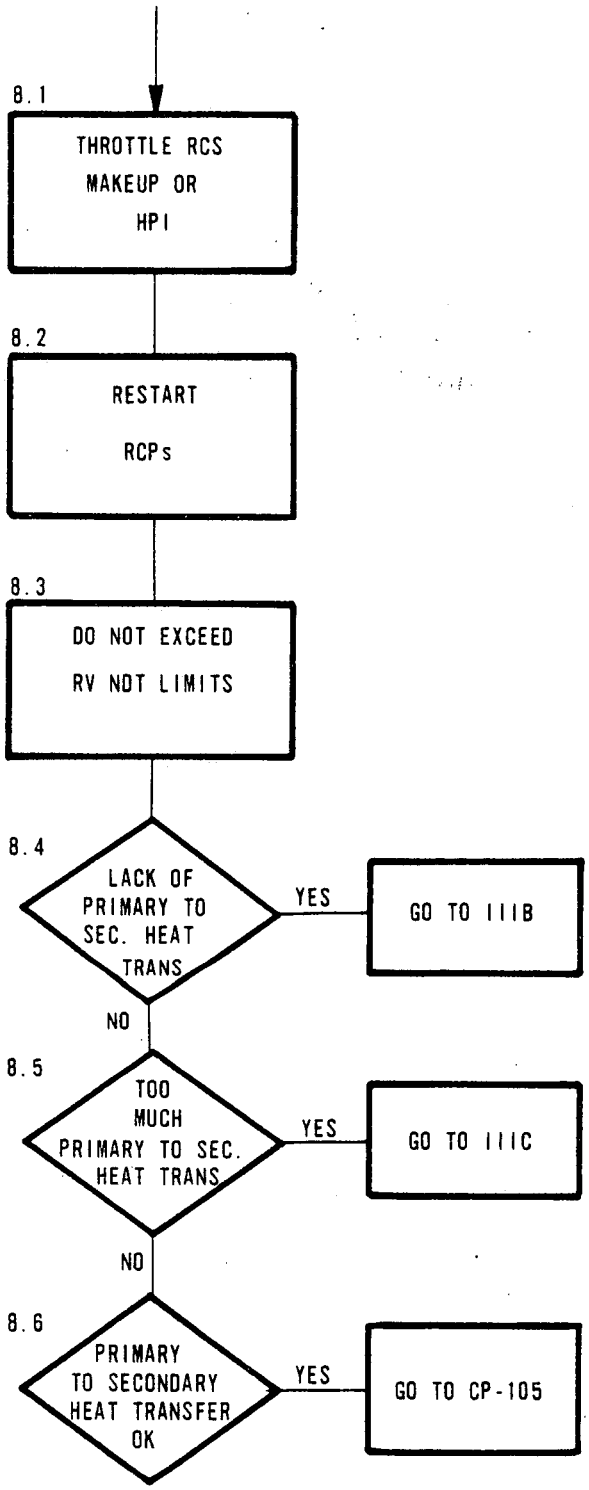
5.3 If Inadequate Core Cooling is indicated, go to Section ICC, otherwise continue.

6.0 Close Pressurizer Spray Block valve (RC-3).

7.0 Close PORV block valve (RC-4).

8.0 If adequate subcooling margin has been established, to to step 8.1.

If adequate subcooling margin has not been established, go to step 8.7.


8.1
THROTTLE RCS MAKEUP OR HPI
8.2
RESTART RCPs
8.3
DO NOT EXCEED RV NOT LIMITS
8.4
LACK OF PRIMARY TO SEC. HEAT TRANS
YES
GO TO IIIB
NO
8.5
TOO MUCH PRIMARY TO SEC. HEAT TRANS
YES
GO TO IIIC
NO
8.6
PRIMARY TO SECONDARY HEAT TRANSFER OK
YES
GO TO CP-105

Adequate Subcooling Margin has been Established

8.1 Throttle RCS makeup, or HPI, to maintain adequate subcooling margin.

8.2 Restart RCPs per OP/3/A/1103/6.

8.3 Do not exceed reactor vessel NDT limits.

8.4 If there is Lack of Primary to Secondary Heat Transfer, go to Section III B, otherwise continue.

8.5 If there is Too Much Primary to Secondary Heat Transfer, go to Section III C, otherwise continue.

8.6 Primary to Secondary Heat Transfer is being controlled properly, go to CP-105.

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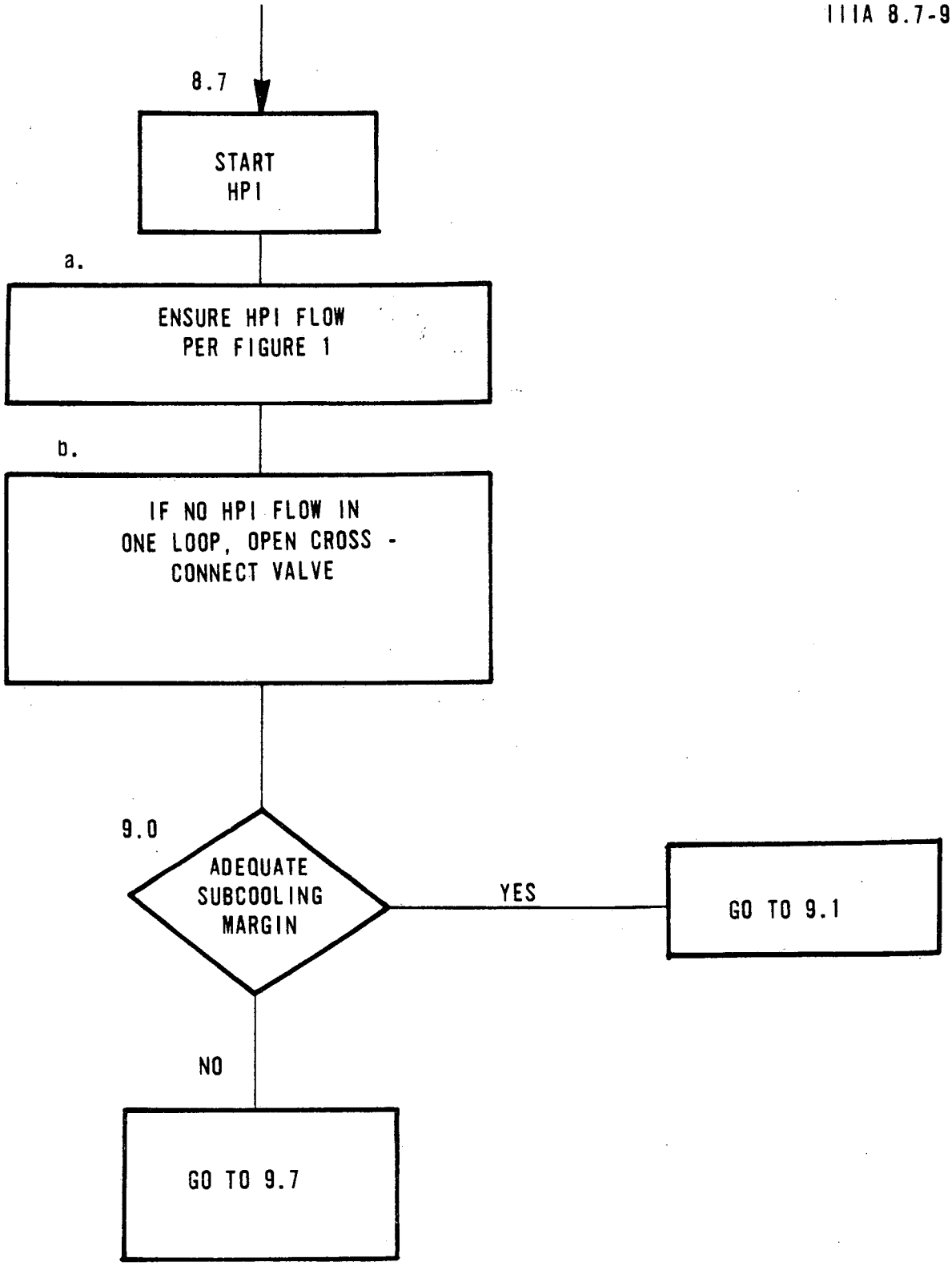
PPS | The RCS is subcooled. There may or may not be a bubble in the pressurizer. OTSG heat transfer is controlled. CP-105 provides instructions either to draw a bubble if necessary and then cooldown normally or to cooldown solid if a bubble cannot be drawn.


8.7
START
HPI
a.
ENSURE HPI FLOW
PER FIGURE 1
b.
IF NO HPI FLOW IN
ONE LOOP, OPEN CROSS -
CONNECT VALVE
9.0
ADEQUATE
SUBCOOLING
MARGIN
YES
GO TO 9.1
NO
GO TO 9.7

Adequate Subcooling Margin has not been established

8.7 Follow the subcooling rule:

Start HPI if not already in operation:

a) Ensure maximum HPI flow per Figure 1

b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header.

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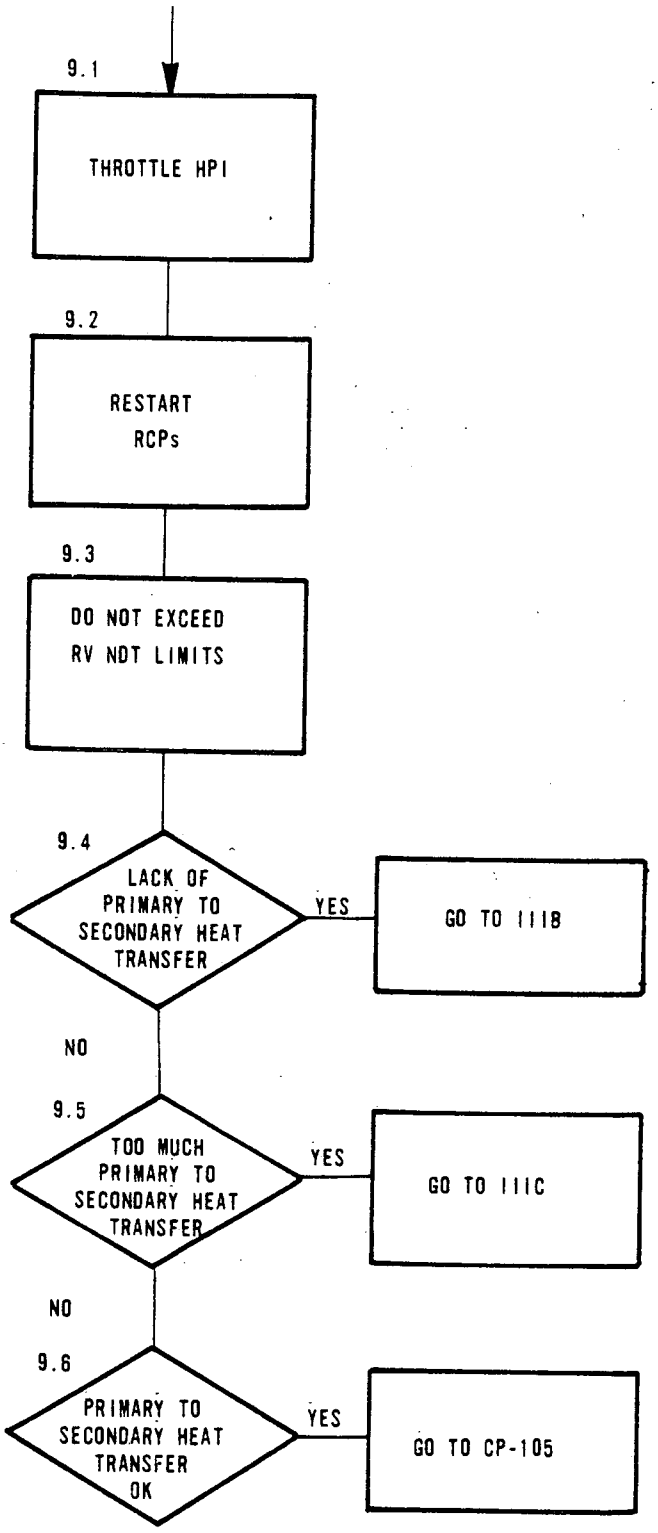
9.0 If adequate subcooling margin has been established, go to step 9.1.

If adequate subcooling margin has not been established, go to step 9.7.


9.1
THROTTLE HPI
9.2
RESTART RCPs
9.3
DO NOT EXCEED RV NDT LIMITS
9.4
LACK OF PRIMARY TO SECONDARY HEAT TRANSFER
YES
GO TO IIIB
NO
9.5
TOO MUCH PRIMARY TO SECONDARY HEAT TRANSFER
YES
GO TO IIIC
NO
9.6
PRIMARY TO SECONDARY HEAT TRANSFER OK
YES
GO TO CP-105

Adequate Subcooling Margin has been established by Full HPI

9.1 Throttle HPI to maintain adequate subcooling margin.

9.2 Restart RCPs per OP/3/A/1103/6.

9.3 Do not exceed reactor vessel NDT limits.

9.4 If there is Lack of Primary to Secondary Heat Transfer, go to Section III B, otherwise continue.

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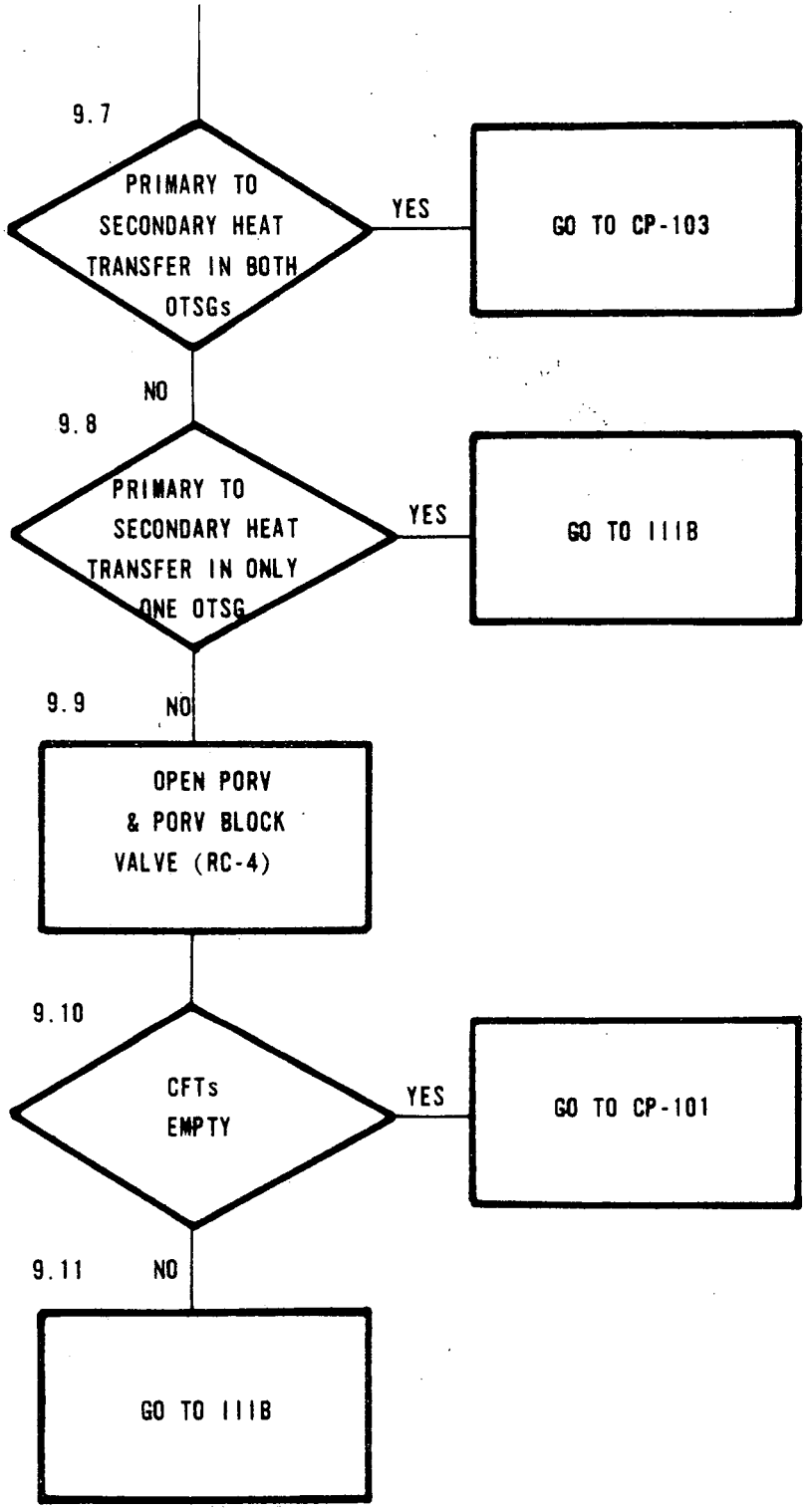
9.5 If there is Too Much Primary to Secondary Heat Transfer, go to Section III C, otherwise continue.

9.6 Primary to Secondary Heat Transfer is being controlled properly, go to CP-105.

PPS | The RCS is subcooled. There may or may not be a bubble in the pressurizer. OTSG heat transfer is controlled. CP-105 provides instructions either to draw a bubble if necessary and then cool down normally or to cool down solid if a bubble cannot be drawn.


9.7
PRIMARY TO SECONDARY HEAT TRANSFER IN BOTH OTSGs
YES
GO TO CP-103
NO
9.8
PRIMARY TO SECONDARY HEAT TRANSFER IN ONLY ONE OTSG
YES
GO TO IIIB
9.9
NO
OPEN PORV & PORV BLOCK VALVE (RC-4)
9.10
CFTs EMPTY
YES
GO TO CP-101
9.11
NO
GO TO IIIB

Adequate Subcooling Margin has not been established by Full HPI

9.7 If there is Primary to Secondary Heat Transfer in both OTSGs, go to CP-103, otherwise continue.

P
P
S

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

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9.8 If there is Primary to Secondary Heat Transfer in only one OTSG, go to Section III B, otherwise continue.

9.9 If there is no Primary to Secondary Heat Transfer:

1. Open PORV block valve (RC-4).

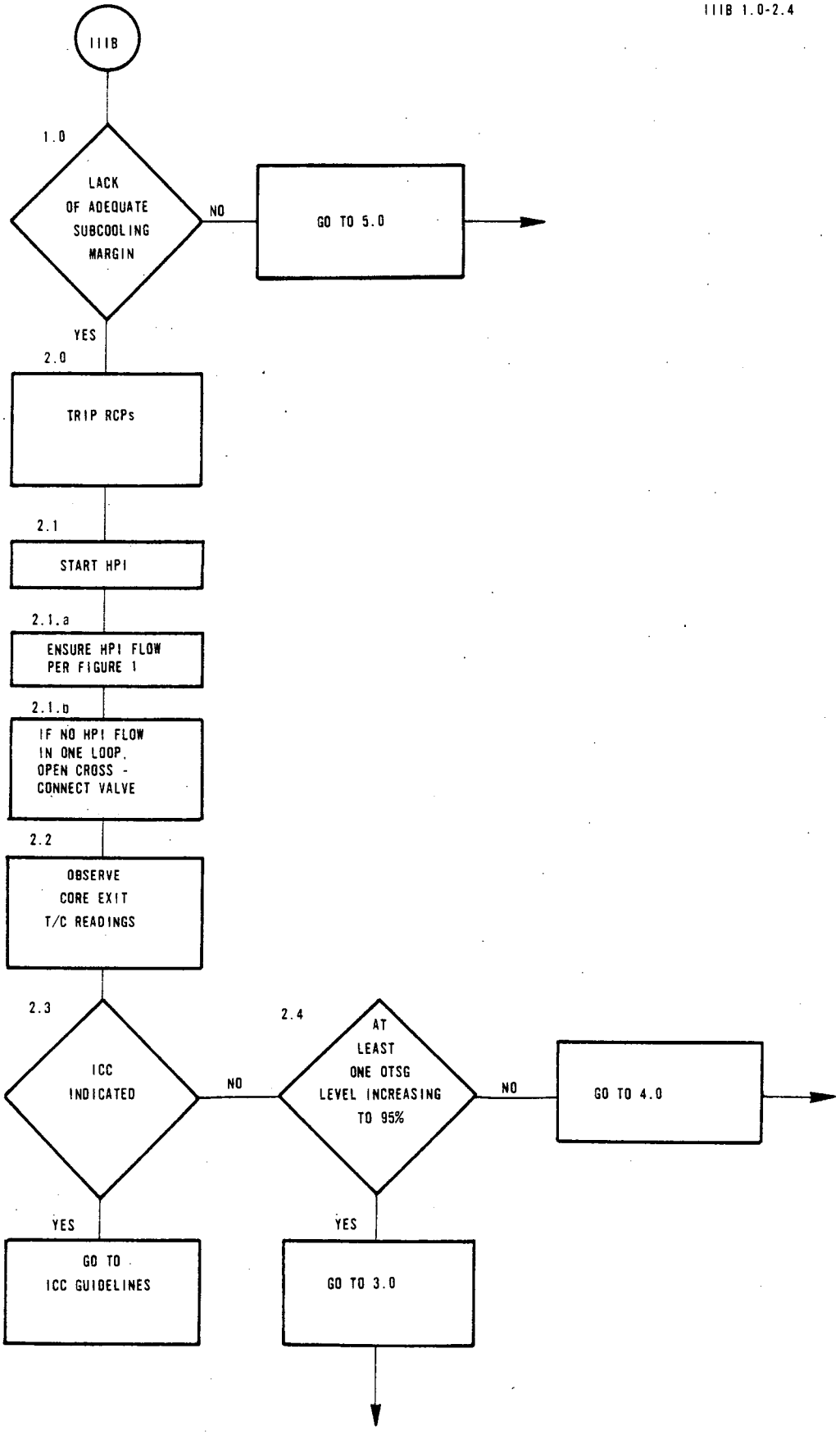
2. Open PORV

9.10 If the CFTs have emptied, 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 core cooling following a major LOCA. Do not go to Section III B. Primary to Secondary Heat Transfer will be lost and cannot be regained.

9.11 If the CFTs have not emptied, go to Section III B.


IIIB
1.0
LACK OF ADEQUATE SUBCOOLING MARGIN
NO
GO TO 5.0
YES
2.0
TRIP RCPs
2.1
START HPI
2.1.a
ENSURE HPI FLOW PER FIGURE 1
2.1.b
IF NO HPI FLOW IN ONE LOOP, OPEN CROSS - CONNECT VALVE
2.2
OBSERVE CORE EXIT T/C READINGS
2.3
ICC INDICATED
NO
2.4
AT LEAST ONE OTSG LEVEL INCREASING TO 95%
NO
GO TO 4.0
YES
GO TO ICC GUIDELINES
YES
GO TO 3.0

Section III B

Follow-up Actions for Treatment of
Lack of Primary to Secondary Heat Transfer in Either OTSG

1.0 If there is Adequate Subcooling Margin, go to step 5.0, otherwise continue.

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Lack of Adequate Subcooling Margin

2.0 Make sure RCPs are tripped.

2.1 Follow the subcooling rule:

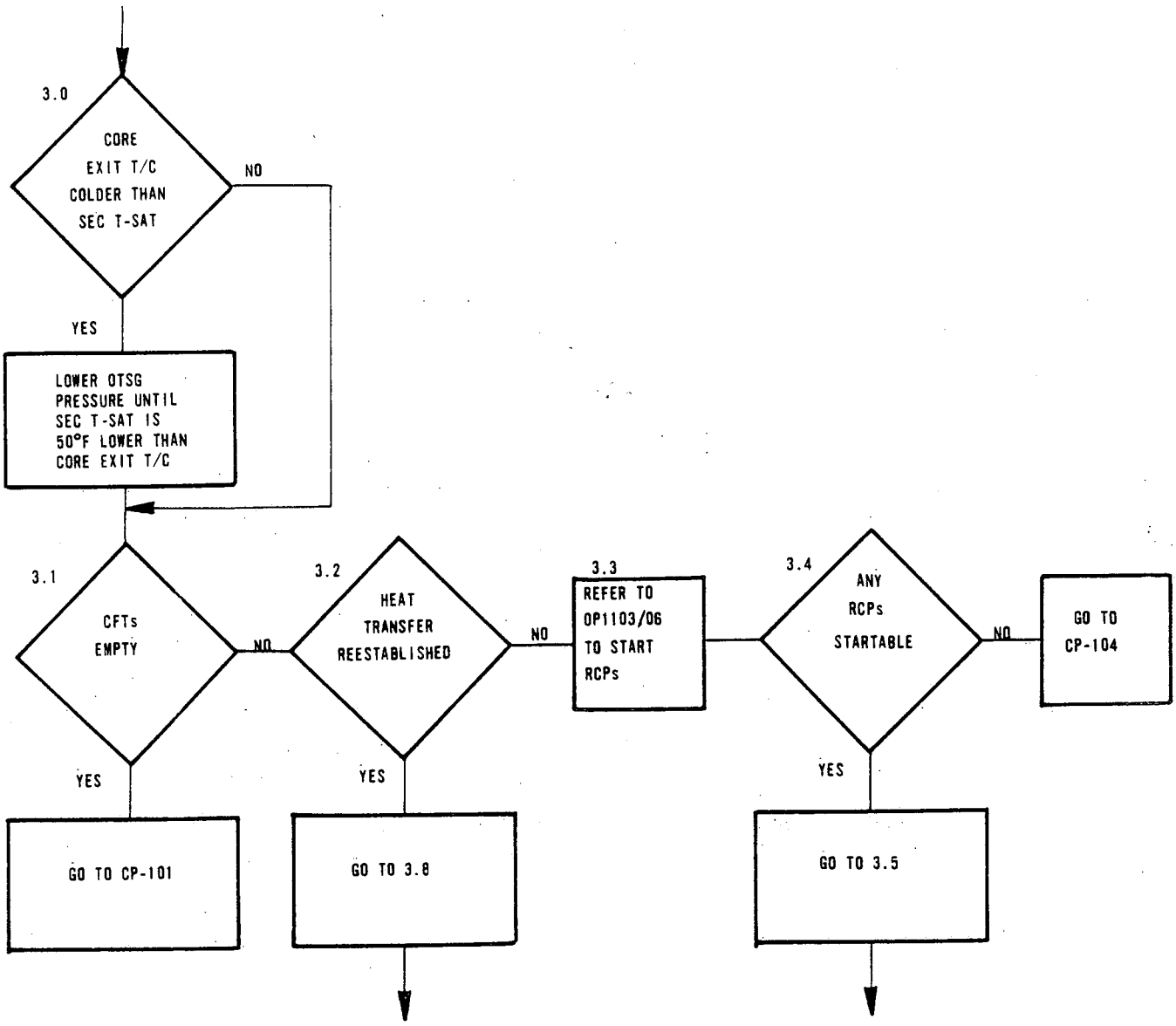
a) Start HPI if not already in operation and ensure maximum HPI flow per Figure 1.

b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header.

2.2 Observe core exit thermocouple temperatures frequently for indication of superheated conditions - Inadequate Core Cooling.

2.3 If Inadequate Core Cooling is indicated, follow Section ICC, otherwise continue.

2.4 Ensure at least one OTSG level is increasing toward, or is approximately at 90-95% on the operate range. If so, go to step 3.0. If not, go to step 4.0.


3.0
CORE EXIT T/C COLDER THAN SEC T-SAT
NO
YES
LOWER OTSG PRESSURE UNTIL SEC T-SAT IS 50°F LOWER THAN CORE EXIT T/C
3.1
CFTs EMPTY
NO
YES
GO TO CP-101
3.2
HEAT TRANSFER REESTABLISHED
NO
YES
GO TO 3.8
3.3
REFER TO OP1103/06 TO START RCPs
3.4
ANY RCPs STARTABLE
NO
YES
GO TO CP-104
GO TO 3.5

Lack of Adequate Subcooling Margin or Adequate Subcooling Margin Recovered - With OTSG Level

3.0 If core exit thermocouple temperature is colder than secondary T-sat in either OTSG, lower OTSG pressure by adjusting TBVs, while maintaining level, until secondary T-sat is approximately 50F lower than core exit thermocouple temperature. Maintain this OTSG pressure.

3.1 If the CFTs have emptied, go to CP-101, otherwise continue.

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The Core Flood Tanks emptying is an indication of a major LOCA. CP-101 provides instructions for long-term core cooling following a major LOCA. Primary to Secondary Heat Transfer is lost and cannot be regained.

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3.2 If heat transfer has been re-established in either OTSG, go to step 3.8, otherwise continue.

3.3 Determine RCP operability per OP/3/A/1103/6

3.4 If RCPs can be started, go to step 3.5, otherwise go to CP-104.

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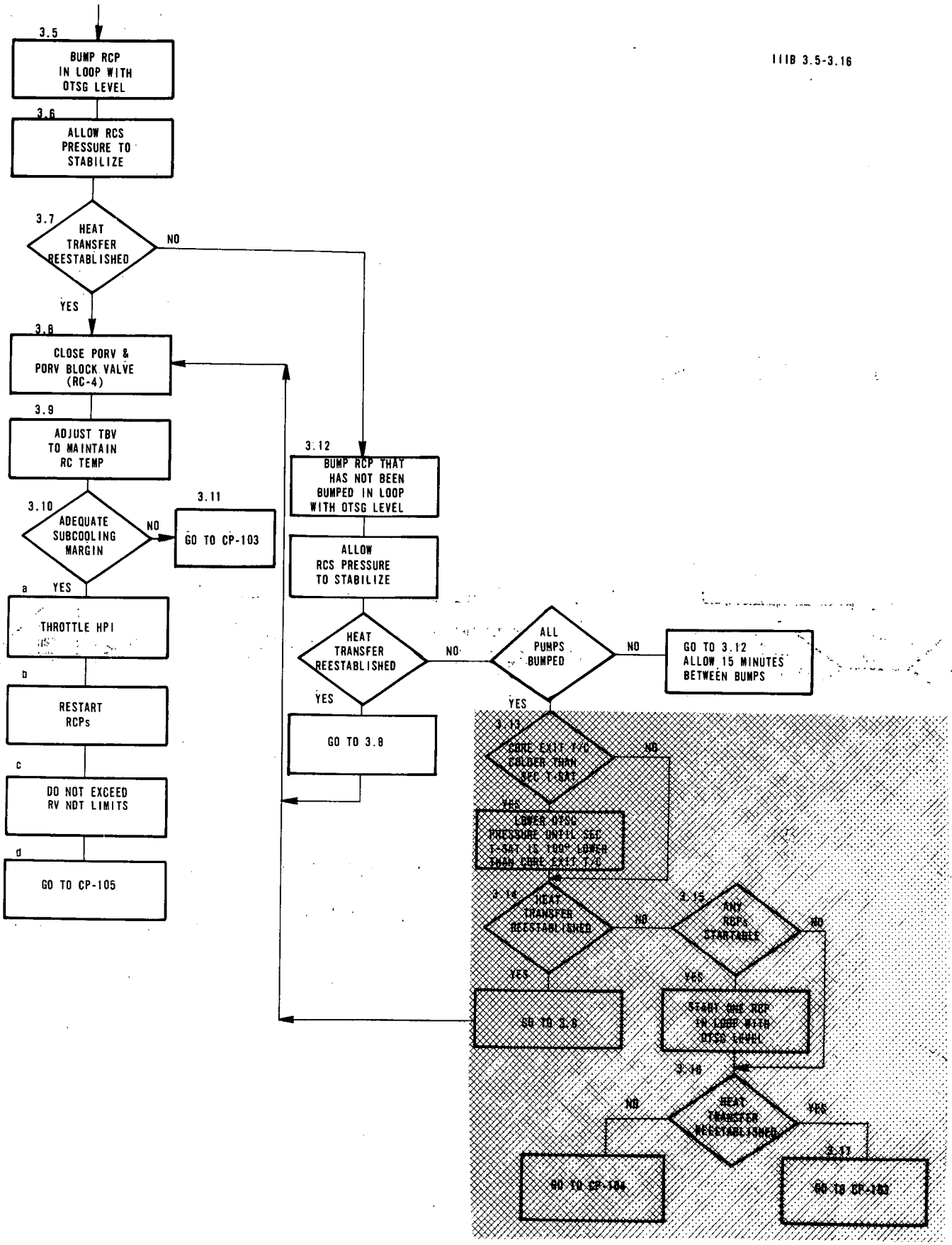
There is no heat transfer to either OTSG. Natural circulation does not exist and cannot be induced by bumping RCPs. The RCS is saturated and the core must be cooled by HPI.


3.5
BUMP RCP IN LOOP WITH OTSG LEVEL
3.6
ALLOW RCS PRESSURE TO STABILIZE
3.7
HEAT TRANSFER REESTABLISHED
NO
YES
3.8
CLOSE PORV & PORV BLOCK VALVE (RC-4)
3.9
ADJUST TBV TO MAINTAIN RC TEMP
3.10
ADEQUATE SUBCOOLING MARGIN
NO
3.11
GO TO CP-103
YES
a
THROTTLE HPI
b
RESTART RCPs
c
DO NOT EXCEED RV NDT LIMITS
d
GO TO CP-105
3.12
BUMP RCP THAT HAS NOT BEEN BUMPED IN LOOP WITH OTSG LEVEL
ALLOW RCS PRESSURE TO STABILIZE
HEAT TRANSFER REESTABLISHED
NO
YES
GO TO 3.8
ALL PUMPS BUMPED
NO
GO TO 3.12 ALLOW 15 MINUTES BETWEEN BUMPS
YES
3.13
CORE EXIT T/C COLDER THAN SEC T-SAT
NO
YES
LOWER OTSG PRESSURE UNTIL SEC T-SAT IS 100° LOWER THAN CORE EXIT T/C
3.14
HEAT TRANSFER REESTABLISHED
NO
YES
GO TO 3.8
3.15
ANY RCPs STARTABLE
NO
YES
START ONE RCP IN LOOP WITH OTSG LEVEL
3.16
HEAT TRANSFER REESTABLISHED
NO
YES
GO TO CP-104
3.17
GO TO CP-103

3.5 Bump an RCP, which is capable of being started, in a loop with level in the OTSG.

3.6 Allow RCS pressure to stabilize.

3.7 If heat transfer has not been re-established, go to step 3.12.

If heat transfer has been re-established, follow steps 3.8 through 3.11.

3.8 Close PORV and PORV block valve (RC-4).

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

3.10 If there is Adequate Subcooling Margin:

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a. Throttle HPI or normal makeup to maintain adequate subcooling margin.

b. Restart RCPs.

c. Do not exceed reactor vessel NDT limits.

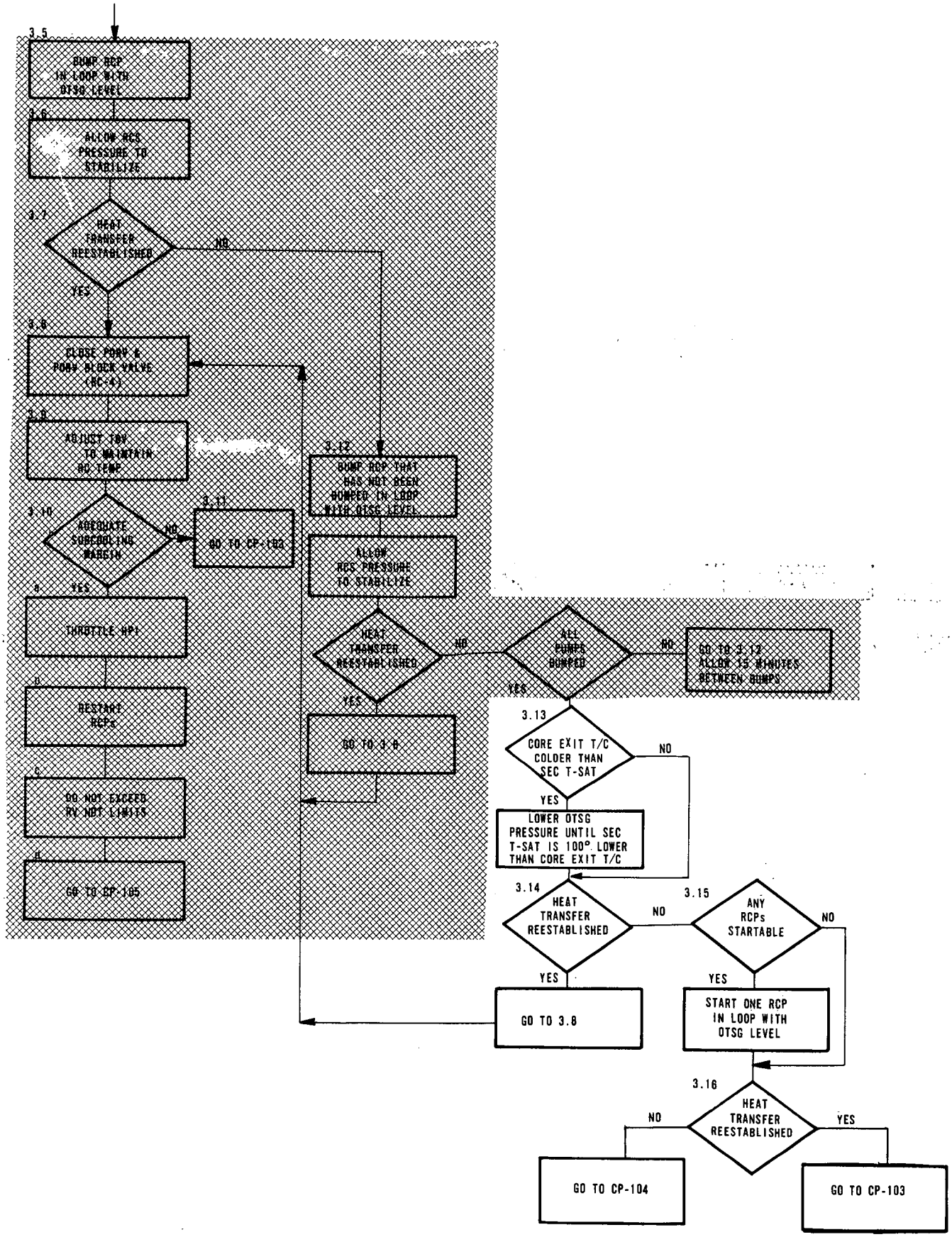
d. Go to CP-105.

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

3.11 If there is Lack of Adequate Subcooling Margin, go to CP-103.

P P S | Natural circulation exists. The RCS is saturated and a small break probably exists. HPI is maintaining RCS inventory.

3.12 Repeat steps 3.5 through 3.7 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 re-established, follow steps 3.13 through 3.16.


3.5
BUMP RCP IN LOOP WITH OTSG LEVEL
3.6
ALLOW RCS PRESSURE TO STABILIZE
3.7
HEAT TRANSFER REESTABLISHED
NO
YES
3.8
CLOSE PORV & PORV BLOCK VALVE (RC-4)
3.9
ADJUST TBV TO MAINTAIN RC TEMP
3.10
ADEQUATE SUBCOOLING MARGIN
NO
3.11
GO TO CP-103
YES
a
THROTTLE HPI
b
RESTART RCPs
c
DO NOT EXCEED PV NOT LIMITS
d
GO TO CP-105
3.12
BUMP RCP THAT HAS NOT BEEN BUMPED IN LOOP WITH OTSG LEVEL
ALLOW RCS PRESSURE TO STABILIZE
HEAT TRANSFER REESTABLISHED
NO
ALL PUMPS BUMPED
NO
GO TO 3.12 ALLOW 15 MINUTES BETWEEN BUMPS
YES
YES
GO TO 3.8
3.13
CORE EXIT T/C COLDER THAN SEC T-SAT
NO
YES
LOWER OTSG PRESSURE UNTIL SEC T-SAT IS 100° LOWER THAN CORE EXIT T/C
3.14
HEAT TRANSFER REESTABLISHED
NO
3.15
ANY RCPs STARTABLE
NO
YES
GO TO 3.8
YES
START ONE RCP IN LOOP WITH OTSG LEVEL
3.16
HEAT TRANSFER REESTABLISHED
NO
YES
GO TO CP-104
GO TO CP-103

3.13 If core exit thermocouple temperature is colder than secondary T-sat in either OTSG, lower OTSG pressure by adjusting TBVs, while maintaining level, until secondary T-sat is approximately 100F lower than core exit thermocouple temperature. Maintain this OTSG pressure.

3.14 If heat transfer has been re-established, go to step 3.8, otherwise continue.

3.15 If at least one hour has past since reactor trip and any RCPs are capable of being started start one RCP preferably in a loop with OTSG level greater than 30".

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3.16 If heat transfer has <u>not</u> been re-established, go to CP-104, otherwise continue.

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There is no heat transfer to either OTSG. 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.

3.17 Heat transfer has been re-established, go to CP-103.

P
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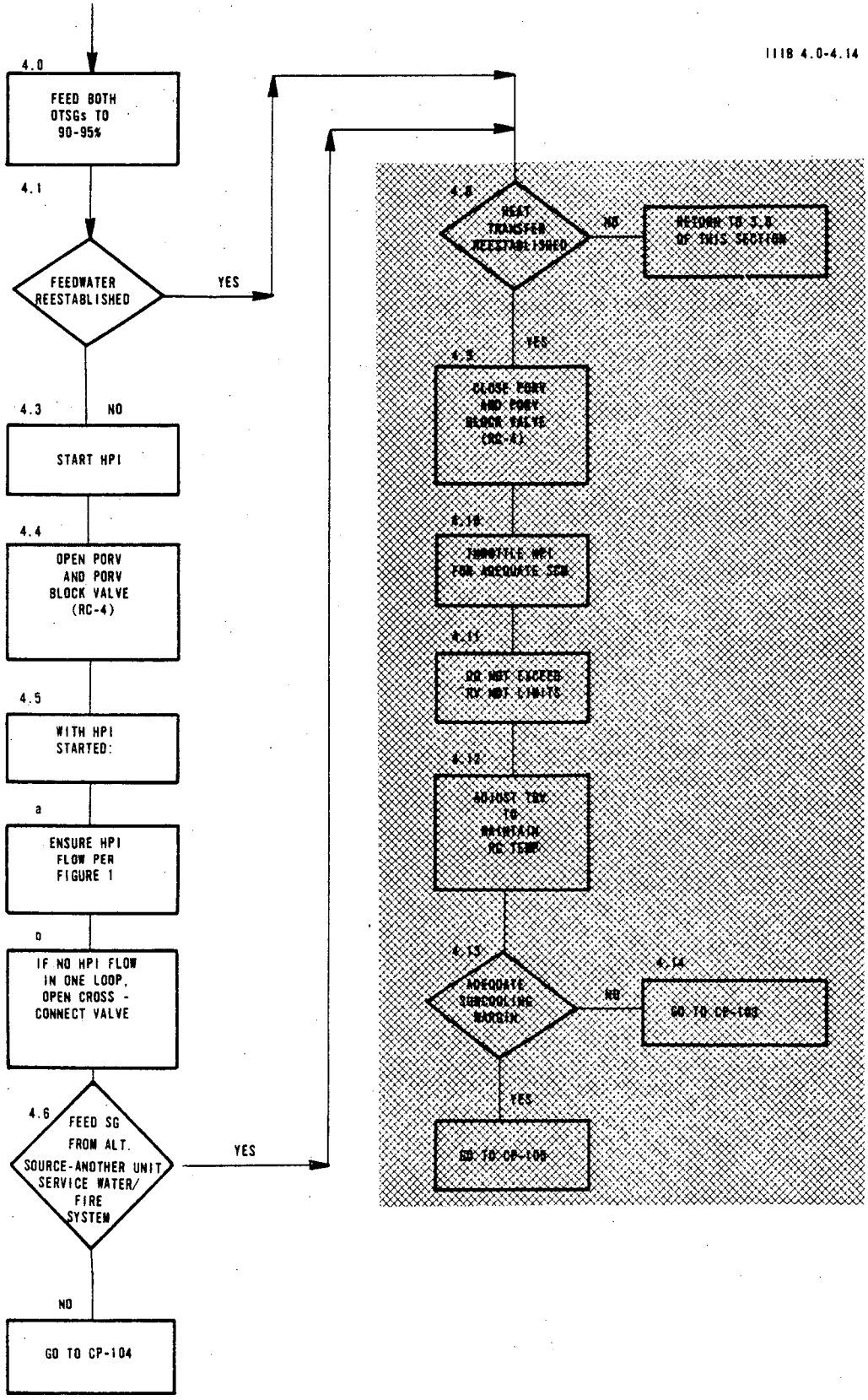
Heat transfer to the OTSGs is by forced circulation from the RCP in operation. The RCS is saturated.


4.0
FEED BOTH OTSGs TO 90-95%
4.1
FEEDWATER REESTABLISHED
YES
NO
4.3
START HPI
4.4
OPEN PORV AND PORV BLOCK VALVE (RC-4)
4.5
WITH HPI STARTED:
a
ENSURE HPI FLOW PER FIGURE 1
b
IF NO HPI FLOW IN ONE LOOP, OPEN CROSS - CONNECT VALVE
4.6
FEED SG FROM ALT. SOURCE-ANOTHER UNIT SERVICE WATER/ FIRE SYSTEM
YES
NO
GO TO CP-104
4.8
HEAT TRANSFER REESTABLISHED
NO
RETURN TO 3.X OF THIS SECTION
YES
4.9
CLOSE PORV AND PORV BLOCK VALVE (RC-4)
4.10
THROTTLE HPI FOR ADEQUATE SCM
4.11
DO NOT EXCEED TCV NOT LIMITS
4.12
ADJUST TBV TO MAINTAIN RC TEMP
4.13
ADEQUATE SUBCOOLING MARGIN
NO
4.14
GO TO CP-103
YES
GO TO CP-105

Saturated RCS with NO OTSG Level

4.0 Feed both OTSGs, with MFW properly throttled, through the EFW header, to 90-95% on the operate range. Use EFW if MFW is not available.

4.1 If feedwater has been re-established, go to step 4.8, otherwise continue.

4.2 If no feedwater is available, follow steps 4.3 through 4.7.

4.3 Start HPI if not already in operation.

4.4 Open PORV and PORV block valve (RC-4).

4.5 With HPI flow in operation:

a) Ensure maximum HPI flow per Figure 1.

b) If HPI flow cannot be verified in both loops , open the cross-connect valve for the HPI header.

4.6 Attempt to feed one OTSG from an alternate source (emergency feedwater cross connect to another unit, service water, fire system, etc.).

4.7 If both OTSGs absolutely cannot be fed, go to CP-104, otherwise continue.

PPS | There is no heat transfer to either OTSG. Natural circulation does not exist and cannot be induced due to a total loss of feedwater. The OTSGs are dry. The RCS is saturated, and the core must be cooled by HPI.

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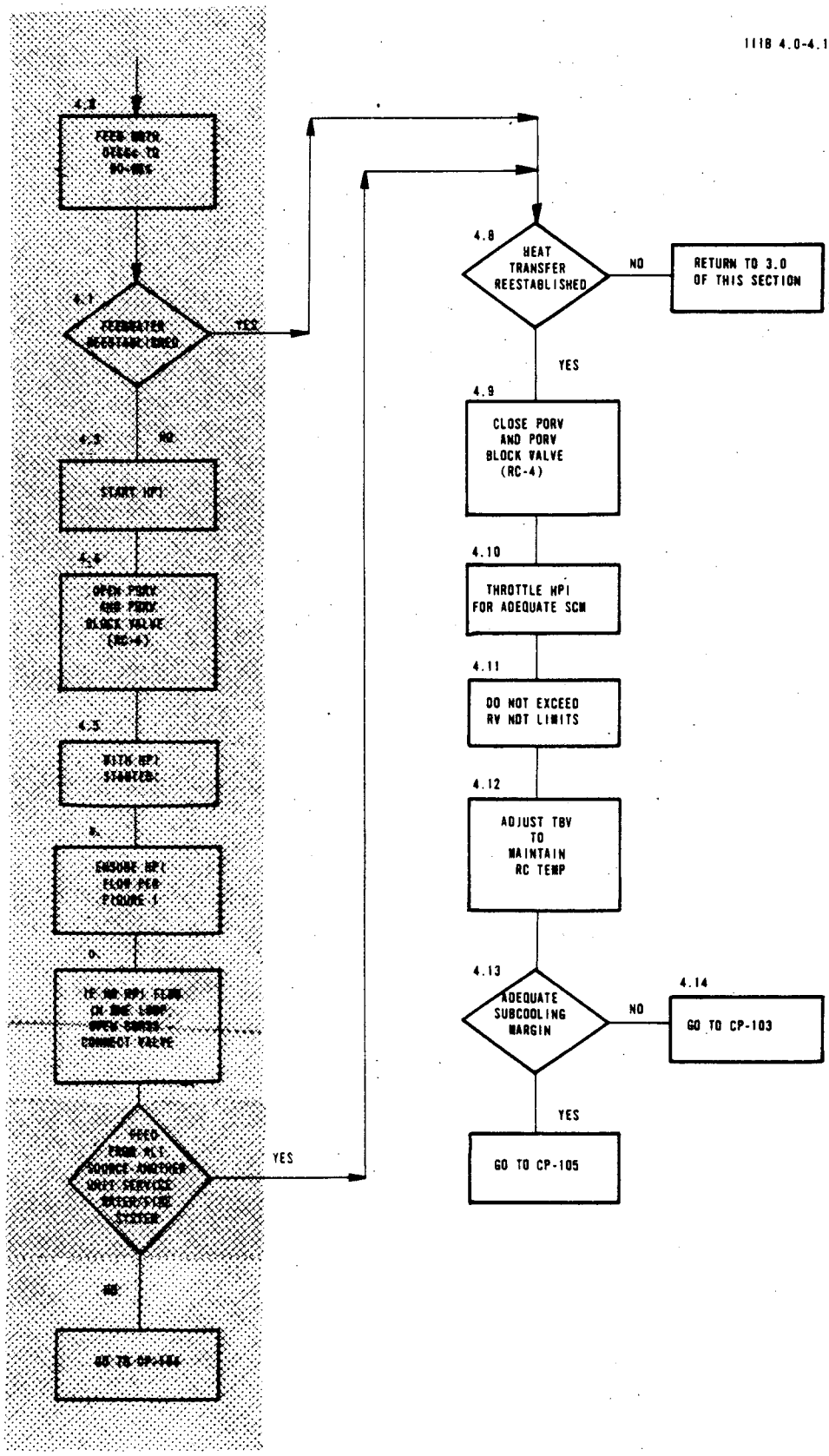
4.8
HEAT TRANSFER REESTABLISHED
NO
RETURN TO 3.0 OF THIS SECTION
YES
4.9
CLOSE PORV AND PORV BLOCK VALVE (RC-4)
4.10
THROTTLE HPI FOR ADEQUATE SCM
4.11
DO NOT EXCEED RV NDT LIMITS
4.12
ADJUST TBV TO MAINTAIN RC TEMP
4.13
ADEQUATE SUBCOOLING MARGIN
NO
4.14
GO TO CP-103
YES
GO TO CP-105
YES
START HPI
CONNECT VALVE

Feedwater has been re-established

4.8 If heat transfer has been re-established in at least one OTSG, follow steps 4.9 through 4.14 below. If heat transfer has not been re-established, return to step 3.0 of this section.

4.9 Close PORV and PORV block valve (RC-4).

4.10 Throttle HPI to maintain Adequate Subcooling Margin.

4.11 Do not exceed reactor vessel NDT limits.

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

4.13 If there is adequate Subcooling Margin, go to CP-105.

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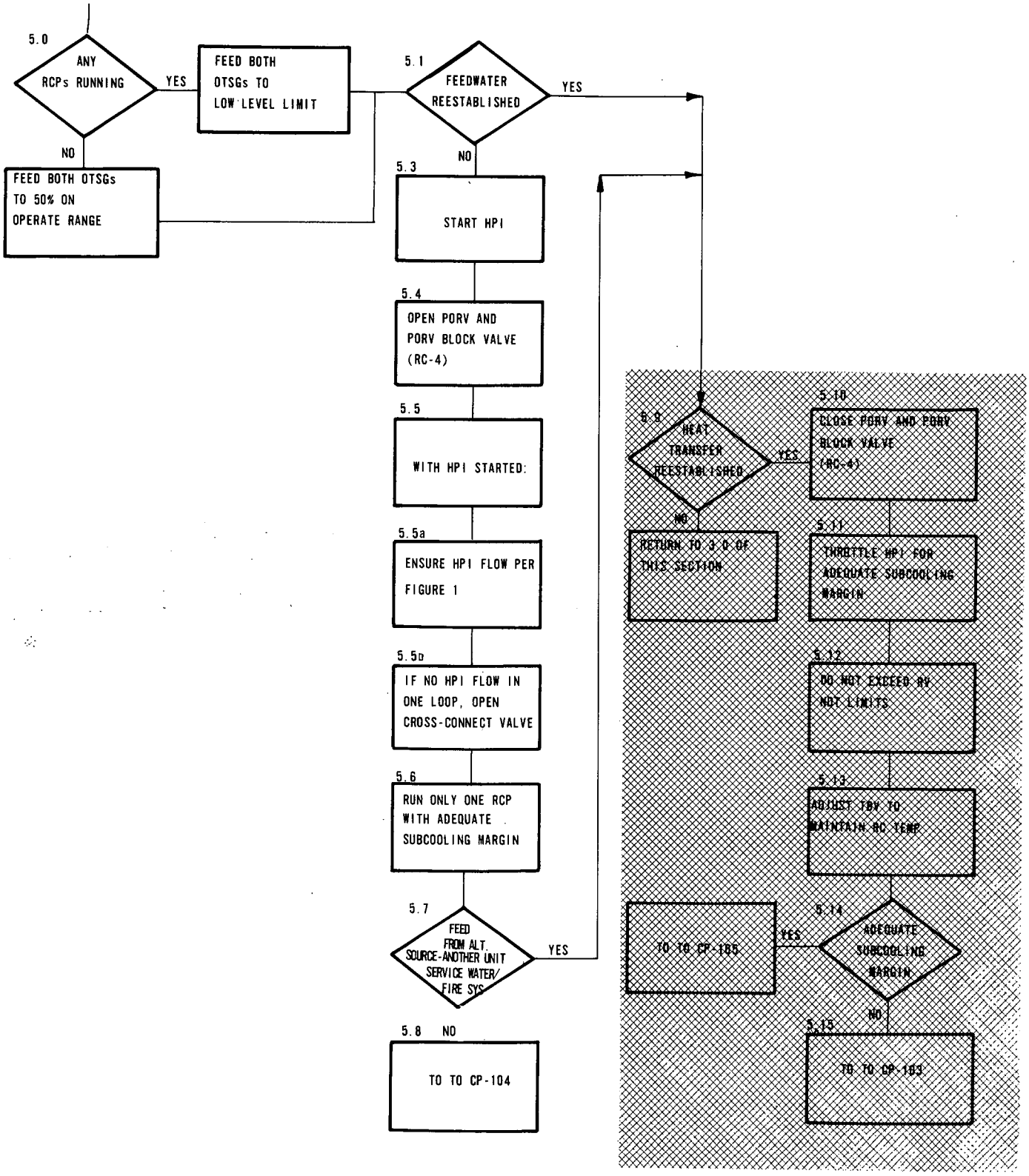
The RCS is subcooled. There may or may not be a bubble in the pressurizer. OTSG heat transfer is controlled. CP-105 provides instructions either to draw a bubble if necessary and then cool down normally or to cool down solid if a bubble cannot be drawn.

4.14 If there is Lack of Adequate Subcooling Margin, go to CP-103.

P
P
S

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


5.0
ANY RCPs RUNNING
YES
FEED BOTH OTSGs TO LOW LEVEL LIMIT
NO
FEED BOTH OTSGs TO 50% ON OPERATE RANGE
5.1
FEEDWATER REESTABLISHED
YES
NO
5.3
START HPI
5.4
OPEN PORV AND PORV BLOCK VALVE (RC-4)
5.5
WITH HPI STARTED:
5.5a
ENSURE HPI FLOW PER FIGURE 1
5.5b
IF NO HPI FLOW IN ONE LOOP, OPEN CROSS-CONNECT VALVE
5.6
RUN ONLY ONE RCP WITH ADEQUATE SUBCOOLING MARGIN
5.7
FEED FROM ALT. SOURCE-ANOTHER UNIT SERVICE WATER/ FIRE SYS
YES
5.8 NO
TO TO CP-104
5.9
HEAT TRANSFER REESTABLISHED
YES
NO
RETURN TO 3.0 OF THIS SECTION
5.10
CLOSE PORV AND PORV BLOCK VALVE (RC-4)
5.11
THROTTLE HPI FOR ADEQUATE SUBCOOLING MARGIN
5.12
DO NOT EXCEED RV NOT LIMITS
5.13
ADJUST TBV TO MAINTAIN RC TEMP
5.14
ADEQUATE SUBCOOLING MARGIN
YES
TO TO CP-105
NO
5.15
TO TO CP-103

Subcooled RCS

5.0 If any RCPs are running, feed both OTSGs, with MFW properly throttled through the EFW header, to the low level limit. If no RCPs are running, feed both OTSGs, with MFW properly throttled through the EFW header, to 50% on the operate range. Use EFW if MFW is not available.

5.1 If feedwater has been re-established, go to step 5.9; otherwise continue.

5.2 If no feedwater is available, follow steps 5.3 through 5.8.

5.3 Start HPI if not already in operation.

5.4 Open PORV and PORV block valve (RC-4).

5.5 With HPI flow in operation:

a) Ensure maximum HPI flow per Figure 1

b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header.

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

5.7 Attempt to feed one OTSG from an alternate source (emergency feedwater cross connect to another unit, service water, fire system, etc.).

5.8 If both OTSGs absolutely cannot be fed, go to CP-104, otherwise continue.

P P S | There is no heat transfer to either OTSG. Natural circulation does not exist and cannot be induced due to a total loss of feedwater. The OTSGs are dry and the core must be cooled by HPI.

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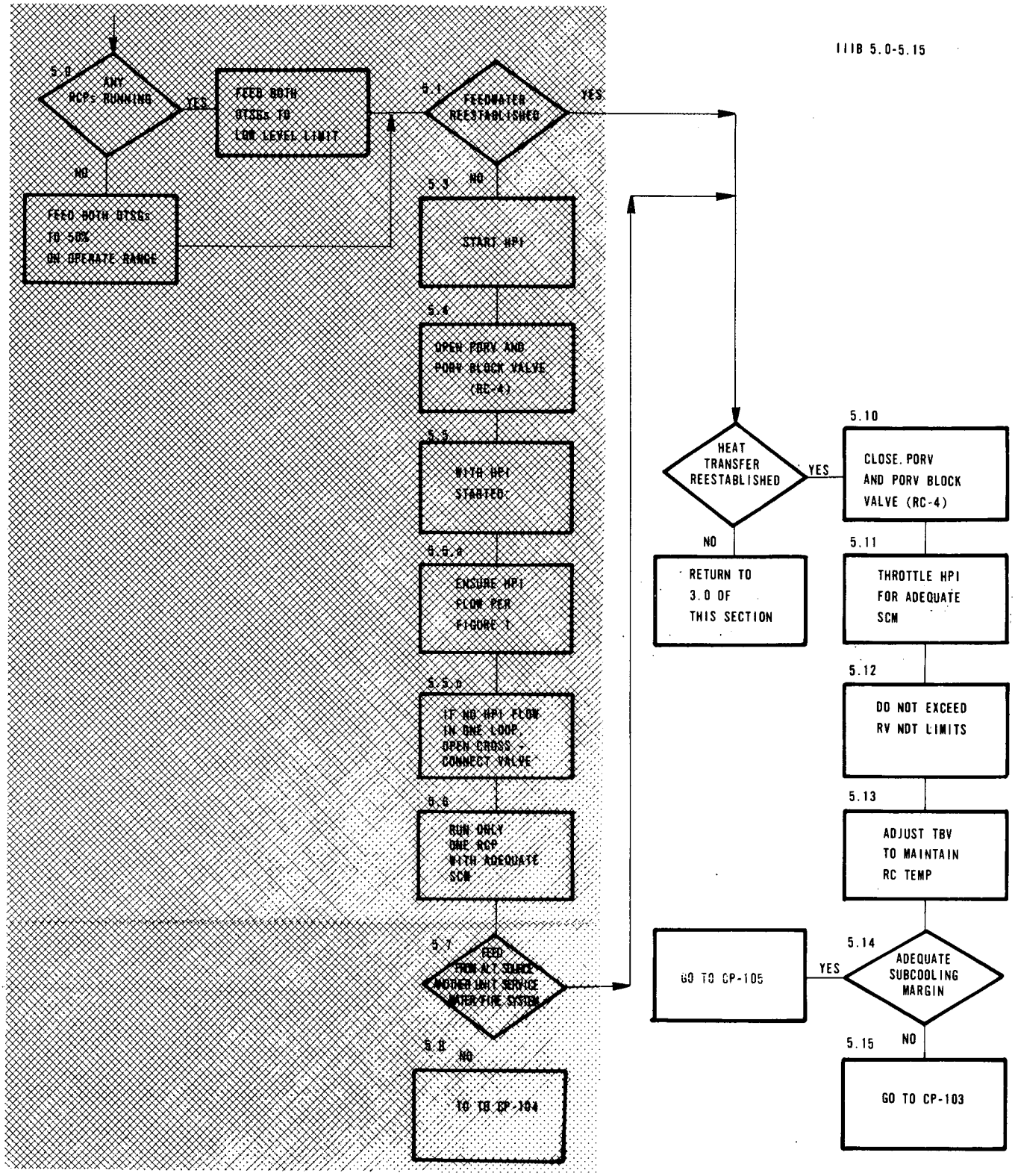
5.0
ANY RCPs RUNNING
YES
NO
FEED BOTH OTSGs TO LOW LEVEL LIMIT
FEED BOTH OTSGs TO 50% ON OPERATE RANGE
5.1
FEEDWATER REESTABLISHED
YES
NO
5.2
START HPI
5.4
OPEN PORV AND PORV BLOCK VALVE (RC-4)
5.5
WITH HPI STARTED:
5.5.a
ENSURE HPI FLOW PER FIGURE 1
5.5.b
IF NO HPI FLOW IN ONE LOOP, OPEN CROSS - CONNECT VALVE
5.6
RUN ONLY ONE RCP WITH ADEQUATE SCM
5.7
FEED FROM ALT SOURCE ANOTHER UNIT SERVICE WATER/FIRE SYSTEM
5.8
NO
TO TO CP-104
HEAT TRANSFER REESTABLISHED
YES
NO
RETURN TO 3.0 OF THIS SECTION
5.10
CLOSE PORV AND PORV BLOCK VALVE (RC-4)
5.11
THROTTLE HPI FOR ADEQUATE SCM
5.12
DO NOT EXCEED RV NDT LIMITS
5.13
ADJUST TBV TO MAINTAIN RC TEMP
5.14
ADEQUATE SUBCOOLING MARGIN
YES
GO TO CP-105
NO
5.15
GO TO CP-103

5.9 If heat transfer has been re-established in at least one OTSG, follow steps 5.10 through 5.15. If heat transfer has not been re-established, return to step 3.0 of this section.

5.10 Close PORV and PORV block valve (RC-4).

5.11 Throttle HPI to maintain Adequate Subcooling Margin.

5.12 Do not exceed reactor vessel NDT limits.

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

5.14 If there is Adequate Subcooling Margin, go to CP-105.

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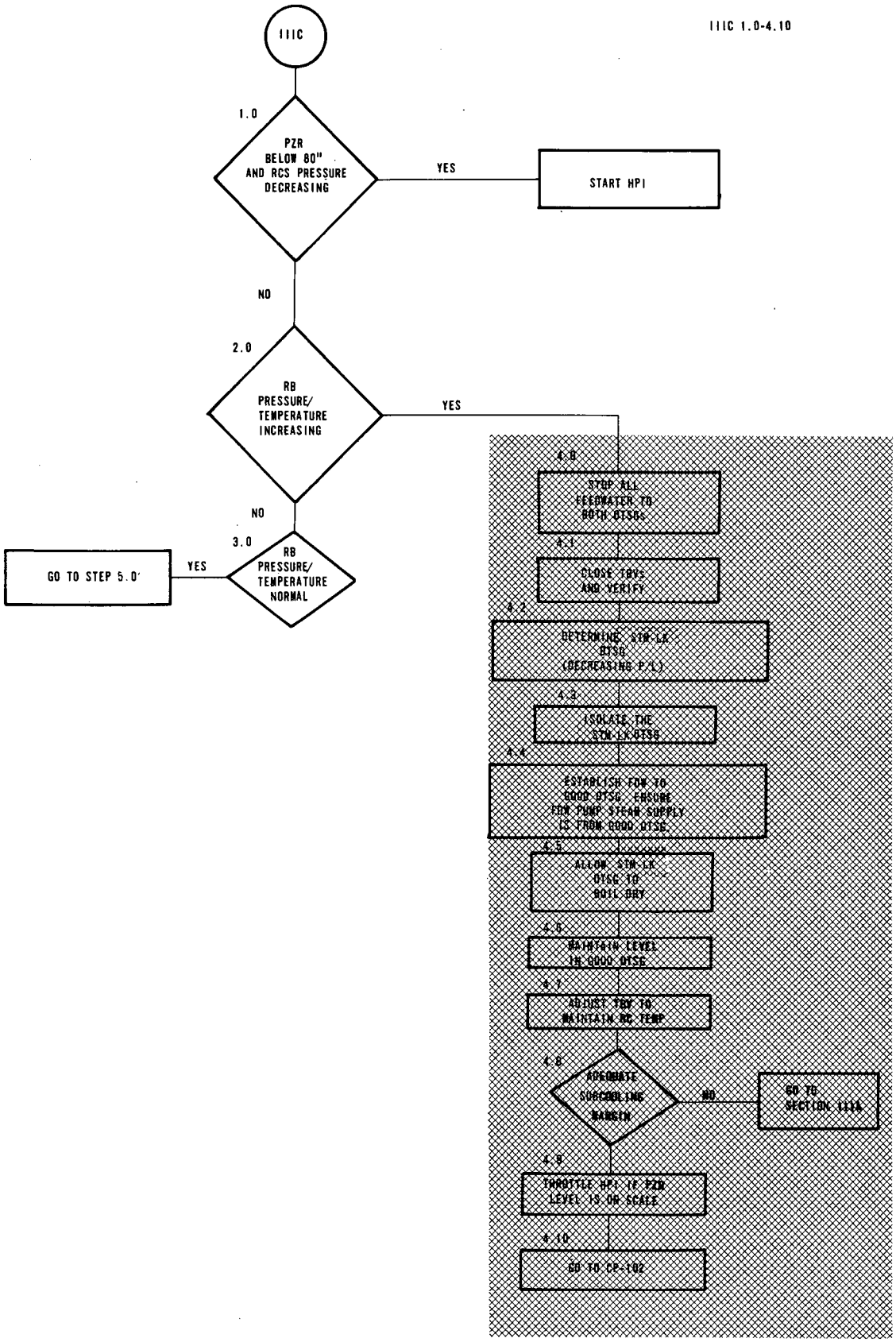
The RCS is subcooled. There may or may not be a bubble in the pressurizer. OTSG heat transfer is controlled. CP-105 provides instructions either to draw a bubble if necessary and then cool down normally or to cool down solid if a bubble cannot be drawn.

5.15 If there is Lack of Adequate Subcooling Margin, go to CP-103.

P
P
S

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


IIIC
1.0
PZR BELOW 80" AND RCS PRESSURE DECREASING
YES
START HPI
NO
2.0
RB PRESSURE/ TEMPERATURE INCREASING
YES
NO
3.0
RB PRESSURE/ TEMPERATURE NORMAL
YES
GO TO STEP 5.0
4.0
STOP ALL FEEDWATER TO BOTH OTSGs
4.1
CLOSE TBVs AND VERIFY
4.2
DETERMINE STM LK OTSG (DECREASING P/L)
4.3
ISOLATE THE STM LK OTSG
4.4
ESTABLISH FDW TO GOOD OTSG ENSURE FDW PUMP STEAM SUPPLY IS FROM GOOD OTSG
4.5
ALLOW STM LK OTSG TO BOIL DRY
4.6
MAINTAIN LEVEL IN GOOD OTSG
4.7
ADJUST TBV TO MAINTAIN RC TEMP
4.8
ADEQUATE SUBCOOLING MARGIN
NO
GO TO SECTION IIIA
4.9
THROTTLE HPI IF PZR LEVEL IS ON SCALE
4.10
GO TO CP-102

Section III C

Follow-up Actions for Treatment of Too Much Primary to Secondary Heat Transfer

1.0 If pressurizer level is below 80" and RCS pressure is decreasing, manually start HPI.

2.0 If Reactor Building pressure and/or temperature are increasing, go to step 4.0.

3.0 If Reactor Building pressure and temperature are normal, go to step 5.0.

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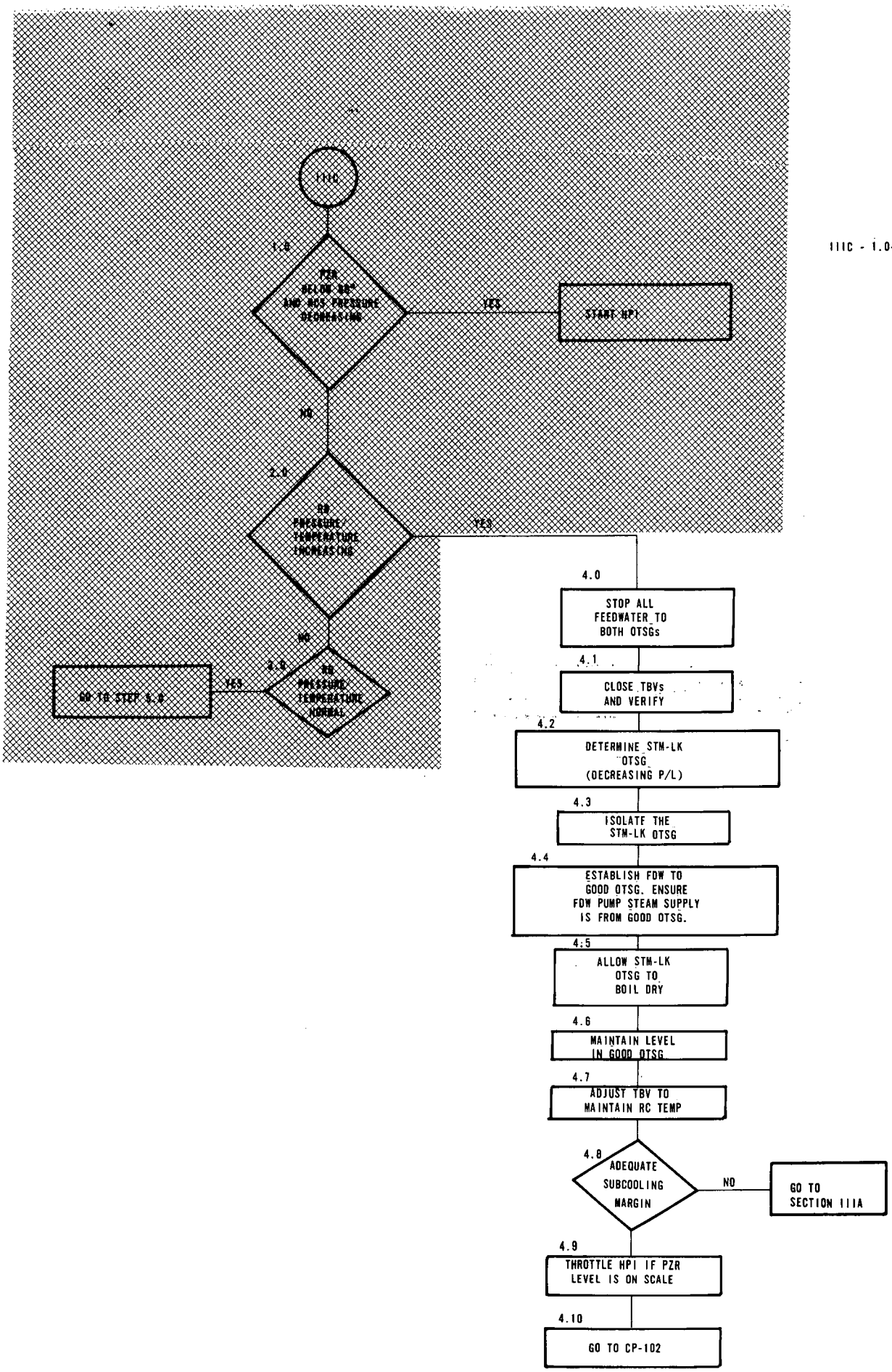
IIIC
1.0
PZR BELOW 50% AND RCS PRESSURE DECREASING
YES
START HPI
NO
2.0
SG PRESSURE/ TEMPERATURE INCREASING
YES
NO
3.0
SG PRESSURE/ TEMPERATURE NORMAL
YES
GO TO STEP 6.0
4.0
STOP ALL FEEDWATER TO BOTH OTSGs
4.1
CLOSE TBVs AND VERIFY
4.2
DETERMINE STM-LK OTSG (DECREASING P/L)
4.3
ISOLATE THE STM-LK OTSG
4.4
ESTABLISH FDW TO GOOD OTSG. ENSURE FDW PUMP STEAM SUPPLY IS FROM GOOD OTSG.
4.5
ALLOW STM-LK OTSG TO BOIL DRY
4.6
MAINTAIN LEVEL IN GOOD OTSG
4.7
ADJUST TBV TO MAINTAIN RC TEMP
4.8
ADEQUATE SUBCOOLING MARGIN
NO
GO TO SECTION IIIA
4.9
THROTTLE HPI IF PZR LEVEL IS ON SCALE
4.10
GO TO CP-102

Reactor Building Temperature and/or Pressure Increasing

4.0 Stop all FW to both OTSGs by closing startup control valves (FDW-35 and -44), main control valves (FDW-32 and -41), and Emergency Feedwater valves (FDW-315 and -316). Do not trip running feed pumps.

4.1 Close TBVs and verify closed.

4.2 Determine OTSG with decreasing level and/or pressure. OTSG with decreasing level and/or pressure is leaking.

4.3 Isolate the STM-LK OTSG by closing its respective valves as follows:

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Valve	OTSG 'A'	OTSG 'B'
Main FW Block	FDW-31	FDW-40
Startup FW Block	FDW-33	FDW-44
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

4.4 Establish feedwater to good OTSG. Ensure steam supply to feed pump is from good OTSG.

4.5 Allow STM-LK OTSG to boil dry. Heat transfer is being intentionally stopped in leaking OTSG. Do NOT go to Section III B.

4.6 Maintain appropriate level in the good OTSG.

4.7 Maintain RC temperature at present value by adjusting TBV position on good OTSG.

4.8 If there is Lack of Adequate Subcooling Margin, go to Section III A.

4.9 Throttle HPI as necessary if pressurizer level is on scale.

4.10 Go to CP-102

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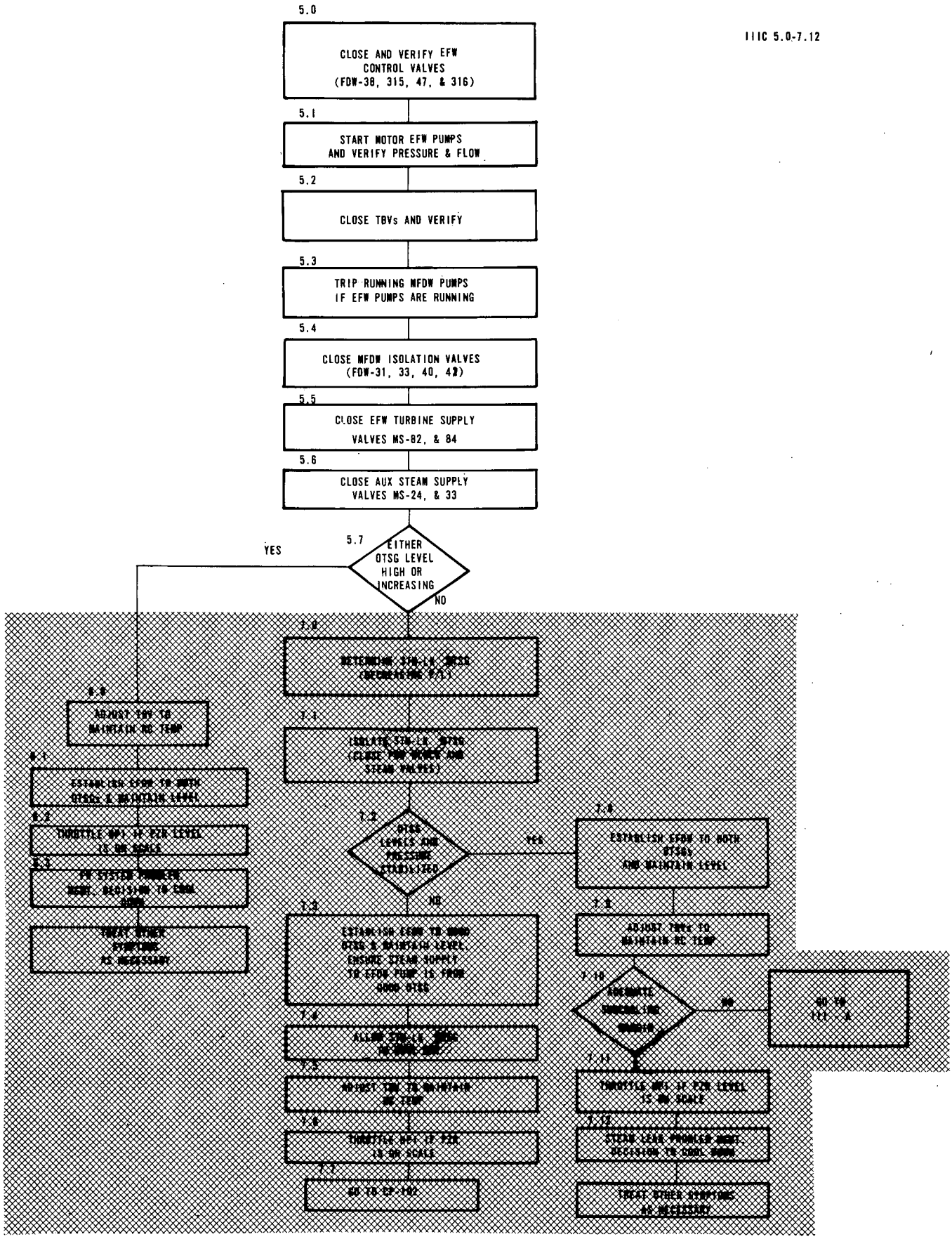
RCS is subcooled with temperature and pressure stable. One OTSG is steaming to the condenser (with vacuum). The other OTSG is isolated and has had a non-isolable steam line break.


5.0
CLOSE AND VERIFY EFW CONTROL VALVES (FDW-38, 315, 47, & 316)
5.1
START MOTOR EFW PUMPS AND VERIFY PRESSURE & FLOW
5.2
CLOSE TBVs AND VERIFY
5.3
TRIP RUNNING MFDW PUMPS IF EFW PUMPS ARE RUNNING
5.4
CLOSE MFDW ISOLATION VALVES (FDW-31, 33, 40, 42)
5.5
CLOSE EFW TURBINE SUPPLY VALVES MS-82, & 84
5.6
CLOSE AUX STEAM SUPPLY VALVES MS-24, & 33
5.7
EITHER OTSG LEVEL HIGH OR INCREASING
YES
NO
7.0
7.1
7.2
OTSG LEVELS AND PRESSURE STABILIZED
YES
NO
7.3
7.4
7.5
7.6
7.7
7.8
7.9
7.10
7.11
7.12
ESTABLISH EFDW TO BOTH OTSGs AND MAINTAIN LEVEL
ADJUST TBVs TO MAINTAIN RC TEMP
THROTTLE MFI IF PZR LEVEL IS ON SCALE
STEAM LEAK PROMPTLY DEPT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY
GO TO EP-102

Reactor Building Pressure and Temperature Normal

5.0 Place EFW control valves (FDW-38, 315, 47, 316) in manual, close and verify closed.

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

5.2 Place TBVs in manual, close and verify closed.

5.3 Trip running main FW pump when EFW pumps are running.

5.4 Close MFW isolation valves (FDW-31, 33, 40, 42).

5.5 Close MS line to EFW turbine valves MS-82 and MS-84.

5.6 Close MS line to auxiliary steam valves MS-24 and MS-33.

5.7 If either OTSG level was increasing or is abnormally high, go to step 6.0; otherwise, go to step 7.0.

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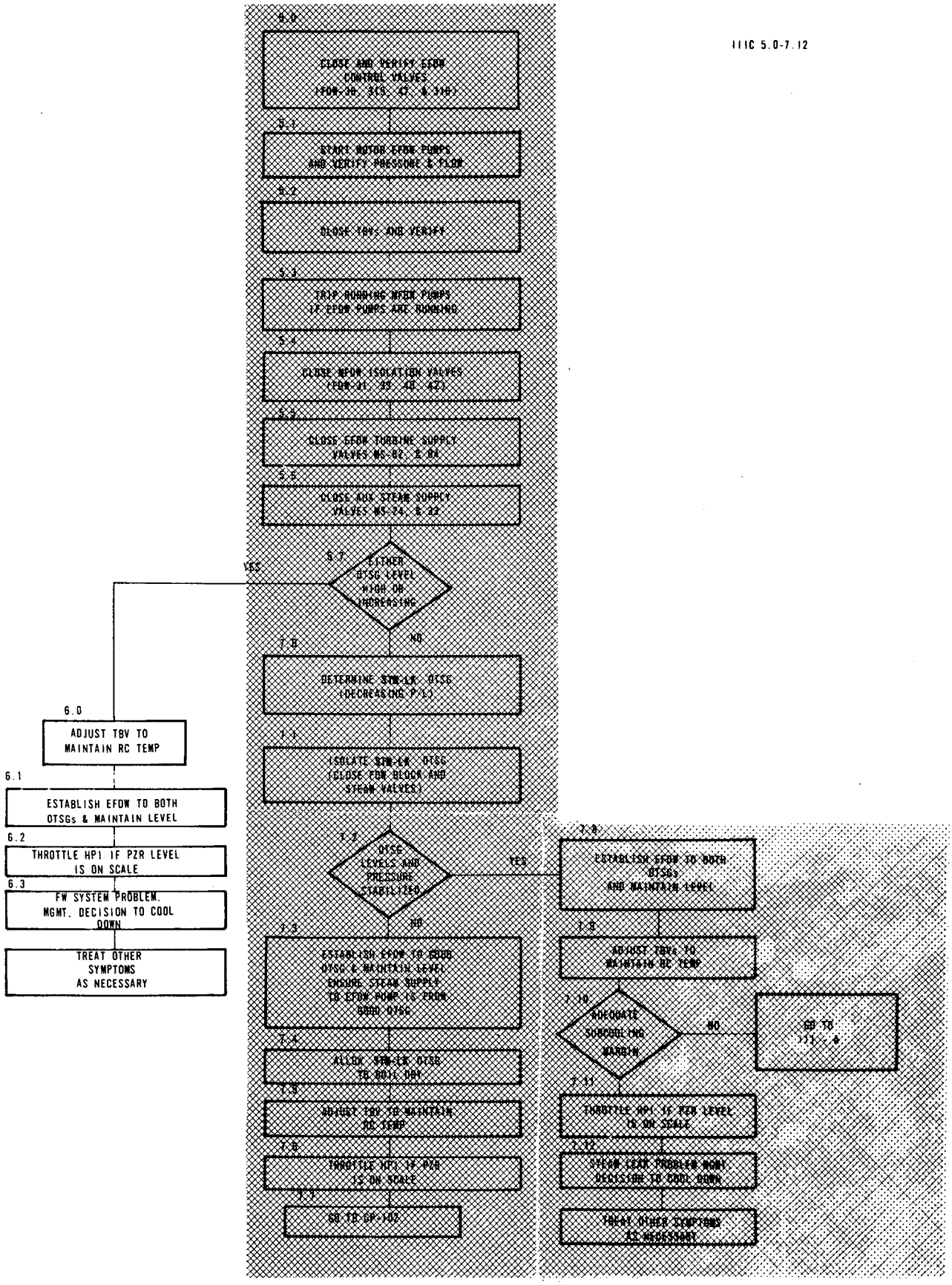
5.0
CLOSE AND VERIFY EFDW CONTROL VALVES (FDW-38, 313, 42, & 318)
5.1
START MOTOR EFDW PUMPS AND VERIFY PRESSURE & FLOW
5.2
CLOSE TBVs AND VERIFY
5.3
TRIP RUNNING MFDW PUMPS IF EFDW PUMPS ARE RUNNING
5.4
CLOSE MFDW ISOLATION VALVES (FDW-31, 39, 48, 42)
5.5
CLOSE EFDW TURBINE SUPPLY VALVES MS-82, & 84
5.6
CLOSE AUX STEAM SUPPLY VALVES MS-24, & 22
5.7
EITHER OTSG LEVEL HIGH OR INCREASING
YES
NO
7.0
DETERMINE STM-LK OTSG (DECREASING P/L)
7.1
ISOLATE STM-LK OTSG (CLOSE FDW BLOCK AND STEAM VALVES)
7.2
OTSG LEVELS AND PRESSURE STABILIZED
YES
NO
7.3
ESTABLISH EFDW TO GOOD OTSG & MAINTAIN LEVEL ENSURE STEAM SUPPLY TO EFDW PUMP IS FROM GOOD OTSG
7.4
ALLOW STM-LK OTSG TO BOIL DRY
7.5
ADJUST TBV TO MAINTAIN RC TEMP
7.6
THROTTLE HPI IF PZR IS ON SCALE
7.7
GO TO GP-102
7.8
ESTABLISH EFDW TO BOTH OTSGs AND MAINTAIN LEVEL
7.9
ADJUST TBVs TO MAINTAIN RC TEMP
7.10
ADEQUATE SUBCOOLING MARGIN
NO
GO TO 111.-4
7.11
THROTTLE HPI IF PZR LEVEL IS ON SCALE
7.12
STEAM LEAK PROBLEM MGMT DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY
6.0
ADJUST TBV TO MAINTAIN RC TEMP
6.1
ESTABLISH EFDW TO BOTH OTSGs & MAINTAIN LEVEL
6.2
THROTTLE HPI IF PZR LEVEL IS ON SCALE
6.3
FW SYSTEM PROBLEM. MGMT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY

High or Increasing OTSG Level

6.0 Maintain RC temperature at present value by adjusting TBV position.

6.1 Establish EFW flow to both OTSGs to maintain appropriate level.

6.2 Throttle HPI as necessary if pressurizer level is on scale.

6.3 A problem in the feedwater system is indicated. Station management needs to decide whether or not a cooldown is required. If there are other abnormal symptoms, treat them per the applicable section of this procedure. If there are no abnormal symptoms, this procedure is complete.

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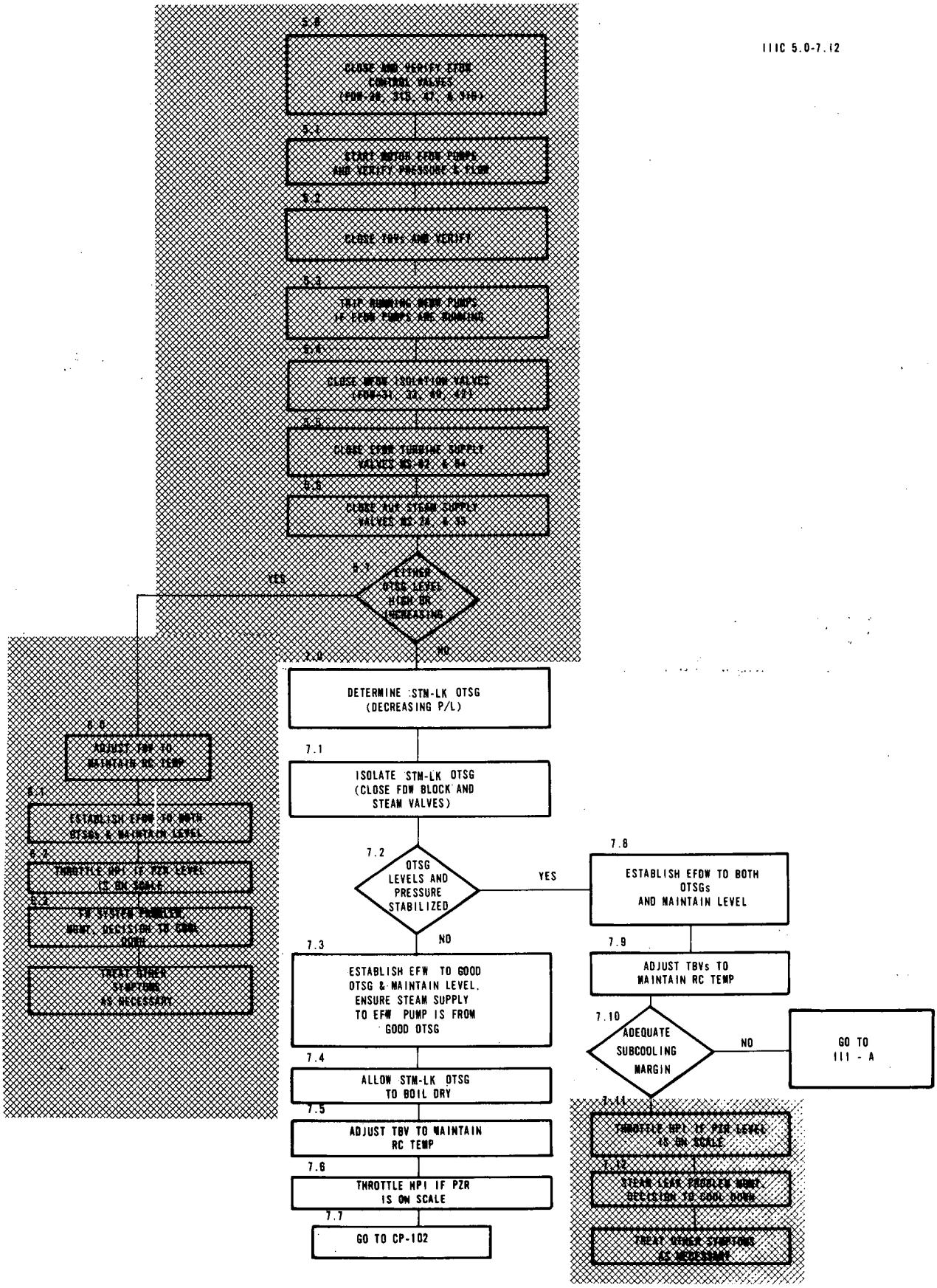

5.0
CLOSE AND VERIFY EFDW CONTROL VALVES (FDW-86, 310, 47, & 146)
5.1
START MOTOR EFDW PUMPS AND VERIFY PRESSURE & FLOW
5.2
CLOSE FDWs AND VERIFY
5.3
TRIP RUNNING MFDW PUMPS IF EFDW PUMPS ARE RUNNING
5.4
CLOSE MFDW ISOLATION VALVES (FDW-31, 32, 80, 47)
5.5
CLOSE EFDW TURBINE SUPPLY VALVES MS-82 & 84
5.6
CLOSE AUX STEAM SUPPLY VALVES MS-36 & 33
5.7
EITHER OTSG LEVEL HIGH OR INCREASING
YES
NO
6.0
ADJUST FDW TO MAINTAIN RC TEMP
6.1
ESTABLISH EFDW TO BOTH OTSGs & MAINTAIN LEVEL
6.2
THROTTLE HPI IF PZR LEVEL IS ON SCALE
6.3
FW SYSTEM PROBLEM MONT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY
7.0
DETERMINE STM-LK OTSG (DECREASING P/L)
7.1
ISOLATE STM-LK OTSG (CLOSE FDW BLOCK AND STEAM VALVES)
7.2
OTSG LEVELS AND PRESSURE STABILIZED
YES
NO
7.3
ESTABLISH EFW TO GOOD OTSG & MAINTAIN LEVEL. ENSURE STEAM SUPPLY TO EFW PUMP IS FROM GOOD OTSG
7.4
ALLOW STM-LK OTSG TO BOIL DRY
7.5
ADJUST TBV TO MAINTAIN RC TEMP
7.6
THROTTLE HPI IF PZR IS ON SCALE
7.7
GO TO CP-102
7.8
ESTABLISH EFDW TO BOTH OTSGs AND MAINTAIN LEVEL
7.9
ADJUST TBVs TO MAINTAIN RC TEMP
7.10
ADEQUATE SUBCOOLING MARGIN
NO
GO TO III - A
7.11
THROTTLE HPI IF PZR LEVEL IS ON SCALE
7.12
STEAM LEAK PROBLEM MONT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY

7.0 If possible, determine OTSG with decreasing level and/or lowest pressure. This is the STM-LK OTSG.

7.1 Isolate the STM-LK OTSG, if it has been determined, by closing its respective valves as follows:

Valve	OTSG 'A'	OTSG 'B'
Main FW Block	FDW-31	FDW-40
Startup FW Block	FDW-33	FDW-44
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

D·R·A·F·T

7.2 If OTSG levels and pressures have stabilized, go to step 7.8, otherwise continue.

7.3 Establish EFW flow and maintain appropriate level in good OTSG only. Ensure steam supply to EFW pump is from good OTSG.

7.4 Allow STM-LK OTSG to boil dry. Heat transfer is intentionally being stopped in STM-LK OTSG. Do NOT go to Section III B.

7.5 Maintain RC temperature at present value by adjusting TBV position.

7.6 Throttle HPI as necessary if pressurizer level is on scale.

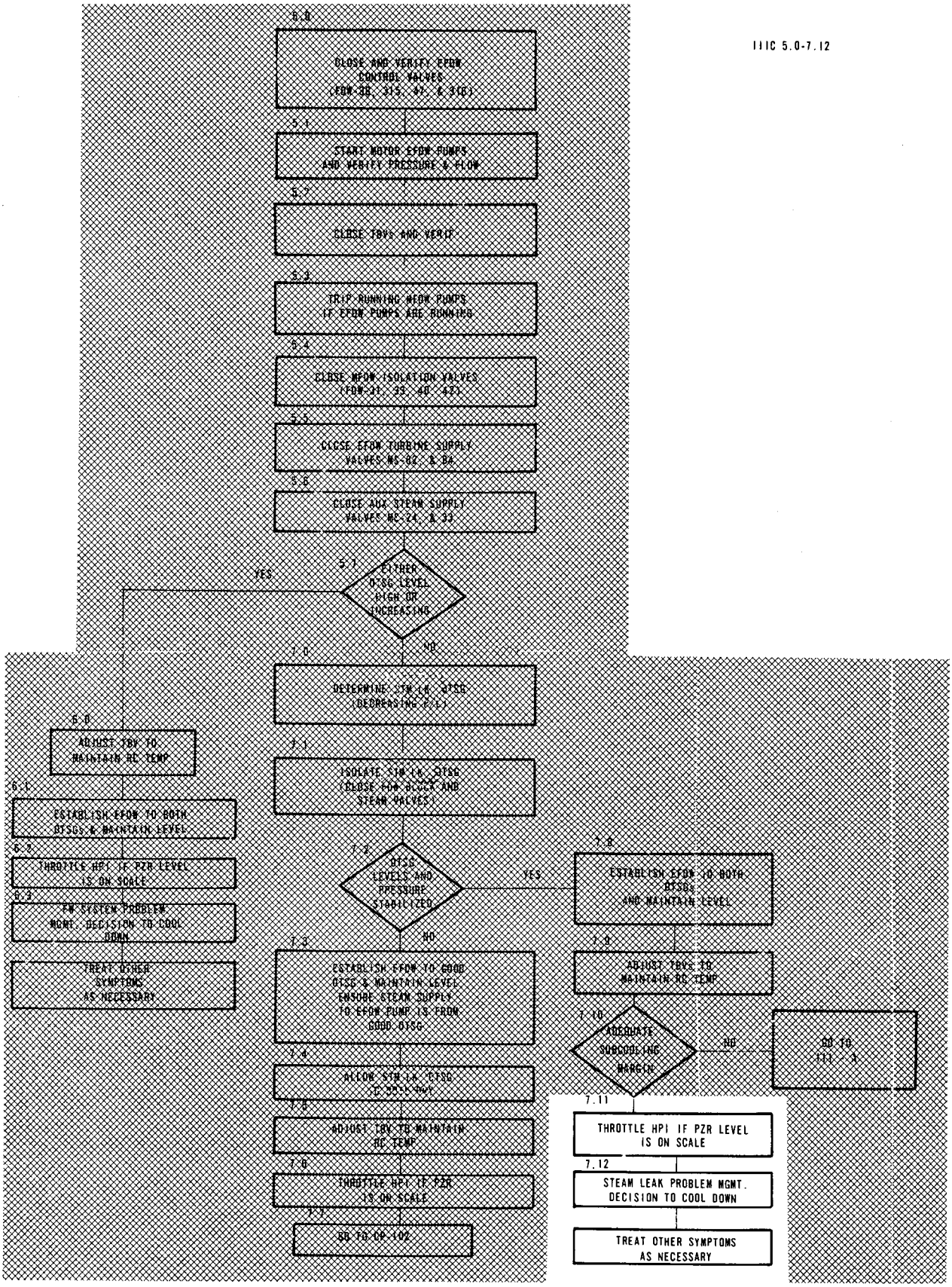
7.7 Go to CP-102.

P | RCS is subcooled with temperature and pressure stable.
P | One OTSG is steaming to the condenser. The other OTSG is isolated with a non-isolable leak.

7.8 Establish EFW flow to both OTSGs and maintain appropriate level.

7.9 Maintain RC temperature at present value by adjusting TBVs on each OTSG either from the control room or manually at the valve.

7.10 If there is Lack of Adequate Subcooling Margin go to Section III A, otherwise continue.


5.0
CLOSE AND VERIFY EFDW CONTROL VALVES (EDW-3B, 31S, 4V, & 31G)
5.1
START MOTOR EFDW PUMPS AND VERIFY PRESSURE & FLOW
5.2
CLOSE TBVS AND VERIFY
5.3
TRIP RUNNING MFDW PUMPS IF EFDW PUMPS ARE RUNNING
5.4
CLOSE MFDW ISOLATION VALVES (FDW-41, 39, 40, 42)
5.5
CLOSE EFDW TURBINE SUPPLY VALVES MS-82, & 84
5.6
CLOSE AUX STEAM SUPPLY VALVES MS-24, & 39
5.7
EITHER O-SG LEVEL HIGH OR INCREASING
YES
NO
6.0
ADJUST TBV TO MAINTAIN RC TEMP
6.1
ESTABLISH EFDW TO BOTH OTSGs & MAINTAIN LEVEL
6.2
THROTTLE HPI IF PZR LEVEL IS ON SCALE
6.3
FW SYSTEM PROBLEM MGMT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY
7.0
DETERMINE STM LK OTSG (DECREASING P.L.)
7.1
ISOLATE STM LK OTSG (CLOSE FDW BLOCK AND STEAM VALVES)
7.2
OTSG LEVELS AND PRESSURE STABILIZED
YES
NO
7.3
ESTABLISH EFDW TO GOOD OTSG & MAINTAIN LEVEL ENSURE STEAM SUPPLY TO EFDW PUMP IS FROM GOOD OTSG
7.4
ALLOW STM LK OTSG TO DEPRESSURIZE
7.5
ADJUST TBV TO MAINTAIN RC TEMP
7.6
THROTTLE HPI IF PZR IS ON SCALE
7.7
GO TO OP-102
7.8
ESTABLISH EFDW TO BOTH OTSGs AND MAINTAIN LEVEL
7.9
ADJUST TBVS TO MAINTAIN RC TEMP
7.10
ADEQUATE SUBCOOLING MARGIN
NO
GO TO III-A
7.11
THROTTLE HPI IF PZR LEVEL IS ON SCALE
7.12
STEAM LEAK PROBLEM MGMT. DECISION TO COOL DOWN
TREAT OTHER SYMPTOMS AS NECESSARY

7.11 Throttle HPI as necessary if presurizer level is on scale.

7.12 A steam leak or open valve in the Steam System is indicated. Station management needs to decide whether or not a cooldown is required. If there are other abnormal symptoms, treat them per the applicable section of this procedure. If there are no abnormal symptoms, this procedure is complete.

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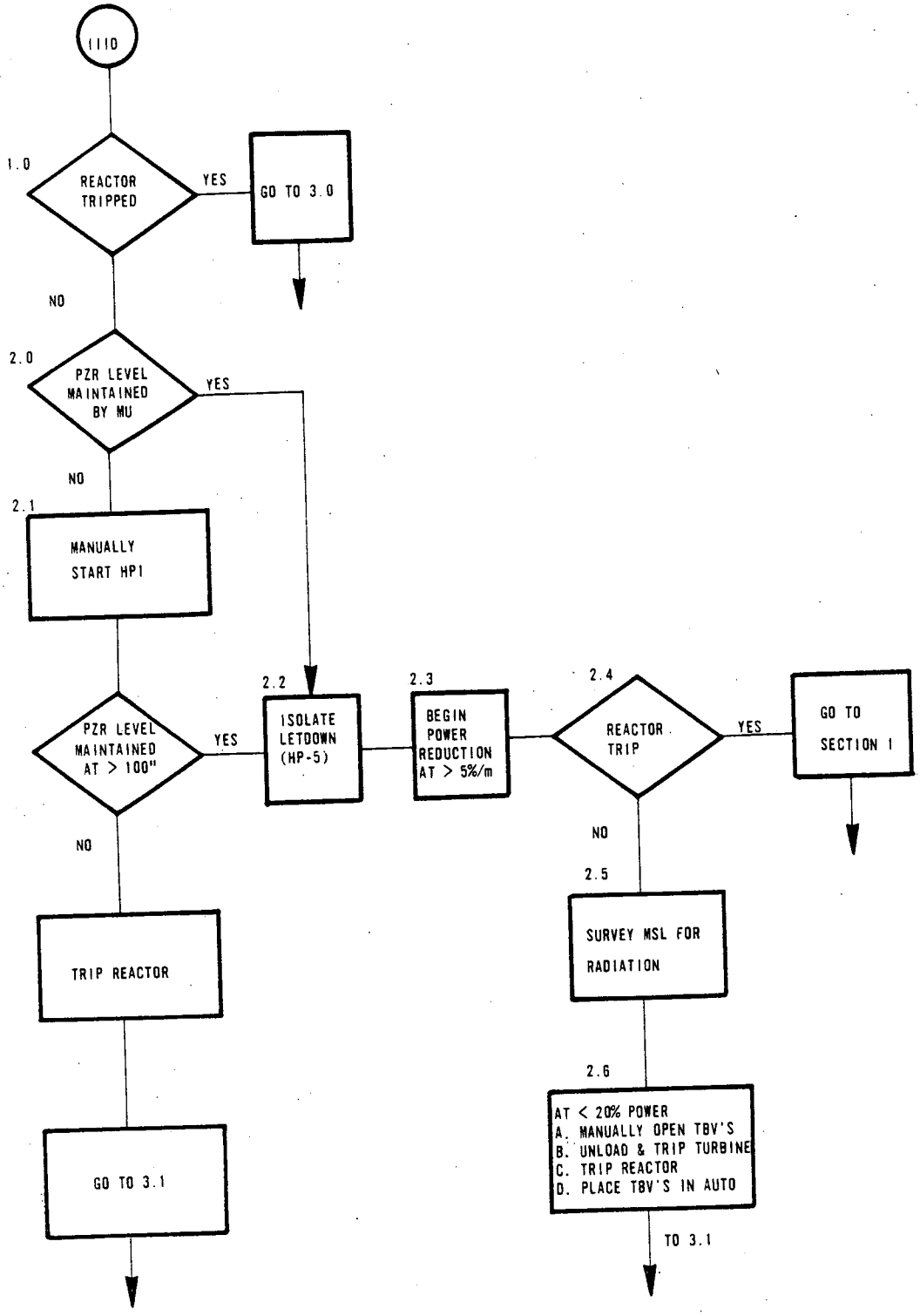

IIID
1.0
REACTOR TRIPPED
YES
GO TO 3.0
NO
2.0
PZR LEVEL MAINTAINED BY MU
YES
NO
2.1
MANUALLY START HPI
PZR LEVEL MAINTAINED AT > 100"
YES
NO
TRIP REACTOR
GO TO 3.1
2.2
ISOLATE LETDOWN (HP-5)
2.3
BEGIN POWER REDUCTION AT > 5%/m
2.4
REACTOR TRIP
YES
GO TO SECTION I
NO
2.5
SURVEY MSL FOR RADIATION
2.6
AT < 20% POWER
A. MANUALLY OPEN TBV'S
B. UNLOAD & TRIP TURBINE
C. TRIP REACTOR
D. PLACE TBV'S IN AUTO
TO 3.1

Section III D

Follow-up Actions for OTSG Tube Rupture

1.0 If the reactor has tripped, go to step 3.0, otherwise continue.

Reactor trip has not occurred

2.0 If pressurizer level is being maintained by the makeup system, go to step 2.2; otherwise continue.

2.1 Manually start HPI as required to maintain pressurizer level greater than 100". If pressurizer level cannot be maintained, trip the reactor and go to step 3.1. Otherwise continue.

D·R·A·F·T

2.2 Isolate letdown (HP-5).

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

2.4 If reactor trip occurs during runback, go to Section I, otherwise continue.

2.5 Make local survey of main steam line to confirm high radiation alarms and identify the TR OTSG.

2.6 At less than 20% reactor power:

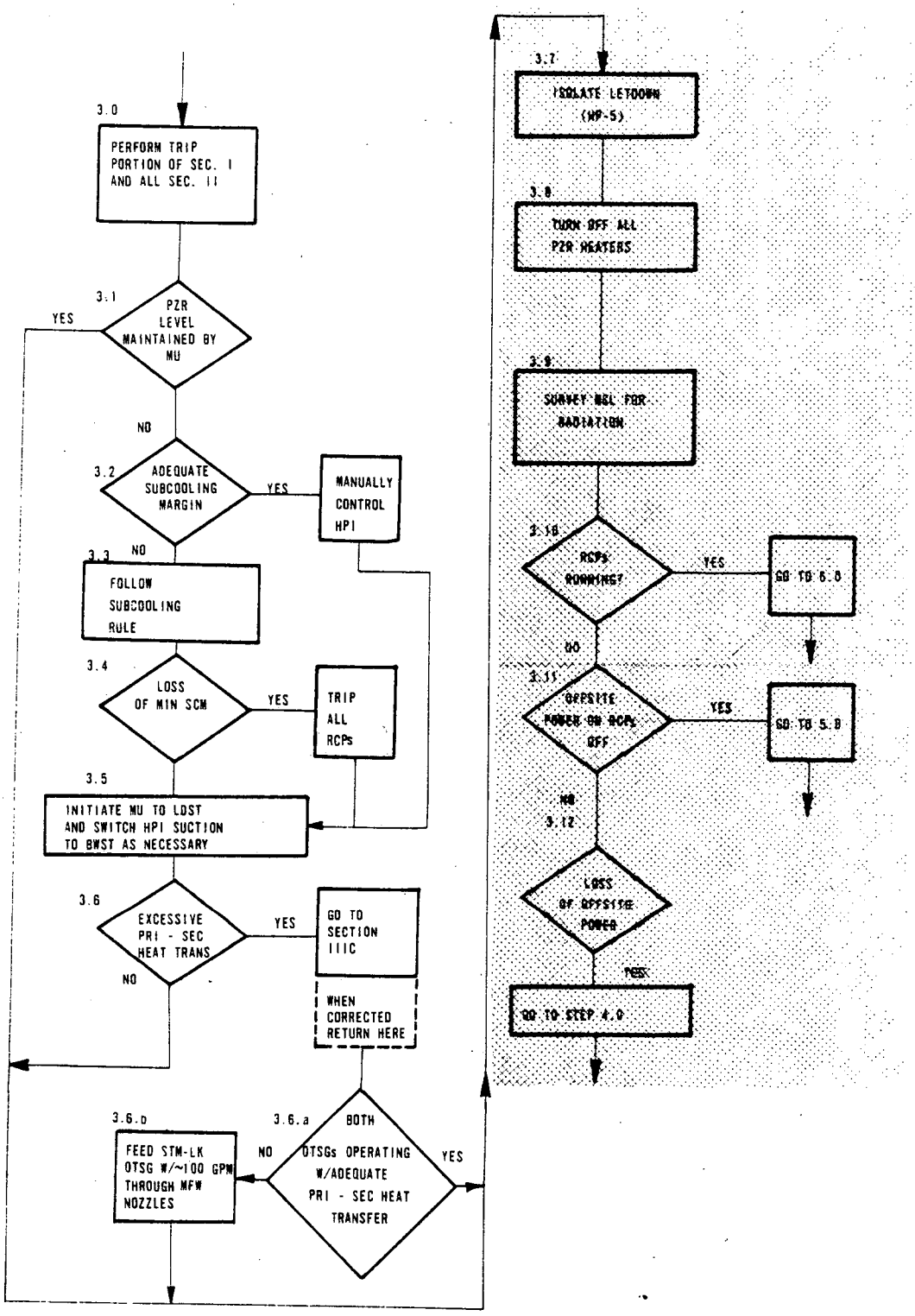
a. Place the TBVs in manual and open.

b. Unload generator and trip turbine.

c. Trip reactor.

d. Place TBVs back in auto.

e. Continue at step 3.0.


3.0
PERFORM TRIP PORTION OF SEC. I AND ALL SEC. II
3.1
PZR LEVEL MAINTAINED BY MU
YES
NO
3.2
ADEQUATE SUBCOOLING MARGIN
YES
MANUALLY CONTROL HPI
NO
3.3
FOLLOW SUBCOOLING RULE
3.4
LOSS OF MIN SCM
YES
TRIP ALL RCPs
3.5
INITIATE MU TO LDST AND SWITCH HPI SUCTION TO BWST AS NECESSARY
3.6
EXCESSIVE PRI - SEC HEAT TRANS
YES
GO TO SECTION IIIC
WHEN CORRECTED RETURN HERE
NO
3.6.a
BOTH OTSGs OPERATING W/ADEQUATE PRI - SEC HEAT TRANSFER
NO
YES
3.6.b
FEED STM-LK OTSG W/~100 GPM THROUGH MFW NOZZLES
3.7
ISOLATE LETDOWN (HP-5)
3.8
TURN OFF ALL PZR HEATERS
3.9
SURVEY NSL FOR RADIATION
3.10
RCPs RUNNING?
YES
GO TO 6.0
NO
3.11
OFFSITE POWER ON RCPs OFF
YES
GO TO 5.0
NO
3.12
LOSS OF OFFSITE POWER
YES
GO TO STEP 4.0

Reactor trip has occurred

3.0 Perform the reactor trip portion of Section I and all of Section II if not already done.

3.1 If pressurizer level is being maintained by the makeup system, go to step 3.6, otherwise continue.

3.2 If adequate subcooling margin exists, manually control HPI as necessary to maintain pressurizer level between 100" and 150".

3.3 If there is lack of adequate subcooling margin, follow the subcooling rule:

Start HPI if not already in operation:

a) Ensure maximum HPI flow per Figure 1.

b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header.

3.4 Immediately upon loss of adequate subcooling margin trip all RC pumps.

3.5 Initiate makeup to LDST. If LDST level reaches 18 inches, open HP-24 to provide suction to the HPI pump from the BWST.

3.6 If primary to secondary heat transfer is excessive, follow Section III C as expeditiously as possible, otherwise continue at Step 3.7.

When heat transfer is stabilized in Section III C, return to Section III D, step 3.6.a. Do NOT go to CPs until directed to do so in Section III D.

a) If both OTSGs are operating with adequate primary to secondary heat transfer, go to step 3.7, otherwise continue.

b) Feed the STM-LK OTSG at approximately 100 gpm through the main FW nozzles.

3.7 Isolate letdown (HP-5).

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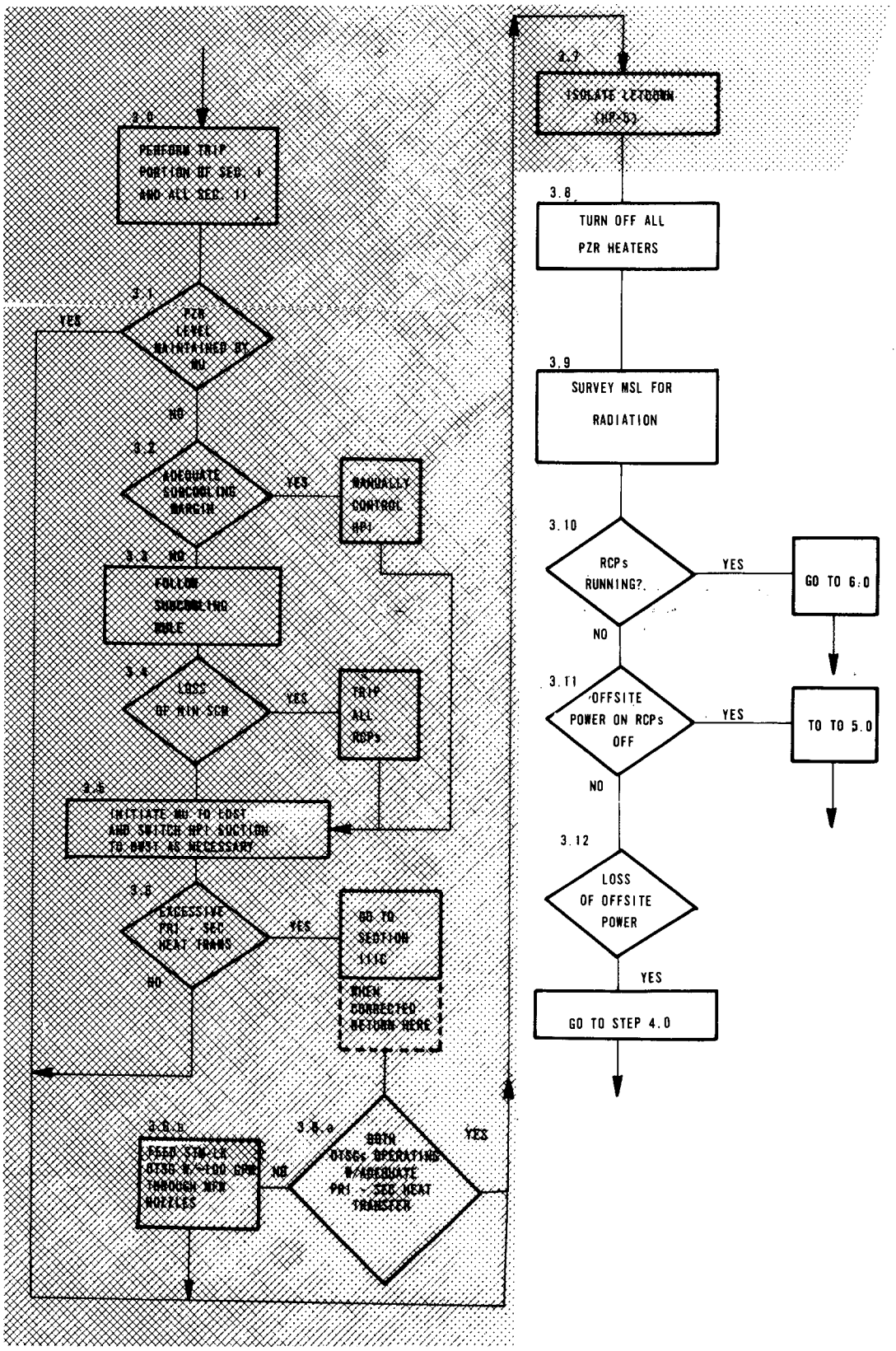
3.0
PERFORM TRIP PORTION OF SEQ. I AND ALL SEQ. II
3.1
PZR LEVEL MAINTAINED BY MU
YES
NO
3.2
ADEQUATE SUBCOOLING MARGIN
YES
MANUALLY CONTROL HPI
NO
3.3
FOLLOW SUBCOOLING RULE
3.4
LOSS OF MIN SCM
YES
TRIP ALL RCPs
3.5
INITIATE MU TO LOST AND SWITCH HPI SUCTION TO BWST AS NECESSARY
3.6
EXCESSIVE PRI - SEC HEAT TRANS
YES
GO TO SECTION IIIC
WHEN CORRECTED RETURN HERE
NO
3.6.b
FEED STM-LK OTSG W/~100 GPM THROUGH MFW NOZZLES
NO
3.6.c
BOTH OTSGs OPERATING W/ADEQUATE PRI - SEC HEAT TRANSFER
YES
3.7
ISOLATE LETDOWN (HP-5)
3.8
TURN OFF ALL PZR HEATERS
3.9
SURVEY MSL FOR RADIATION
3.10
RCPs RUNNING?
YES
GO TO 6.0
NO
3.11
OFFSITE POWER ON RCPs OFF
YES
TO TO 5.0
NO
3.12
LOSS OF OFFSITE POWER
YES
GO TO STEP 4.0

3.8 Turn off all pressurizer heaters.

3.9 Ensure that local survey of main steam line is being made to confirm high radiation alarms and verify the TR OTSG.

3.10 If the reactor coolant pumps are running, go to step 6.0. Otherwise continue.

3.11 If offsite power is available but RC pumps are not running, go to step 5.0. Otherwise continue.

3.12 If loss of offsite power has occurred, go to step 4.0.

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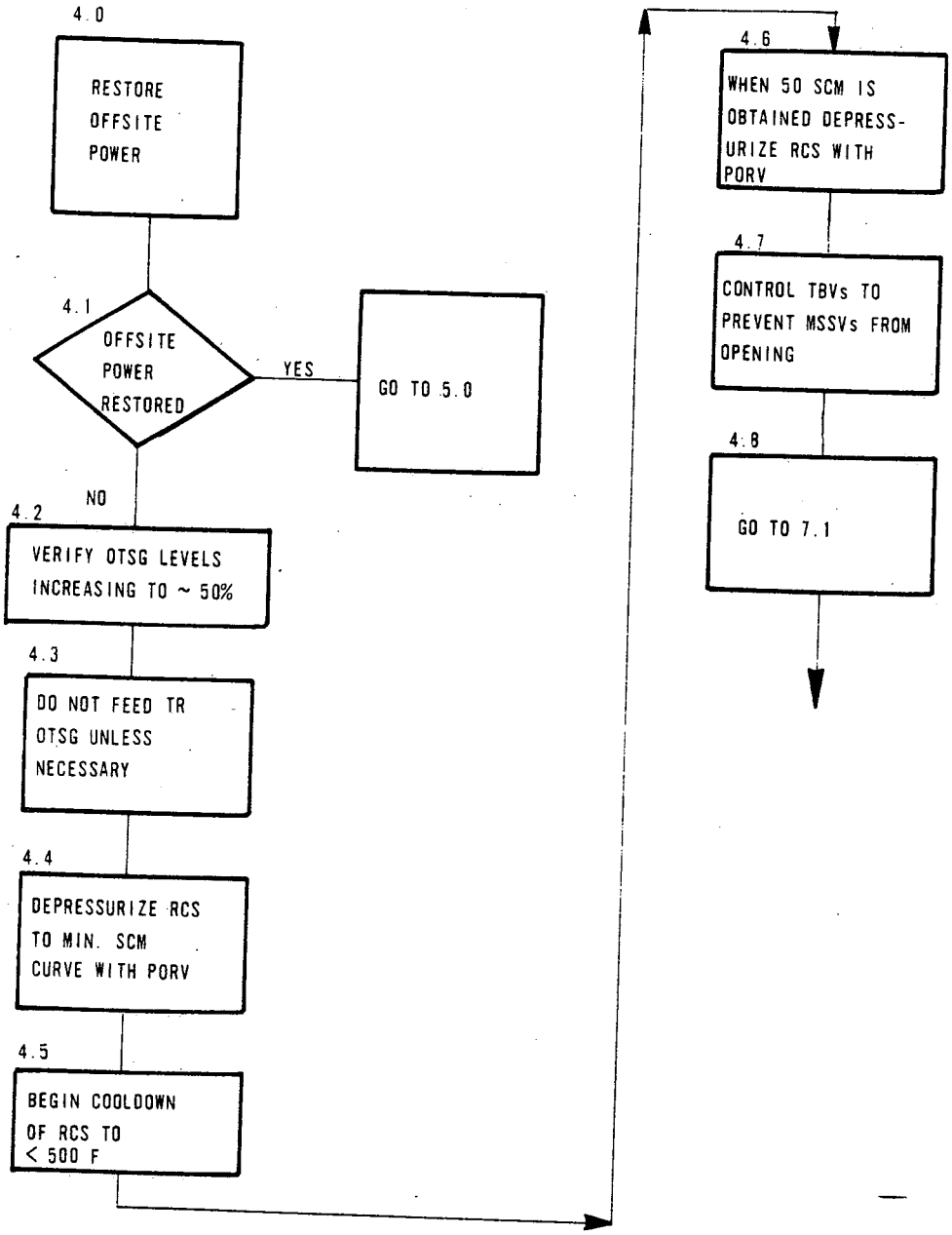

4.0
RESTORE OFFSITE POWER
4.1
OFFSITE POWER RESTORED
YES
GO TO 5.0
NO
4.2
VERIFY OTSG LEVELS INCREASING TO ~ 50%
4.3
DO NOT FEED TR OTSG UNLESS NECESSARY
4.4
DEPRESSURIZE RCS TO MIN. SCM CURVE WITH PORV
4.5
BEGIN COOLDOWN OF RCS TO < 500 F
4.6
WHEN 50 SCM IS OBTAINED DEPRESSURIZE RCS WITH PORV
4.7
CONTROL TBVs TO PREVENT MSSVs FROM OPENING
4.8
GO TO 7.1

Loss of Offsite Power

4.0 Restore offsire power as soon as possible.

4.1 If offsite power is restored, go to step 5.0, otherwise continue.

4.2 Verify that OTSG levels are increasing to approximately 50% on the operate range with EFW properly throttled.

4.3 As soon as the TR OTSG is identified, DO NOT feed the TR OTSG unless needed to maintain the low level limit, to induce natural circulation, or to maintain adequate subcooling margin.

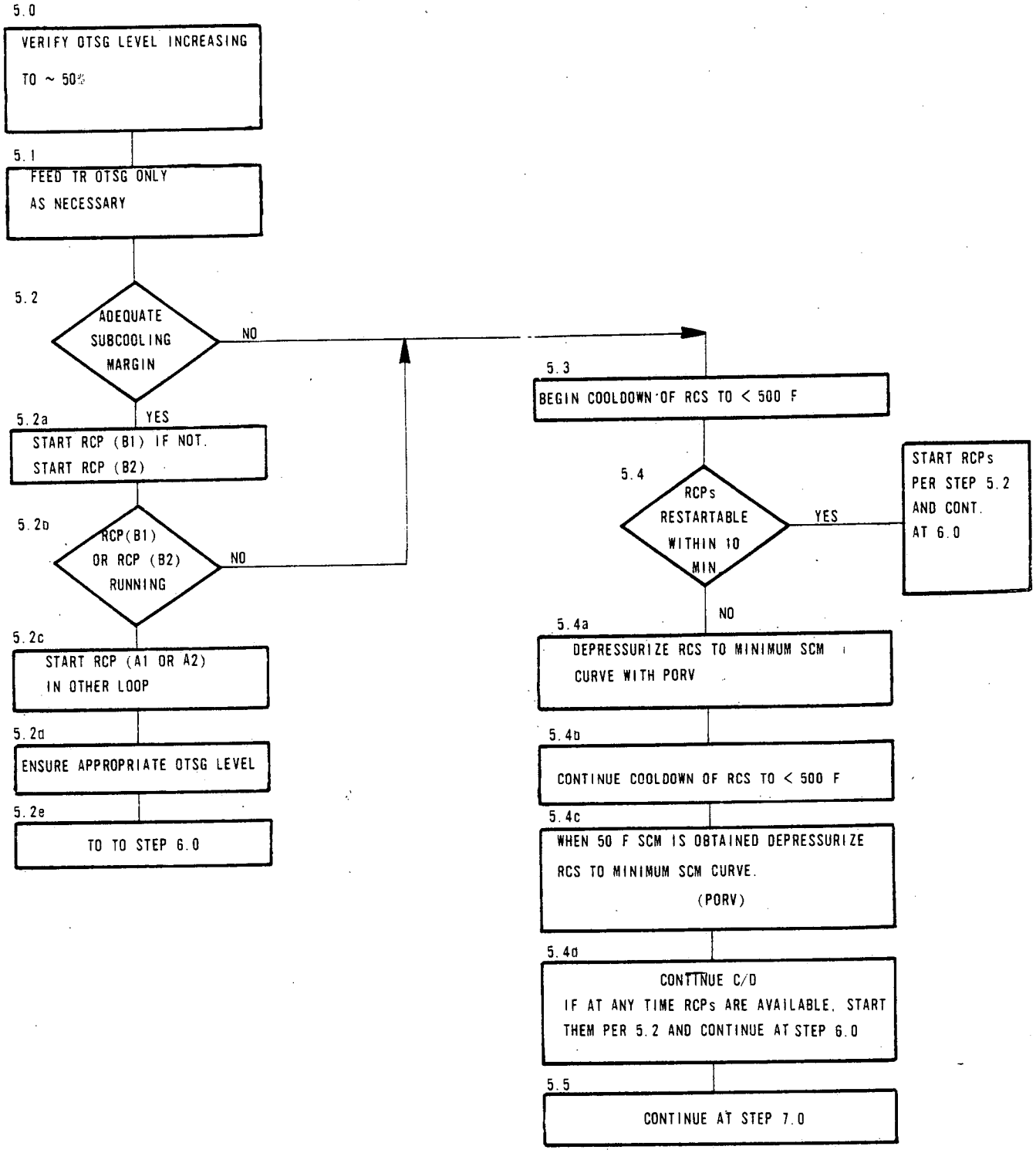
D·R·A·F·T

4.4 Depressurize the RCS to the adequate subcooling margin curve by opening the PORV.

4.5 As quickly as possible, begin cooldown of the RCS to less than 500F with the TBVs initially using both steam generators.

4.6 Whenever a 50F subcooling margin is obtained, depressurize the RCS to the adequate subcooling margin curve by opening the PORV.

4.7 Continue to step 7.0.


5.0
VERIFY OTSG LEVEL INCREASING TO ~ 50%
5.1
FEED TR OTSG ONLY AS NECESSARY
5.2
ADEQUATE SUBCOOLING MARGIN
NO
YES
5.2a
START RCP (B1) IF NOT. START RCP (B2)
5.2b
RCP(B1) OR RCP (B2) RUNNING
NO
5.2c
START RCP (A1 OR A2) IN OTHER LOOP
5.2d
ENSURE APPROPRIATE OTSG LEVEL
5.2e
TO TO STEP 6.0
5.3
BEGIN COOLDOWN OF RCS TO < 500 F
5.4
RCPs RESTARTABLE WITHIN 10 MIN
YES
START RCPs PER STEP 5.2 AND CONT. AT 6.0
NO
5.4a
DEPRESSURIZE RCS TO MINIMUM SCM CURVE WITH PORV
5.4b
CONTINUE COOLDOWN OF RCS TO < 500 F
5.4c
WHEN 50 F SCM IS OBTAINED DEPRESSURIZE RCS TO MINIMUM SCM CURVE. (PORV)
5.4d
CONTINUE C/D
IF AT ANY TIME RCPs ARE AVAILABLE, START THEM PER 5.2 AND CONTINUE AT STEP 6.0
5.5
CONTINUE AT STEP 7.0

Reactor coolant pumps not running

5.0 Verify that OTSG levels are increasing to approximately 50% on the operate range with feedwater properly throttled.

5.1 As soon as the TR OTSG is identified, stop feeding the TR OTSG unless needed to maintain the low level limit, to induce natural circulation, or to maintain adequate subcooling margin.

5.2 Whenever adequate subcooling margin is obtained:

a. Start RCP (B1) which provides the most pressurizer spray flow or RCP (B2).

b. If neither RCP (B1 or B2) in the pressurizer loop can be restarted, go to step 5.3, otherwise continue.

c. Start one RCP (A1 or A2) in the other loop.

d. Ensure appropriate steam generator level is obtained after restarting the RCPs.

e. Go to step 6.0.

D.R.A.F.T

5.3 As soon as possible, begin cooldown of the RCS to less than 500F with the TBVs, initially on both steam generators.

5.4 If the RCPs cannot be restarted within 10 minutes after they tripped or were tripped:

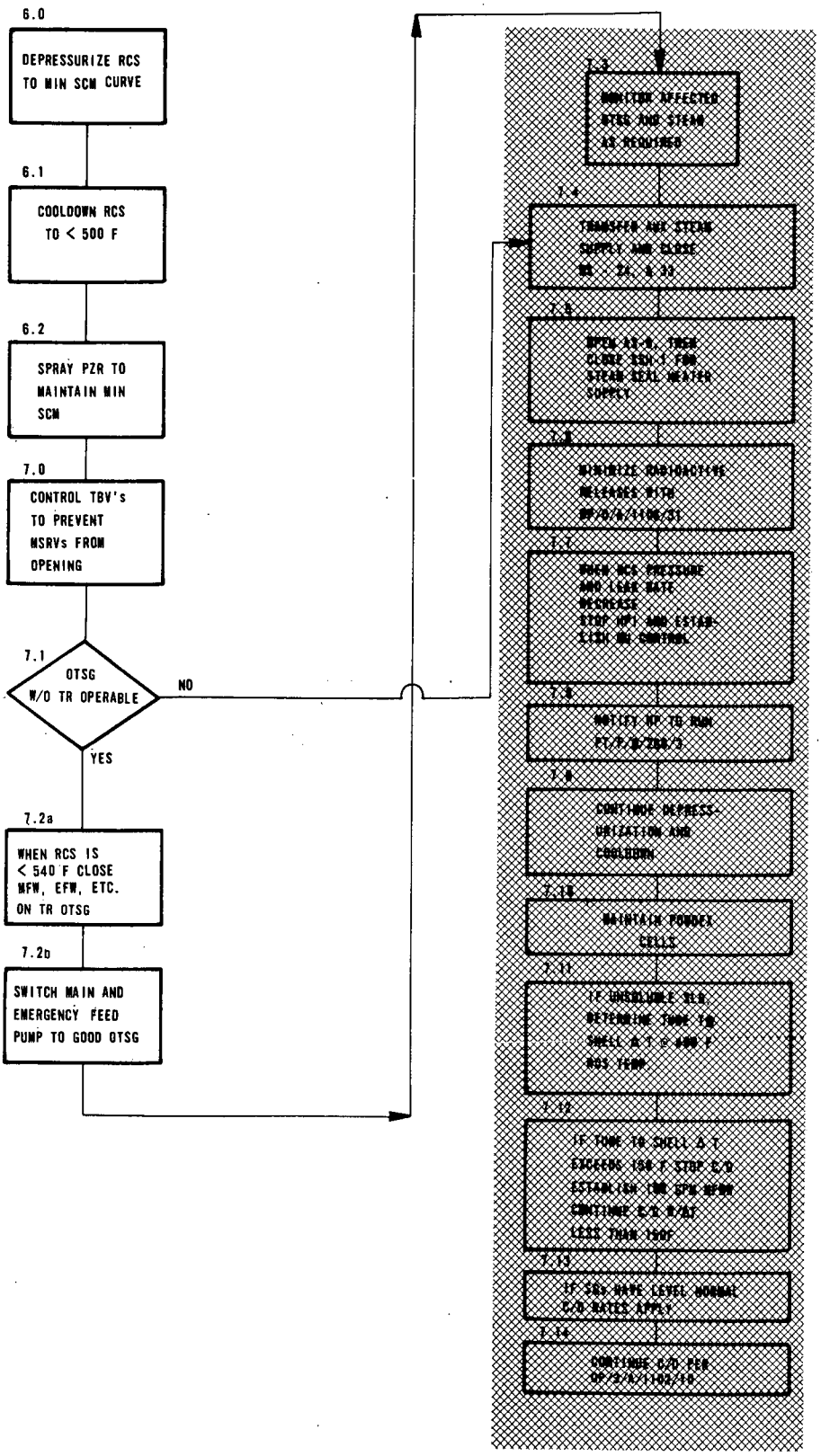
a. Depressurize the RCS to adequate subcooling margin by opening the PORV.

b. Continue cooldown of the RCS to less than 500F with the TBVs initially on both steam generators.

c. Whenever a 50F subcooling margin is obtained, depressurize the RCS to the adequate subcooling margin curve by opening the PORV.

d. Continue cooldown and depressurization in this manner until the RCPS (B1 or B2) can be restarted per step 5.2.

5.5 Continue to step 7.0.


6.0
DEPRESSURIZE RCS TO MIN SCM CURVE
6.1
COOLDOWN RCS TO < 500 F
6.2
SPRAY PZR TO MAINTAIN MIN SCM
7.0
CONTROL TBV's TO PREVENT MSRVs FROM OPENING
7.1
OTSG W/O TR OPERABLE
NO
YES
7.2a
WHEN RCS IS < 540 F CLOSE MFW, EFW, ETC. ON TR OTSG
7.2b
SWITCH MAIN AND EMERGENCY FEED PUMP TO GOOD OTSG
7.3
MONITOR AFFECTED BTEG AND STEAM AS REQUIRED
7.4
TRANSFER AUX STEAM SUPPLY AND CLOSE MS 24, & 33
7.5
OPEN AS-6, THEN CLOSE SEN-1 FOR STEAM SEAL HEATER SUPPLY
7.6
MINIMIZE RADIOACTIVE RELEASES WITH OP/0/A/1106/31
7.7
WHEN RCS PRESSURE AND LEAK RATE DECREASE STOP HPI AND ESTABLISH RCS CONTROL
7.8
NOTIFY RP TO RUN PT/P/0/200/3
7.9
CONTINUE DEPRESSURIZATION AND COOLDOWN
7.10
MAINTAIN POWDEX CELLS
7.11
IF UNRESOLVABLE DIFF. BETWEEN TUBE TO SHELL Δ T @ 400 F RCS TEMP
7.12
IF TUBE TO SHELL Δ T EXCEEDS 100 F STOP C/D ESTABLISH TBV SPW MFWP CONTINUE C/D W/AT LESS THAN 150F
7.13
IF SGs HAVE LEVEL NORMAL C/D RATES APPLY
7.14
CONTINUE C/D PER OP/2/A/1102/10

Reactor coolant pumps are running

6.0 Begin depressurizing the RCS to the adequate subcooling margin curve by opening the pressurizer spray valve (RC-1).

6.1 As quickly as possible, begin cooldown of the RCS to less than 500F with the TBVs initially on both steam generators.

6.2 Continue spraying the pressurizer as necessary to maintain only adequate subcooling margin.

Continue cooldown and isolate affected OTSG

D.R.A.F.T

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

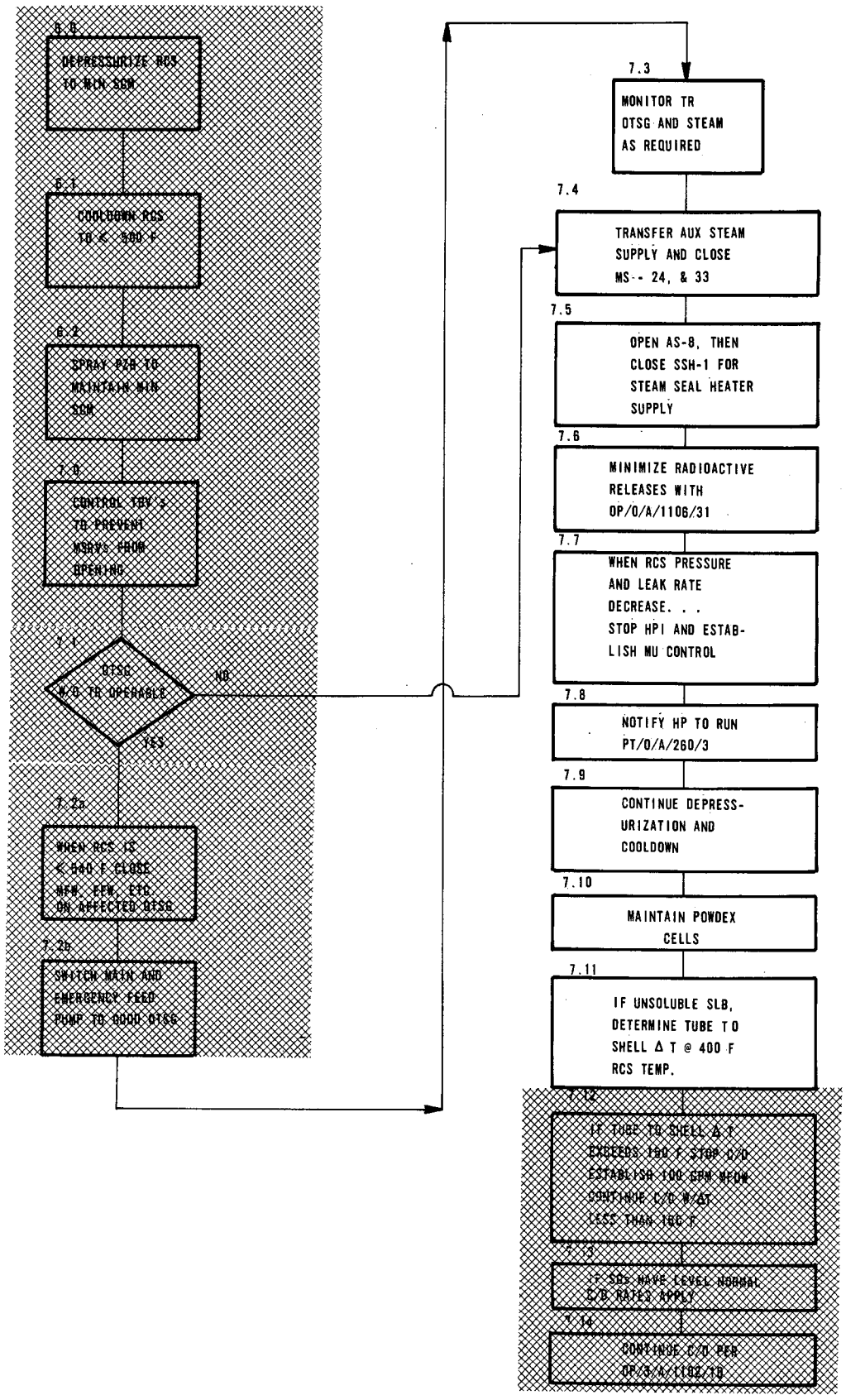
7.1 If the OTSG without TR is not operable, go to step 7.4 and continue cooldown with the TR OTSG, otherwise continue.

7.2 As soon as the TR OTSG is identified and the RCS is below 540F:

a. Isolate the TR OTSG by closing its respective valves as follows:

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	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 -89

b. Switch both the main and emergency feed pump steam supply to the unaffected OTSG.


6.0
DEPRESSURIZE RCS TO MIN SGW
6.1
COOLDOWN RCS TO ≤ 500 F
6.2
SPRAY PZR TO MAINTAIN MIN SGW
7.0
CONTROL TBV ≤ TO PREVENT MSRVS FROM OPENING
7.1
OTSG W/O TR OPERABLE
NO
YES
7.2a
WHEN RCS IS ≤ 940 F CLOSE MFW, FEW, ETC ON AFFECTED OTSG
7.2b
SWITCH MAIN AND EMERGENCY FEED PUMP TO GOOD OTSG
7.3
MONITOR TR OTSG AND STEAM AS REQUIRED
7.4
TRANSFER AUX STEAM SUPPLY AND CLOSE MS-- 24, & 33
7.5
OPEN AS-8, THEN CLOSE SSH-1 FOR STEAM SEAL HEATER SUPPLY
7.6
MINIMIZE RADIOACTIVE RELEASES WITH OP/0/A/1106/31
7.7
WHEN RCS PRESSURE AND LEAK RATE DECREASE. . . STOP HPI AND ESTAB-LISH MU CONTROL
7.8
NOTIFY HP TO RUN PT/0/A/260/3
7.9
CONTINUE DEPRESS-URIZATION AND COOLDOWN
7.10
MAINTAIN POWDEX CELLS
7.11
IF UNSOLUBLE SLB, DETERMINE TUBE TO SHELL Δ T @ 400 F RCS TEMP.
7.12
IF TUBE TO SHELL Δ T EXCEEDS 100 F STOP C/D ESTABLISH 100 GPM MFDW CONTINUE C/D W/Δ T LESS THAN 100 F
7.13
IF SGS WAVE LEVEL NORMAL C/D RATES APPLY
7.14
CONTINUE C/D PER OP/3/A/1102/10

7.3 Periodically monitor the TR OTSG's pressure and level. Initiate steaming as necessary to maintain the OTSG pressure below 1000 psig and OTSG level below 95% on the operate range.

7.4 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.

7.5 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.

D·R·A·F·T

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

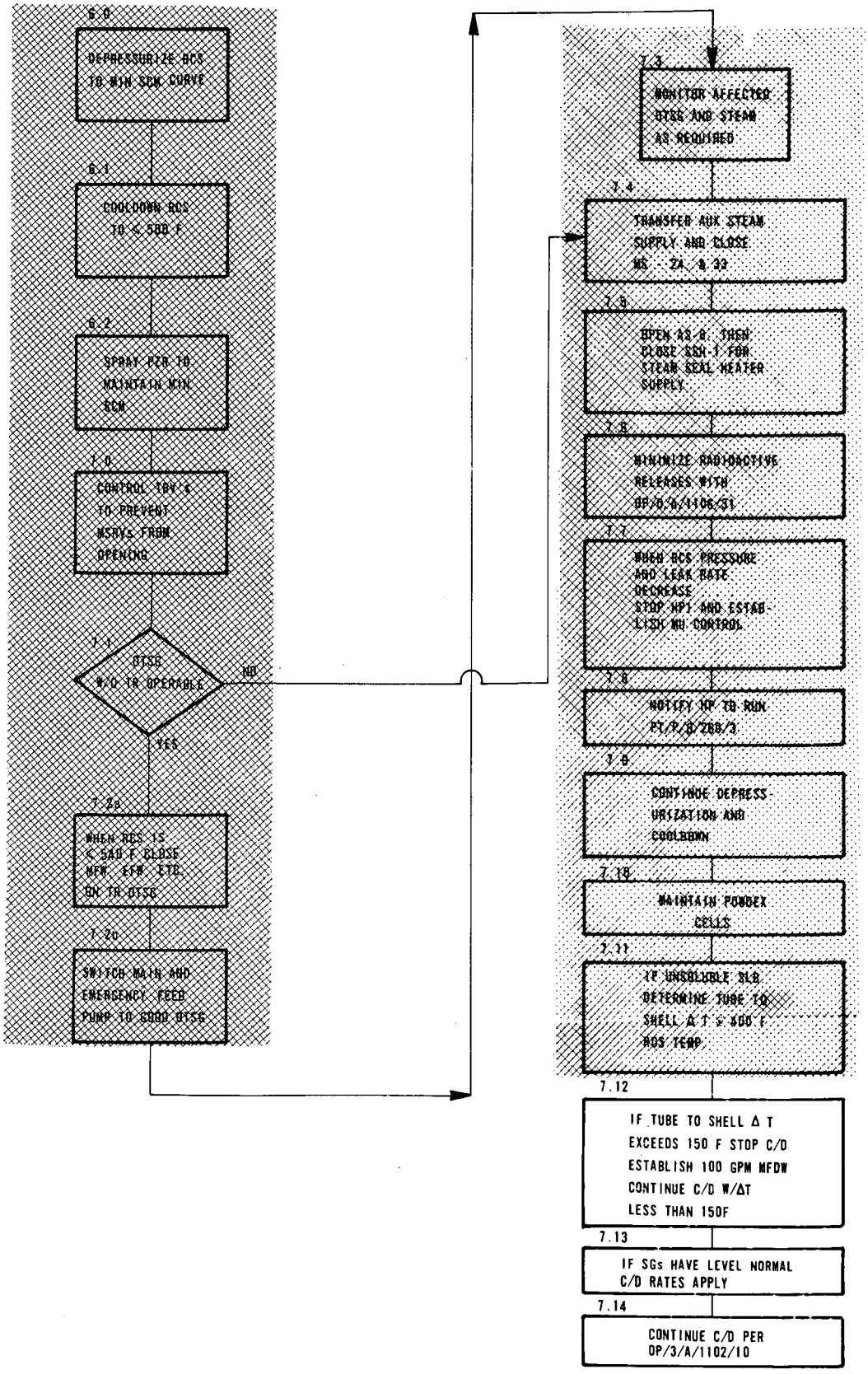
7.7 As RCS pressure and leak rate decrease and RCS inventory and subcooling can be maintained by the MU system, then stop the HPI system and establish normal MU control.

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

7.9 Continue depressurization and cooldown at maximum cooldown rate on OTSG without TR, not to exceed 100F/hr, while maintaining adequate subcooling margin.

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

7.11 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.


6.0
DEPRESSURIZE RCS TO MIN SCM CURVE
6.1
COOLDOWN RCS TO < 500 F
6.2
SPRAY PZR TO MAINTAIN MIN SCM
7.0
CONTROL TBV'S TO PREVENT MSRVS FROM OPENING
7.1
OTSG W/O TR OPERABLE
NO
YES
7.2a
WHEN RCS IS < 540 F CLOSE MFW, EFW, ETC. ON TR OTSG
7.2b
SWITCH MAIN AND EMERGENCY FEED PUMP TO GOOD OTSG
7.3
MONITOR AFFECTED OTSG AND STEAM AS REQUIRED
7.4
TRANSFER AUX STEAM SUPPLY AND CLOSE MS 24 & 33
7.5
OPEN AS-8, THEN CLOSE SSH-1 FOR STEAM SEAL HEATER SUPPLY
7.6
MINIMIZE RADIOACTIVE RELEASES WITH OP/0/A/1106/31
7.7
WHEN RCS PRESSURE AND LEAK RATE DECREASE STOP HPI AND ESTABLISH MU CONTROL
7.8
NOTIFY HP TO RUN PT/P/0/260/3
7.9
CONTINUE DEPRESSURIZATION AND COOLDOWN
7.10
MAINTAIN POWDEX CELLS
7.11
IF UNISOLABLE SLB DETERMINE TUBE TO SHELL Δ T @ 500 F RCS TEMP
7.12
IF TUBE TO SHELL Δ T EXCEEDS 150 F STOP C/D ESTABLISH 100 GPM MFDW CONTINUE C/D W/ΔT LESS THAN 150F
7.13
IF SGs HAVE LEVEL NORMAL C/D RATES APPLY
7.14
CONTINUE C/D PER OP/3/A/1102/10

7.12 If tube to shell ΔT exceeds 150F stop cooldown. Establish main feedwater flow through MFW nozzles at approximately 100 gpm. When ΔT is less than 150F cooldown may continue while maintaining ΔT less than 150F.

7.13 If a level is established maximum cooldown rates of the RCS apply.

7.14 Continue cooldown per procedure OP/3/A/1102/10 using only the good OTSG.

P
P
S

The TR OTSG has been identified. The RCS is subcooled and the pressurizer is controlling RCS pressure.

D·R·A·F·T

CP-101

Transient Termination Following Large LOCA
When CF Tank Has Emptied

1. Verify the following:

   A. RCPs tripped

   b. Letdown storage tank outlet valve, HP-23, closed

   c. HPI, LPI, and RB spray actuated

   d. Containment isolated

   e. CF Tank empty

   f. RB Emergency Cooling actuated

D·R·A·F·T

2. Isolate CFTs from RCS, after CFT level has decreased to 0 ft to prevent N_2 introduction into RCS.

3. Notify the Duty Engineer.

4. Throttle LPI and RB spray flows to control in normal operational bounds and also prevent pump runout.

5. Ensure maximum HPI flow per Figure 1.

6. If LPI flow has been greater than 1000 gpm in each injection line for at least 20 minutes, then RCS will not repressurize and HPI flow may be stopped.

   a. Stop HPI pumps.

   b. Close HPI valves HP-26 and HP-27.

   c. Go to Step 8.

7. If the conditions of Step 6 are not met before the BWST level approaches Lo-Lo-Level, 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.

8. When BWST level drops to approximately 6 feet or BWST LO-LO-Level Alarms (minimum time 1/2 to 1 hour) transfer LPI suction to reactor building 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 and open.

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

9. Throttle LPI valves LP-12 and LP-14 to prevent pump cavitation.

10. If only one LPI pump is operable, continue cooldown in "piggyback" mode until the second LPI pump is operable.

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

12. After DHR system flow has been greater than 1000 gpm in each injection line for at least 20 minutes, terminate HPI.

13. Isolate Containment Penetration of major lines.

   a. CLOSE the following valves to isolate the steam generators:

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-79	MS-76

   b. Stop EFW pumps and close EFPT steam supply valves MS-82 and MS-84.

14. Close PORV block valve, RC-4.

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

D·R·A·F·T

16. Continue LPI cooling until further instructions are given.

17. Measure the pH and add appropriate caustic to coolant per OP/1104/30 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.

18. Sample the RCS fluid for boron concentration to ensure that the RC is not being diluted.

19. Return two RB cooling fans to full speed, when RB pressure decreases to 10 psig.

D·R·A·F·T

20. 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.

21. Monitor the Hydrogen level in the RB. Start the RB Hydrogen Purge System per OP/O/A/1104/29.

22. Within 24 hours,

    a) Rack in breakers on LP-103 and LP-14 and open these valves.

    b) If unable to verify flow through LP-103 and LP-104, OPEN LP-3, LP-2, LP-1, LP-108, and LP-109 and verify flow through this line.

CP-102

NORMAL COOLDOWN

Check RC flow condition

1.0 If any RCPs are running, go to step 2.0, otherwise continue.

1.1 If natural circulation is in progress and RCPs can be started (refer to OP/3/A/1103/06, RCP Operation) do so, otherwise continue.

1 of 2 OTSGs in service

2.0 If 2 OTSGs are in service, go to OP/3/A/1102/10. Otherwise continue.

Cooldown with dry OTSG (unrecoverable)

D.R.A.F.T

3.0 Feed the dry OTSG with approximately 100 gpm through the main FW nozzles.

3.1 Calculate the existing tube to shell ΔT for the dry OTSG:

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

ΔT = _____F This value must not exceed ±60 F

3.2 When the ΔT, as determined in step 5.0 above, is ≤ 60 F, open the bypass valves on the operable OTSG and commence cooldown. DO NOT exceed 60F ΔT tube to shell on the dry OTSG.

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

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

CP-103

Transient termination following an occurrence that leaves the RCS saturated with OTSGs removing heat

1. Verify:

   a. RCS saturated using core exit T/Cs.
   b. HPI is maintaining RCS inventory.
   c. OTSG remains pressurized above 150 psig.
   d. RCS is in natural ciruclation.
   e. OTSG levels are being maintained approximately 95%.
   f. CFTs have not emptied.

D·R·A·F·T

2. Begin cooldown of RCS by increasing OTSG steaming.
3. Verify that OTSGs continue to provide a heat sink for the RCS by remaining pressurized and core exit T/Cs decrease as OTSG pressure is lowered.
4. Continue saturated cooldown by decreasing OTSG pressure.
5. If the RCS does not cooldown as the OTSGs are depressurized, bump an RCP to re-establish heat transfer via Natural Circulation.
6. If the pump bump does not establish natural circulation, then go to CP-104 Step 1.
7. If the RCS becomes subcooled at any time, by comparing both exit T/Cs and hot leg RTDs, start an RC pump (preferrably RCP B1 or B2).
8. If the RCS remains subcooled after starting the RC pump, go to CP-105, otherwise continue.
9. If for any reason the RCS becomes superheated, proceed to Section ICC.
10. If the RCS becomes subcooled during the Natural Circulation cooldown, go to CP-105, otherwise continue.

11. Isolate CF tanks when RCS pressure reaches 700 psig.

12. When LPI flow has been in excess of 1000 gpm in each injection line for at least 20 minutes, stop HPI pumps if running and continue, otherwise go to Step 15.

13. When BWST Level drops to approximately 6 feet or BWST LO-LO-LEVEL alarms (minimum time 1/2 to 1 hour) transfer LPI suction to reactor building sump. When the following valve manipulations are made, manual override 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.

D·R·A·F·T

14. Continue with unit shutdown per OP/3/A/1102/10.

15. If the conditions of Step 12 are not met before the BWST level drops to approximately 6 feet or BWST LO-LO-Level alarms (minimum time 1/2 to 1 hour), align HPI system to take suction from the reactor building sump using the LPI system to provide HPI pump suction.

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

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

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

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

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

16. Continue in this HPI/LPI "piggyback" mode until RCS pressure is 250 psig.

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

18. When Adequate Subcooling Margin is established, continue with Steps 19 through 23.

19. If only one LPI pump is operable, continue cooldown in "piggyback" mode until the second LPI pump is operable.

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

21. Throttle HPI to approximately 150 psig and align second LPI pump in LPI mode.

22. After DHR system flow has been greater than 1000 gpm in each injection line for at least 20 minutes, terminate HPI.

23. Continue with unit shutdown per OP/3/A/1102/10.

D·R·A·F·T

CP-104

Transient Termination Following an Occurrence that Leaves the RCS Being Cooled by HPI Cooling

1. If RC pumps are running, go to step 3. Otherwise continue.
2. As long as NO RC pumps are operating, the RC pressure/temperature combination shall be kept within the no forced flow region of Figure 2.
   a) Determine the RC temperature by averaging the five highest incore thermocouple temperature readings.
   b) When adequate subcooling margin is obtained, continually reduce the HPI flow rate to maintain the P/T limits of Figure 2.
   c) As soon as RC pressure/temperature is below the maximum limit of the DHRS, start the DHRS and maintain the RC pressure/temperature within the limits of the DHRS.
   d) Continue at step 3.
3. Verify PORV open.
4. HPI pumps are running at sufficient flow to maintain the core in saturated or subcooled conditions. Refer to Figure 2 for NDT limits.
5. Isolate CF Tanks when RCS pressure decreases to 700 psig.
6. If at any time the saturated RCS becomes subcooled but voids are still trapped in high points of loops, or if heat transfer to OTSGs is restored, or HPI capacity exceeds leak, then follow Steps 19 through 31.

D·R·A·F·T

7. When LPI flow has been in excess of 1000 gpm in each injection line for at least 20 minutes, stop HPI pumps is running and continue; otherwise go to Step 10.

8. When BWST Level drops to approximately 6 feet or BWST LO-LO-LEVEL alarms (minimum time 1/2 to 1 hour) transfer LPI suction to reactor building sump. When the following valve manipulations are made, manual override 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.

D·R·A·F·T

9. Continue with unit shutdown per OP/3/A/1102/10.

10. If the conditions of Step 6 are not met before the BWST level drops to approximately 6 feet or BWST LO-LO-Level alarms (minimum time 1/2 to 1 hour), align HPI system to take suction from the reactor building sump using the LPI system to provide HPI pump suction.

    a) Verify RB sump suction valves LP-19 and LP-20 are open.
    b) Verify MU pump suction crossover valves, HP-98, HP-99, and HP-100 are open.
    c) Verify running or start LPI pumps LP-3A and LP-3B.
    d) Open LP-15 and LP-16, LPI discharge to MU pump suction.
    e) Close BWST outlet valves, LP-21 and LP-22 to prevent pumping BWST dry.

11. Continue in the HPI/LPI "piggyback" mode until RCS pressure is 250 psig.

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

13. When adequate subcooling margin is established continue with Steps 14 through 17.

14. If only one LPI pump is operable, continue cooldown in "piggyback" mode until the second LPI pump is operable.

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

16. Throttle HPI to approximately 150 psig and align second LPI pump in LPI mode.

D·R·A·F·T

17. After DHR system flow has been greater than 1000 gpm in each injection line for at least 20 minutes, terminate HPI.

18. Continue with unit shutdown per OP/3/A/1102/10.

19. Verify the following:

    a. RCS subcooled using core exit thermocouples; if not, ensure maximum HPI flow per Figure 1.

    b. RCPs ready for restart; if not, try to get at least one RCP ready for restart.

    c. OTSG levels being maintained at 95%; if not, attempt to restore FW and increase levels to 95%.

    Continue with following steps.

20. Has natural circulation been established by:

    a. Thot and exit core T/Cs (average of 5 highest) becoming subcooled and decreasing.

    b. Thot - T_{cold} less than 50F.

21. If RCS becomes subcooled and natural circulation is established, go to CP-105, otherwise continue.

22. Depressurize OTSGs by an amount that would reduce secondary T_{sat} by approximately 50F lower than the core exit thermocouple temperature.

23. If natural ciruclation is established, go to CP-105. Otherwise continue.

24. Bump RC pump, which is capable of being started, in a loop with level in the OTSG.

25. Allow RCS pressure to stabilize.

26. If natural circulation is established, go to CP-105.
If natural circulation is not established, continue.

D·R·A·F·T

27. Repeat Steps 20 through 22 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 re-established, continue with Step 28.

28. Depressurize OTSGs by an amount that would reduce secondary T_{sat} by approximately 50F lower than the core exit thermocouple temperature.

29. If natural circulation has been established, go to CP-105; otherwise continue.

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

31. If RCS remains subcooled, go to CP-105. If RCS remains saturated, continue cooldown per Steps 1 through 14.

CP-105

Transient Termination Following An Occurrence That May Require Pressusrizer Recovery or Solid Plant Cooldown

Determination of Pressurizer Conditions

1.0 If there is a bubble in the pressurizer, go to CP-102; otherwise continue.

2.0 Adjust HPI and/or makeup flow to maintain adequate subcooling margin in the RCS.

D·R·A·F·T

3.0 Close or verify closed PORV and PORV block valve (RC-4).

4.0 Establish letdown flow.

5.0 Control at adequate subcooling margin with HPI and/or makeup and letdown flow.

Try and Establish a Pressurizer Bubble

6.0 Turn on all available pressurizer heaters.

6.1 Monitor the increase in pressurizer water temperature until pressurizer temperature reaches saturation for the existing RC pressure. At this point, a bubble will be formed.

6.2 Shift supervisor should determine whether or not to try to establish a bubble in the pressurizer (a leak in the pressurizer will slow the temperature rise and may stop it entirely) or proceed with solid plant cooldown, step 7.0.

6.3 When a bubble is established in the pressurizer, lower pressurizer level to approximately 220 inches.

6.4 Go to CP-102.

Solid Plant Cooldown

7.0 Using Figure 1 determine maximum allowable flow rate for each operable HPI pump. Record the total available flow rate here. _____ GPM.

7.1 Subtract the present HPI flow rate from the flow rate determined in step 7.0.

(_____GPM from 7.0 - (_____GPM HPI flow) = _____GPM

7.2 Stop letdown.

7.3 Increase the HPI flow until 50F subcooling margin is attained or until the additional HPI flow equals the amount determined in step 7.1, whichever is less.

D·R·A·F·T

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

7.5 Further adjustment of HPI flow and turbine bypass valve position should be accomplished so as to maximize the cooldown rate while maintaining adequate subcooling margin.

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

CP-106

Cooldown Following ICC

Transient termination following possible fuel damage with cooling being supplied by LPI system with/without primary to secondary heat transfer.

1.0 If RCPs are running, decrease to two (2) RC pump operation (one per Loop).

2.0 Isolate the core flood tanks.

3.0 If using turbine driven EFWP, do not reduce OTSG pressure less than _____ psig until one motor driven EFWP is available.

D·R·A·F·T

4.0 When LPI flow has been in excess of 1000 gpm in each injection lines for at least 20 minutes, stop HPI pumps if running and continue with 5.0. Otherwise, go to step 8.0.

5.0 When BWST level drops to approximately 6 feet or BWST LO-LO-LEVEL alarms (minimum time 1/2 to 1 hour) transfer LPI suction to reactor building 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.

6.0 Stop the remaining reactor coolant pumps.

7.0 Continue LPI cooling until further instructions are given.

8.0 If primary temperature can be controlled by steaming the OTSG(s) go to Step 13, otherwise, continue at Step 9.0.

9.0 Ensure maximum HPI flow.

9.1 Throttle HPI flow only as necessary to prevent exceeding NDT limits.

10.0 Stop the reactor coolant pumps.

11.0 When the BWST level reaches the LO-LO-LEVEL alarm, align HPI system to take suction from the reactor building sump using the LPI system to provide HPI pump suction.

a) Verify RB sump suction valves, LP-19 and LP-20 are open.
b) Verify MU pump suction crossover valves, HP-98, HP-99, and HP-100 are open.
c) Verify running or start LPI pumps LP-3A and LP-3B.
d) Open LP-15 and LP-16, LPI discharge to MU pump suction.
e) Close BWST outlet valves, LP-21 and LP-22 to prevent pumping BWST dry.

D·R·A·F·T

12.0 Continue in this mode of cooling until further instructions are given.

13.0 Cooldown the RCS by steaming the operable OTSGs while maintaining ECCS flow.

14.0 Throttle HPI flow to prevent exceeding NDT limits.

15.0 Close the PORV and cycle as necessary to maintain less than 150 psig RCS pressure.

16.0 When the BWST level reaches the LO-LO-LEVEL alarm, align HPI system to take suction from the reactor building sump using the LPI system to provide HPI pump suction.

a) Verify RB sump suction valves, LP-19 and LP-20 are open.
b) Verify MU pump suction crossover valves, HP-98, and HP-99, and HP-100 are open.

c) Verify running or start LPI pumps LP-3A and LP-3B.
d) Open LP-15 and LP-16, LPI discharge to MU pump suction.
e) Close BWST outlet valves, LP-21 and LP-22 to prevent pumping BWST dry.

17.0 Continue in this mode of cooling until further instructions are given.

D·R·A·F·T

Section ICC

Follow-up Actions for Inadequate Core Cooling

1.0 Follow the subcooling rule:

Start HPI if not already in operation:

a) Ensure maximum HPI flow per Figure 1.
b) If HPI flow cannot be verified in both loops, open the cross-connect valve for the HPI header.

2.0 If LPI is delivering flow, increase LPI flow to maximum.

3.0 Ensure OTSG levels are increasing toward, or at approximately 90-95% on the operate range.

D·R·A·F·T

4.0 Depressurize OTSG(s) while maintaining level(s) to achieve secondary T-sat approximately 100F lower than incore thermocouple temperature and maintain this ΔT.

5.0 Ensure CFT isolation valves are open.

6.0 Determine RCS temperature using an average of the highest incore thermocouple readings (average the five highest) and take actions depending on which region is indicated on Figure 3.

6.1 If in region #1, incore thermocouple temperature $\leq$ saturation, go to CP-103.

6.2 If in region #2, incore thermocouple temperature is greater than saturation but less than curve #1 Figure 3, continue steps 1.0 through 5.0 above.

6.3 If in region #3, incore thermocouple temperature is $\geq$ curve #1 but less than curve #2 Figure 3, go to step 7.0.

6.4 If in Region #4, incore thermocouple temperature curve #2 Figure 3, go to step 8.0.

7.0 If RC pumps are not operating, start one pump per loop (if possible). Do not override normal RC pump interlocks.

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.

7.2 If primary to secondary heat transfer is not established:

a) Open PORV and leave open.

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

c) Go to CP-104.

7.3 If primary to secondary heat transfer is established:

a) Cycle PORV as necessary to maintain RCS pressure 25-50 psi greater than OTSG pressure.

b) Go to CP-103.

D·R·A·F·T

8.0 If possible, start all RC pumps. Starting interlocks should be defeated if necessary.

a) Do not defeat the overload trip circuit.

b) If CCW is lost and not restored to the motor within 30 minutes, trip the RC pump.

8.1 Depressurize the operative steam generator(s) as quickly as possible to the minimum steam pressure necessary to power the steam driven emergency feedwater pump.

8.2 Open the PORV and leave open.

8.3 Depressurize the RCS until LPI restores core cooling.

8.4 Once incore thermocouple temperature returns to the saturation temperature for the existing RCS pressure, go to CP-106.

Figure 1 HPI FLOW VS. RC PRESSURE

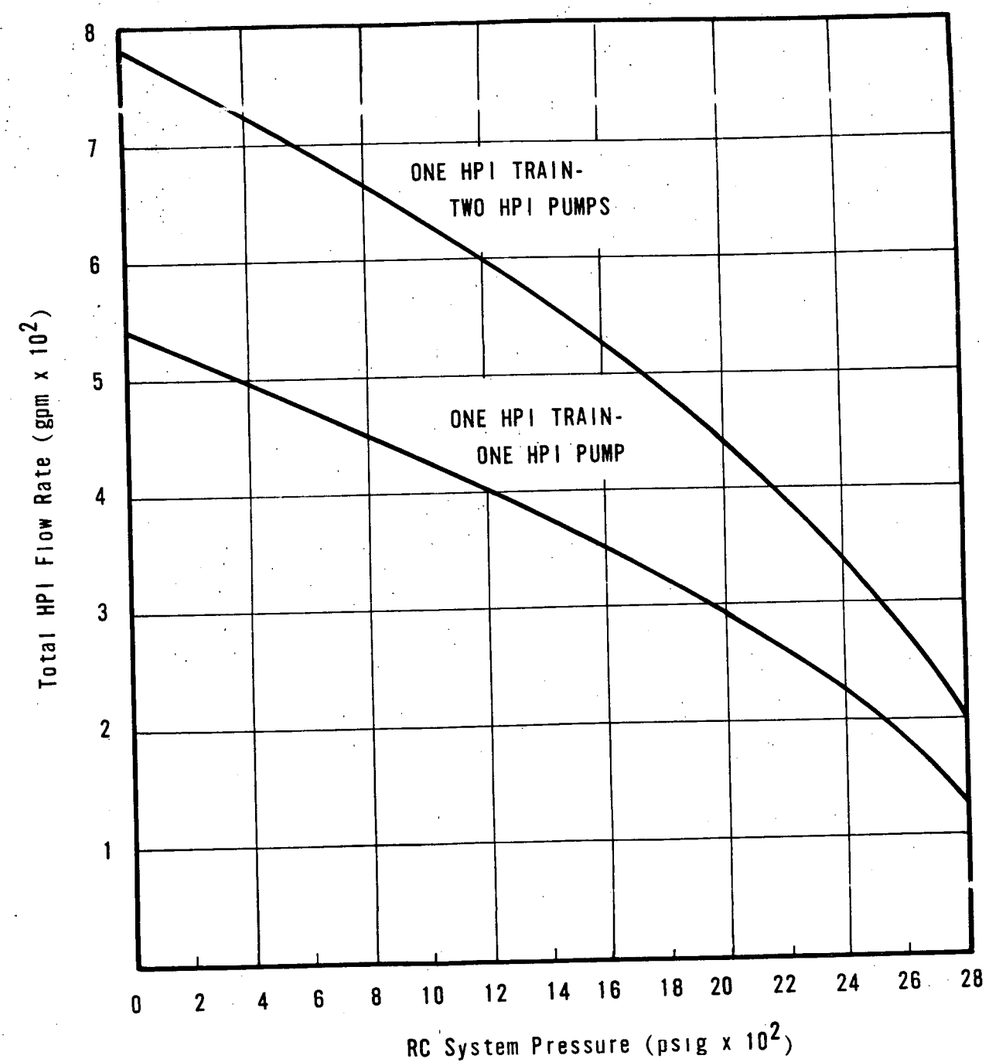


Figure 2 RC PRESSURE/TEMPERATURE LIMITS

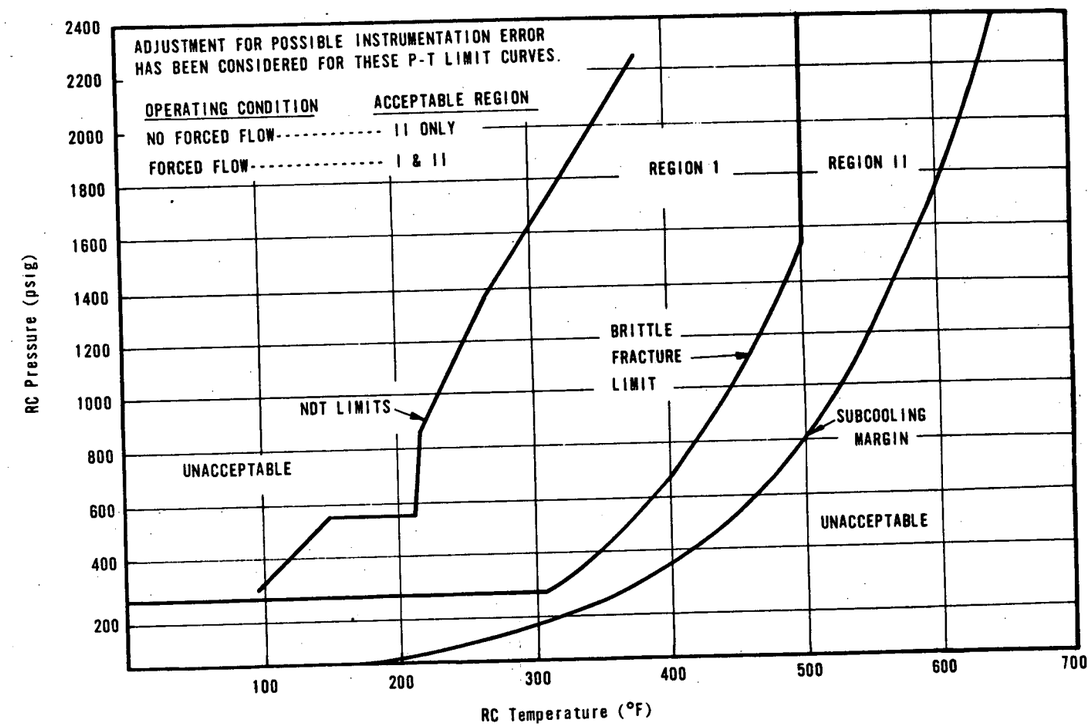
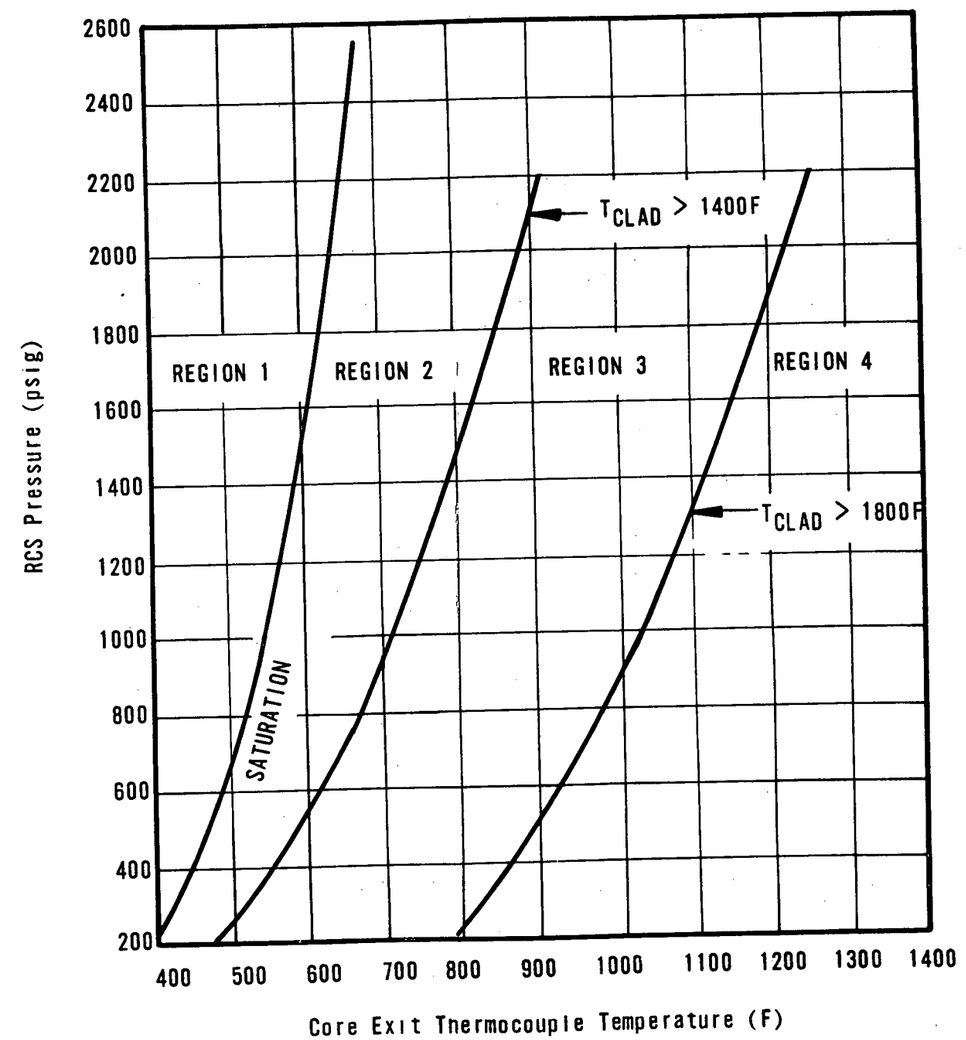


Figure 3 CORE EXIT FLUID TEMPERATURE FOR INADEQUATE CORE COOLING



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