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EMERGENCY OPERATING PROCEDURES TECHNICAL BASES DOCUMENT

Volume 1
Generic Emergency Operating Guidelines

AmerGen Energy Company, LLC
Duke Energy Corporation
Entergy Operations, Inc.
FirstEnergy Nuclear Operating Company
Florida Power Corporation

74-1152414

FRAMATOME TECHNOLOGIES

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TECHNICAL DOCUMENT

EMERGENCY OPERATING PROCEDURES TECHNICAL BASES DOCUMENT

VOLUME 1

GENERIC EMERGENCY OPERATING GUIDELINES

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for

The B&W Owners Group
Operator Support Committee

AmerGen Energy Company, LLC
Duke Energy Corporation
Entergy Operations, Inc.
FirstEnergy Nuclear Operating Company
Florida Power Corporation

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Part I

Introduction

The Generic Emergency Operating Guideline (GEOG) Bases is a guideline developed from the technical bases contained in Volume 3. The GEOG is intended to demonstrate how the individual sections of the Technical Bases document (TBD) can be assembled into one overall transient mitigation guideline. It represents the vendor-preferred path relative to options included in the TBD.

The GEOG is not a procedure nor should it be used as a direct model for a procedure. The development of this document did not rigorously adhere to any set of human factors principles other than to achieve consistency in the use of terms, such as IF-THEN statements (the users of this document have their own plant specific procedure writer's guides to control procedure format and content). The GEOG should also not be used as a stand-alone document. All of the TBD volumes must be read and understood before implementing TBD guidance.

GEOG Structure

The GEOG comprises seven parts:

- Introduction: basic information on use.
- List of acronyms and abbreviations.
- Diagnosis and mitigation: covers entry, diagnosis of abnormal conditions, mitigation of transients and plant stabilization.
- Cooldown: covers cooldown under abnormal conditions of LOCA, HPI cooling, or degraded SGs.
- Repetitive tasks: covers guidance for tasks that may apply in several mitigation or cooldown sections.
- Rules: covers important guidance that always applies after the reactor is shutdown when the stated conditions exist.
- Figures: provides any figures used in the GEOG other than the section flowcharts.

The GEOG uses the following logic terms and conventions:

- IF-THEN: denotes a condition that applies at the time the step is performed.
- IF AT ANY TIME-THEN: denotes a condition that applies from that point forward in the same section; conditional statements are NOT carried over between sections.
- WHEN-THEN: denotes a hold until either the stated condition exists or a previous IF AT ANY TIME step becomes applicable.
- Brackets typed in bold (i.e., **[ ]**) are used to identify the insertion of the noted plant-specific information.
- For the purpose of understanding the GEOG, each GEOG step is followed in succession unless directed otherwise. This does not imply any specific sequencing requirements are imposed on EOPs. GEOG step sequencing bases are provided in Volume 2.
- The use of "go to" intends that the guidance path be redirected at that point. However, a reference, usually by noting the referenced section in parentheses, intends that the referenced guidance be used in conjunction with the current section.
- The terms "verify" and "ensure" have specific meaning as used in the GEOG. Verify means to check for the stated condition, but perform no action. Ensure, which is more prevalent in the GEOG, means to check and, if the stated condition does not exist, perform the actions necessary to establish the condition. For example, "Ensure HPVs are closed" means to take the action to close all of the HPVs if they are not closed when checked. The term "ensure" is used, rather than just stating to perform the action, to reduce confusion in cases where the condition may or may not exist. In the previous example, the HPVs may not have been opened, depending on the path and conditions prior to this point. Thus a step stating to close the HPVs may be confusing if they are not open. The term ensure covers both cases without confusion.

General usage rules of the GEOG are:

- The guidance, with two exceptions, does not apply unless the reactor is shutdown. The two exceptions are the reactor trip actions, including ATWS, in Section III.A and the controlled reactor shutdown with a tube rupture in Section III.E. All other guidance, including the Rules in Part VI, does not apply until the reactor is shutdown.

- Symptoms are treated whenever they occur, and are treated in order of priority. This precludes the need for repeated steps in the guidelines to require symptom status checks. Symptom checks are specified where their occurrence is more likely or as a transfer check at the completion of a section.

- Symptom priorities are, in descending order:

  - Loss of SCM

  - Upsets in heat transfer (lack of or excessive)

  - Steam generator tube rupture

  ICC is not a symptom, and can only occur following a loss of SCM. The possibility of ICC conditions developing is always monitored when SCM does not exist.

- Rules (Part VI) are used for specific guidance that always applies when the stated conditions exist. This also reduces the need for repeated steps, but more importantly fosters the better response and consistency that is achievable using rule-based behavior.

- The intent of the guidelines is to proceed through the appropriate actions without undue delay and to primarily mitigate transients from the control room when possible. Except for specific hold points or loops, it is not expected that delays will be encountered due to either prolonged attempts to achieve satisfactory results from a lesser impact action or due to attempting significantly time-consuming actions from outside the control room. For example, it is expected that a feedwater pump will be tripped to terminate overfeeding a SG if initial attempts to control flow were unsuccessful, rather than repeated attempts at local valve manipulation.

Transient Mitigation Sections

The transient mitigation sections are intended to provide the necessary guidance to bring the plant to a safe and stable condition following the occurrence of a symptom (i.e., abnormal transient).

Once the plant is in a safe stable configuration, the guidance routes to either an appropriate cooldown section, or back to Section III.A for completion of VSSV checks, or provides the option to remain in the stable configuration and await station management's decision relative to continued operation or shutdown.

The transient mitigation sections are:

- **Loss of SCM**
- **Lack of Heat Transfer**
- **Excessive Heat Transfer**
- **Steam Generator Tube Rupture**
- **Inadequate Core Cooling**

Cooldown Sections

The cooldown sections provide guidance to cooldown the plant following an abnormal transient when normal plant configurations and/or conditions do not exist. Normal plant configuration and conditions are defined here as both SGs operating, forced primary flow, normal pressurizer bubble control, and no on-going transient conditions such as SG tube leaks, LOCA, secondary steam leaks, post-ICC conditions, etc.. If a normal plant configuration and normal plant conditions exist, then a cooldown, if desired, would be performed in accordance with normal plant guidance.

The cooldown sections are:

- **LOCA Cooldown**
  This section covers cooldowns with or without SCM where HPI is operating in response to a LOCA. A concurrent SGTR may exist.
- **HPI Cooldown**
  This section covers cooldowns when HPI cooling is in progress. A concurrent RCS leak, including SGTR may exist.
- **Forced Cooldown**
  This section covers cooldowns with degraded SG conditions. One SG may be dry or one or both SGs may have unisolable steam leaks.

Cooldowns required due to a tube rupture are covered within Section III.E unless a LOCA exists or HPI cooling is required.

It is assumed that a cooldown in an abnormal plant configuration will only be performed when necessary. It is further assumed that the plant configuration will be aligned as normal as possible prior to performing the cooldown. Thus, there is a possibility that the entire cooldown will be performed in the same configuration.

Providing cooldown guidance for given plant conditions allows streamlining and simplifying the guidance so that only pertinent information is included. This also eliminates the need to continually refer to the possibility to restore equipment or alter the plant configuration throughout the guidelines.

The cooldown sections include appropriate SG tube rupture guidance.

Repetitive Actions Sections

The Repetitive Actions sections provide guidance for specific evolutions that can occur throughout the guidelines. Providing the appropriate steps in one central location eliminates the need for duplication.

These sections are:

- **RCP Restart**
  This section covers the actions necessary to restore forced circulation.

- **RCS Pressure Control**
  This section covers actions in response to high or low RCS pressure and to maintain RCS pressure within the P-T limits.

- **Sump Switchover**
  This section covers actions to realign ECCS suctions from the BWST to the RB sump.

Rules

Rules provide guidance that always applies whenever the reactor is shutdown and the stated conditions exist. It is expected that a rule will be adhered to whenever it applies without the necessity of a specific reference to the rule.

Part II

List of Acronyms/Abbreviations

ADV	Atmospheric Dump Valve
ANO-1	Arkansas Nuclear One Unit 1
ATWS	Anticipated Transient Without Scram
BWST	Borated Water Storage Tank
CFT	Core Flood Tank
CRDM	Control Rod Drive Motor
DB	Davis-Besse
DHRS	Decay Heat Removal System
ECCS	Emergency Core Cooling Systems
EFPT	Emergency Feedwater Pump Turbine
EFW	Emergency Feedwater
EFWP	Emergency Feedwater Pump
ES	Engineered Safeguards
FW	Feedwater
GPM	Gallons Per Minute
HPI	High Pressure Injection
HPV	High Point Vent
IA	Instrument Air
ICC	Inadequate Core Cooling
ICS	Integrated Control System
LOCA	Loss Of Coolant Accident
LOFW	Loss Of Feedwater
LPI	Low Pressure Injection
LTOP	Low Temperature Overpressure Protection
LSCM	Loss Of Subcooling Margin
MFPT	Main Feed Pump Turbine
MFW	Main Feedwater
MS	Main Steam
MSIV	Main Steam Isolation Valve
MSSV	Main Steam Safety Valve
MU	Make Up System
NC	Natural Circulation
NNI	Non-Nuclear Instrumentation
NPSH	Net Positive Suction Head
PCT	Peak Clad Temperature
PORV	Pressurizer Power or Pilot Operated Relief Valve
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gauge
PSV	Pressurizer Safety Valve
P-T	Pressure versus Temperature

List of Acronyms/Abbreviations (Cont'd)

PTS	Pressurized Thermal Shock
PZR	Pressurizer
RB	Reactor Building or Containment
RBS	Reactor Building Spray
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RTD	Resistance Temperature Detector
RV	Reactor Vessel
SAG	Severe Accident Guidelines
SBO	Station Blackout
SCM	Subcooling Margin
SG	Steam Generator
SGTR	Steam Generator Tube Rupture
SPPS	Secondary Plant Protection System
TBS	Turbine Bypass System
TBV	Turbine Bypass Valve
T/C	Thermocouple
T_{cold}	Reactor Coolant System Cold Leg Temperature
T_{hot}	Reactor coolant System Hot Leg Temperature
TR	Tube Rupture
T_{sat}	Saturation Temperature
VLV	Valve
VSSV	Vital System Status Verification

SECTION III.A
EOP ENTRY

"ENTRY CONDITIONS"

- A reactor trip has occurred.
- Any RPS reactor trip limit or other plant specific limit requiring reactor trip is present whether or not the reactor has tripped.
- A symptom (Loss of SCM, Excessive Heat Transfer, Loss of Heat Transfer, SGTR) has occurred while the reactor is shutdown above decay heat removal system operation.
- SGTR symptom occurs while reactor is not shutdown (in which case entry is directly to Section III.E).

IMMEDIATE ACTIONS

1.0 TRIP THE REACTOR.

1.1 IF AT ANY TIME during the performance of steps 1.1-1.6 the reactor is shutdown, THEN go to step 2.0.

1.2 Deenergize CRDMs [prioritized list of available breakers].

1.3 Maintain adequate primary to secondary heat transfer.

1.4 Begin maximum boric acid addition to RCS.

1.5 IF main feedwater is not available, THEN ensure main turbine tripped and EFW actuated.

1.6 Do not continue until the reactor is shutdown.

2.0 TRIP THE TURBINE.

2.1 Ensure steam flow is secured to the turbine.

Section III.A

VITAL SYSTEM STATUS VERIFICATION

NOTE

If during the performance of the VSSV section, an upset in heat transfer symptom or SGTR symptom occurs, then treat the symptom immediately.

Verification Column **Verify The Following:**	Remedial Action Column **If Verification Cannot Be Made, Perform The Following:**
3.0 ALL RODS EXCEPT GROUP 8 FULLY INSERTED.	Begin boration as necessary to achieve [acceptable shutdown margin].
4.0 PROPER SECONDARY INVENTORY CONTROL.	a. IF either SG level > [SG high level], THEN secure feed flow to affected SG(s). b. Control FW.
5.0 PROPER SECONDARY PRESSURE CONTROL.	Control TBVs or ADVs manually to maintain desired header pressure. Reduce header pressure if necessary to reseat MSSVs.
6.0 MU FLOW RESPONDING PROPERLY TO CONTROL PZR LEVEL TO [post-trip level setpoint].	Control makeup and letdown manually as required.
7.0 GENERATOR OUTPUT AND EXCITER BREAKERS OPEN.	Ensure the output breakers are open; then open the exciter breaker.
8.0 INSTRUMENT AIR SYSTEM PRESSURE PROPER.	Refer to [procedure number].
9.0 NNI/ICS POWER ON.	Refer to [procedure number].

Verification Column	Remedial Action Column
Verify The Following:	**If Verification Cannot Be Made, Perform The Following:**
10.0 ES BUSSES ENERGIZED FROM [normal source].	a. Ensure proper operation of emergency AC supply. b. IF no [emergency power source (or alternate AC source)] starts and loads, THEN refer to [SBO procedure] as appropriate. c. Start a MU pump and reestablish seal injection per [plant specific guidance].
11.0 NO ES ACTUATION SETPOINT REACHED.	Ensure actuation of appropriate channels.
12.0 NO [secondary plant protection system] ACTUATION SETPOINT REACHED.	Ensure actuation as appropriate.
13.0 SUBCOOLING MARGIN $\geq$ [subcooling margin limit].	Go to Loss of SCM, Section III.B, Step 1.0.
14.0 CONTROLLED PRIMARY TO SECONDARY HEAT TRANSFER EXISTS.	FOR LACK OF HEAT TRANSFER go to Section III.C Step 1.0. FOR EXCESSIVE HEAT TRANSFER go to Section III.D Step 1.0.
15.0 [plant specific indications] DO NOT INDICATE A SGTR IS OCCURRING.	Go to SGTR Section III.E Step 1.0.

Verification Column	Remedial Action Column
Verify The Following:	**If Verification Cannot Be Made, Perform The Following:**
16.0 RCS LEAKAGE < NORMAL MAKEUP CAPACITY.	Go to Section IV.A, step 1.0.
17.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.	

STATUS THE PLANT IS IN A SAFE SHUTDOWN SUBCOOLED CONDITION WITH CONTROLLED PRIMARY TO SECONDARY HEAT TRANSFER. RCS LEAKAGE WITHIN THE CAPACITY OF NORMAL MAKEUP MAY EXIST. PLANT OPERATORS WILL CONTINUE TO MAINTAIN SURVEILLANCE OF KEY PLANT PARAMETERS FOR INDICATION OF UPSETS IN HEAT TRANSFER. FURTHER ACTION AT THIS POINT WILL BE AT THE DISCRETION OF MANAGEMENT.

Section III.B
LOSS OF SCM

1.0 TRIP RCPs (Rule 1.0)

2.0 INITIATE HPI/LPI (Rules 1.0, 2.0 AND 3.0).

3.0 INITIATE EFW (Rules 1.0 AND 4.0).

4.0 IF AT ANY TIME RCS PRESSURE < LPI OPERATIONAL PRESSURE AND LPI FLOW EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

5.0 IF HPI FLOW IS < FULL FLOW FROM ONE HPI PUMP, THEN PERFORM THE FOLLOWING:

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

5.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

5.2 Perform RCS cooldown at as fast a rate as possible.

5.3 Ensure PORV block valve is open. Manually cycle the PORV as necessary to maintain RCS pressure between the PORV setpoint and 1600 PSIG.

5.4 Ensure CFT isolation valves are open.

6.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

7.0 PERFORM [actions required for control room habitability].

8.0 ISOLATE POSSIBLE RCS LEAKS. IF HPI COOLING IN PROGRESS, THEN DO NOT CLOSE PORV OR PORV BLOCK VALVE.

9.0 IF AT ANY TIME INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, THEN GO TO SECTION III.F, STEP 1.0.

10.0 IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

11.0 IF HPI FLOW < FULL FLOW FROM ONE HPI PUMP, AND SCM DOES NOT EXIST, THEN GO TO STEP 5.0.

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

12.0 ESTABLISH APPROPRIATE COOLDOWN RATE.

12.1 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

12.2 IF the core exit is saturated, THEN establish desired cooldown rate using available SGs.

12.3 IF the core exit is subcooled, THEN limit the cooldown rate per technical specifications or to 50°F/hr (if a head void exists), whichever is lower.

13.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS NOT ADEQUATE, THEN PERFORM THE FOLLOWING:

13.1 IF SCM exists, THEN go to Section III.C, step 1.0.

13.2 Open the PORV and PORV block valve.

13.3 Go to Section IV.B, step 1.0.

14.0 IF PRIMARY TO SECONDARY HEAT TRANSFER IS EXCESSIVE, THEN GO TO SECTION III.D, STEP 1.0.

15.0 IF SGTR INDICATED ON SG(s) IN USE, THEN GO TO SECTION III.E, STEP 1.0.

16.0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

17.0 IF A SG IS ISOLATED OR HAS AN UNISOLABLE STEAM LEAK, THEN GO TO SECTION IV.C, STEP 1.0.

18.0 GO TO SECTION III.A, STEP 3.0.

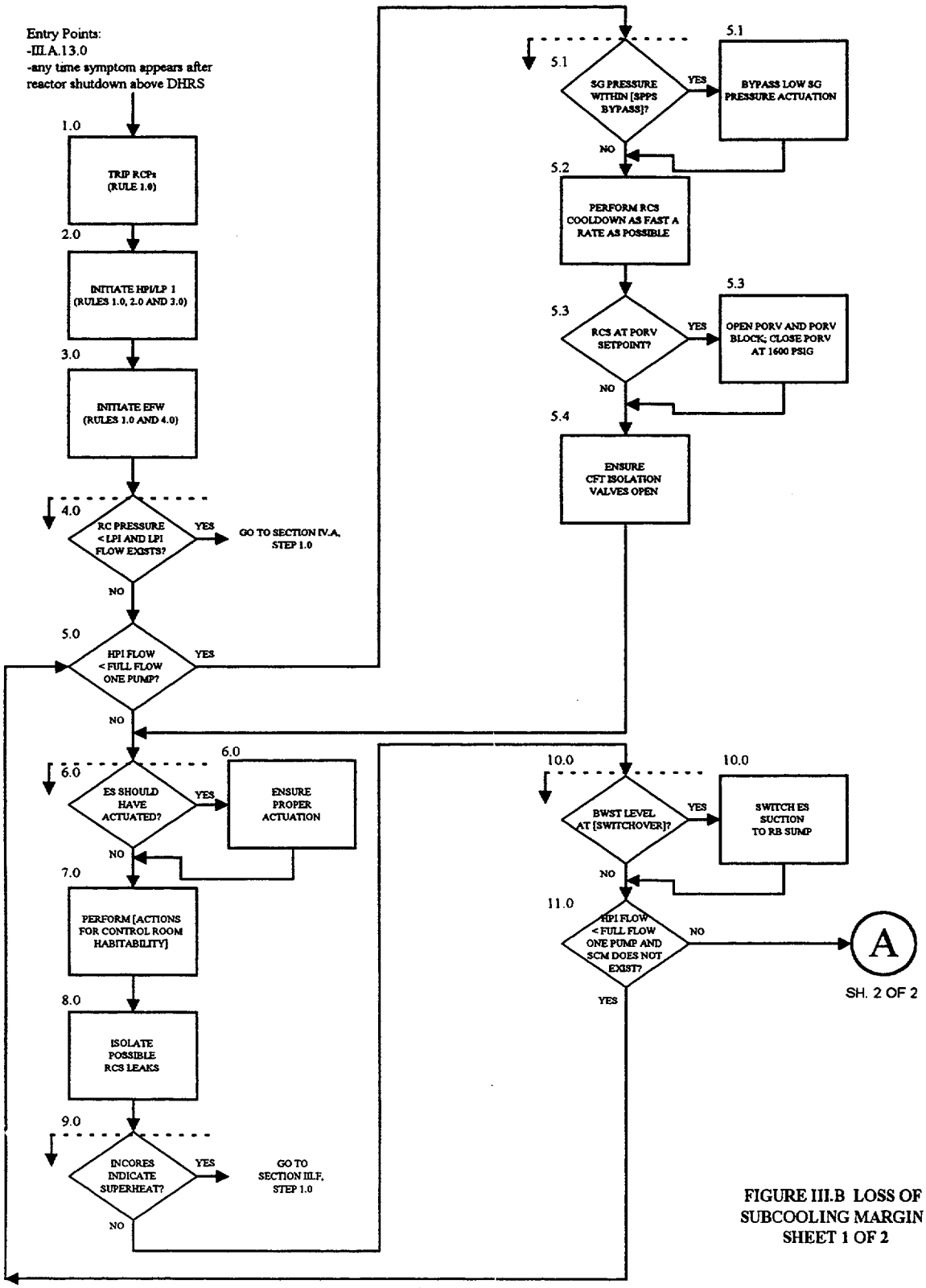


FIGURE III.B LOSS OF SUBCOOLING MARGIN SHEET 1 OF 2

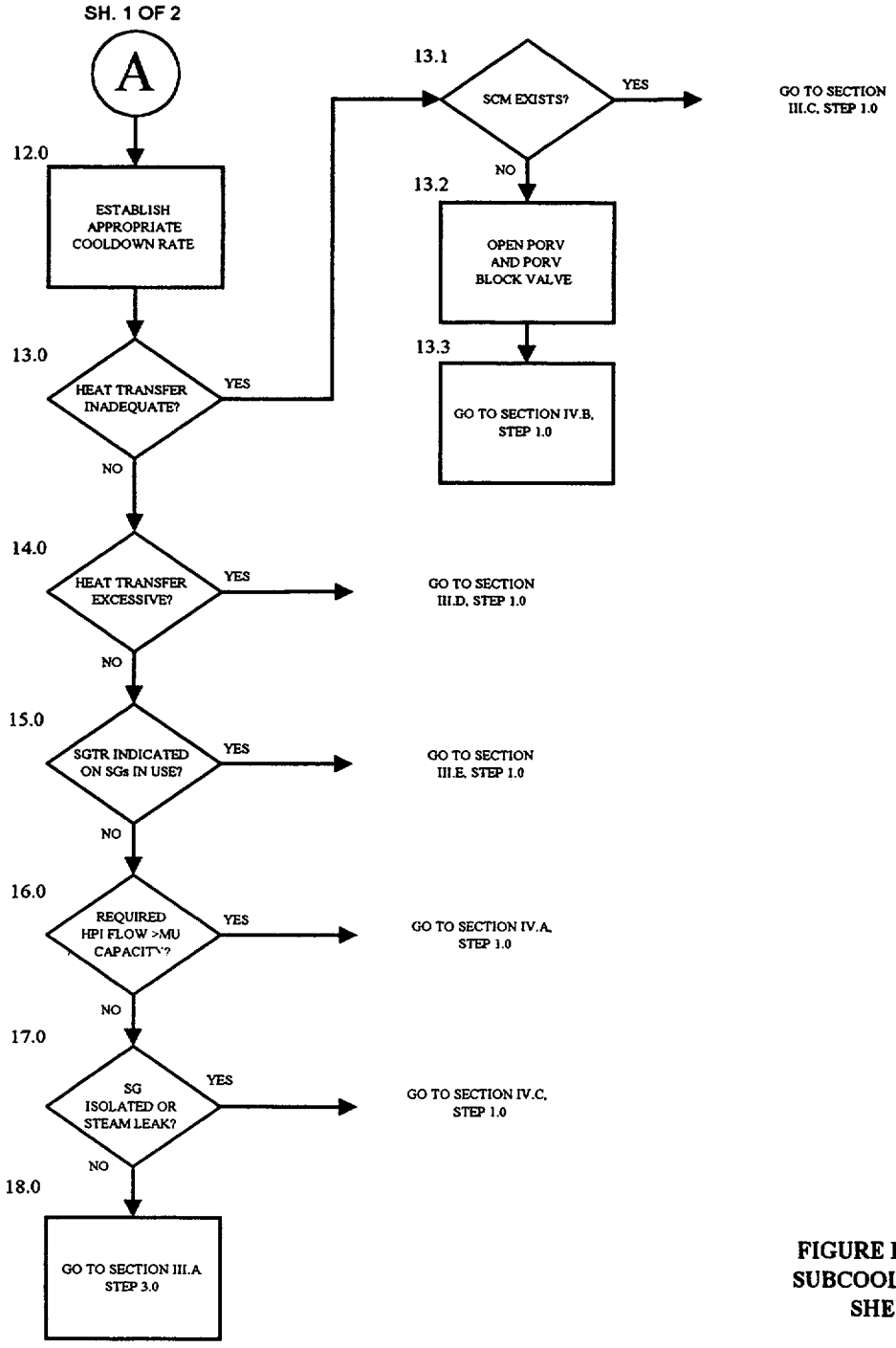


FIGURE III.B LOSS OF SUBCOOLING MARGIN SHEET 2 OF 2

Section III.C

LACK OF HEAT TRANSFER

1.0 RESTORE FW (Rule 4.0)

2.0 IF AT ANY TIME RCS HEATS TO THE POINT WHERE SCM IS LOST, THEN GO TO STEP 6.0.

3.0 IF AT ANY TIME FW IS ESTABLISHED, THEN GO TO STEP 7.0.

4.0 REDUCE RCP OPERATION TO A 1/1 CONFIGURATION AND RUN AS LONG AS SCM EXISTS AND SG TUBE-SHELL ΔT LIMITS ARE NOT EXCEEDED

(Step 5.0 is for all plants except Davis Besse; for Davis Besse step 5.0 see attachment 1)

5.0 WHEN ANY OF THE FOLLOWING LIMITS IS REACHED:

- RCS PRESSURE APPROACHES PORV SETPOINT
- RCS P-T LIMIT
- PORV AUTOMATICALLY LIFTS

THEN CONTINUE.

NOTE

SCM may be lost when the PORV is opened and does not require transfer to III.B.

6.0 INITIATE HPI (MU/HPI) COOLING BY PERFORMING THE FOLLOWING:

6.1 Initiate HPI (MU/HPI) cooling (Rule 3.0).

6.2 Isolate letdown.

6.3 Reduce to one RCP and run as long as SCM exists and SG tube-shell ΔT limits are not exceeded.

6.4 IF HPI (MU/HPI) flow cannot be established, THEN perform the following:

6.4.1 Ensure the PORV is closed (close PORV block if PORV cannot be closed).

6.4.2 Trip running RCP(s).

6.4.3 Manually cycle the PORV as necessary to maintain RCS pressure between the PORV setpoint or RV P-T limit and minimum SCM (if subcooled) or 1600 PSIG (if saturated).

6.4.4 IF AT ANY TIME incore thermocouple temperatures indicate superheat, THEN go to Section III.F, step 1.0.

6.4.5 Continue attempts to establish HPI (MU/HPI) and FW.

6.4.6 IF AT ANY TIME HPI (MU/HPI) is established while heat transfer does not exist, THEN open the PORV (and PORV block if necessary) and go to step 6.5.

6.4.7 IF FW is established, THEN go to step 7.0 while continuing attempts to restore HPI (MU/HPI).

6.4.8 Go to step 6.4.3.

6.5 Go to Section IV.B, step 1.0.

7.0 IF AT ANY TIME HEAT TRANSFER IS ESTABLISHED, THEN GO TO STEP 14.0.

8.0 MANUALLY CYCLE THE PORV AS NECESSARY TO MAINTAIN RCS PRESSURE BETWEEN THE PORV SETPOINT AND MINIMUM SCM (IF SUBCOOLED) OR 1600 PSIG (IF SATURATED).

9.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS (Rule 4.0).

10.0 REDUCE SG PRESSURE AS NECESSARY TO ESTABLISH A PRIMARY TO SECONDARY ΔT OF APPROXIMATELY 50°F.

11.0 IF SCM EXISTS AND RCPs ARE AVAILABLE, THEN START A RCP, PREFERABLY IN A LOOP WITH FW (Section V.A).

12.0 OPEN HPVs IN LOOP(s) WITHOUT RUNNING RCP.

13.0 WHEN HEAT TRANSFER IS ESTABLISHED, THEN CONTINUE.

14.0 CONTROL HEAT TRANSFER RATE.

15.0 ENSURE HPVs ARE CLOSED.

16.0 WHEN SCM EXISTS OR HPI FLOW ESTABLISHED, THEN CONTINUE.

17.0 IF SGTR INDICATED, THEN GO TO SECTION III.E, STEP 1.0.

18.0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

19.0 IF A SG IS ISOLATED OR HAS AN UNISOLABLE STEAM LEAK, THEN GO TO SECTION IV.C, STEP 1.0.

20.0 GO TO SECTION III.A, STEP 3.0.

ATTACHMENT 1

LACK OF HEAT TRANSFER STEP 5.0 FOR DAVIS-BESSE ONLY

5.0 INITIATE MU/HPI COOLING ALIGNMENT BY PERFORMING THE FOLLOWING:

5.1 Establish flow to the RCS from all available MU pumps with suction aligned to the BWST.

5.2 Align HPI and MU pumps to piggyback mode.

5.3 If flow cannot be achieved from both MU pumps, THEN go to step 6.0.

5.4 IF the PORV fails open prior to core exit temperature reaching 600°F, THEN do not close PORV block valve and go to step 6.0.

5.5 WHEN any of the following limits is reached,

- Core exit temperature reaches 600°F
- RC pressure increases to the RV P-T limit,

THEN continue.

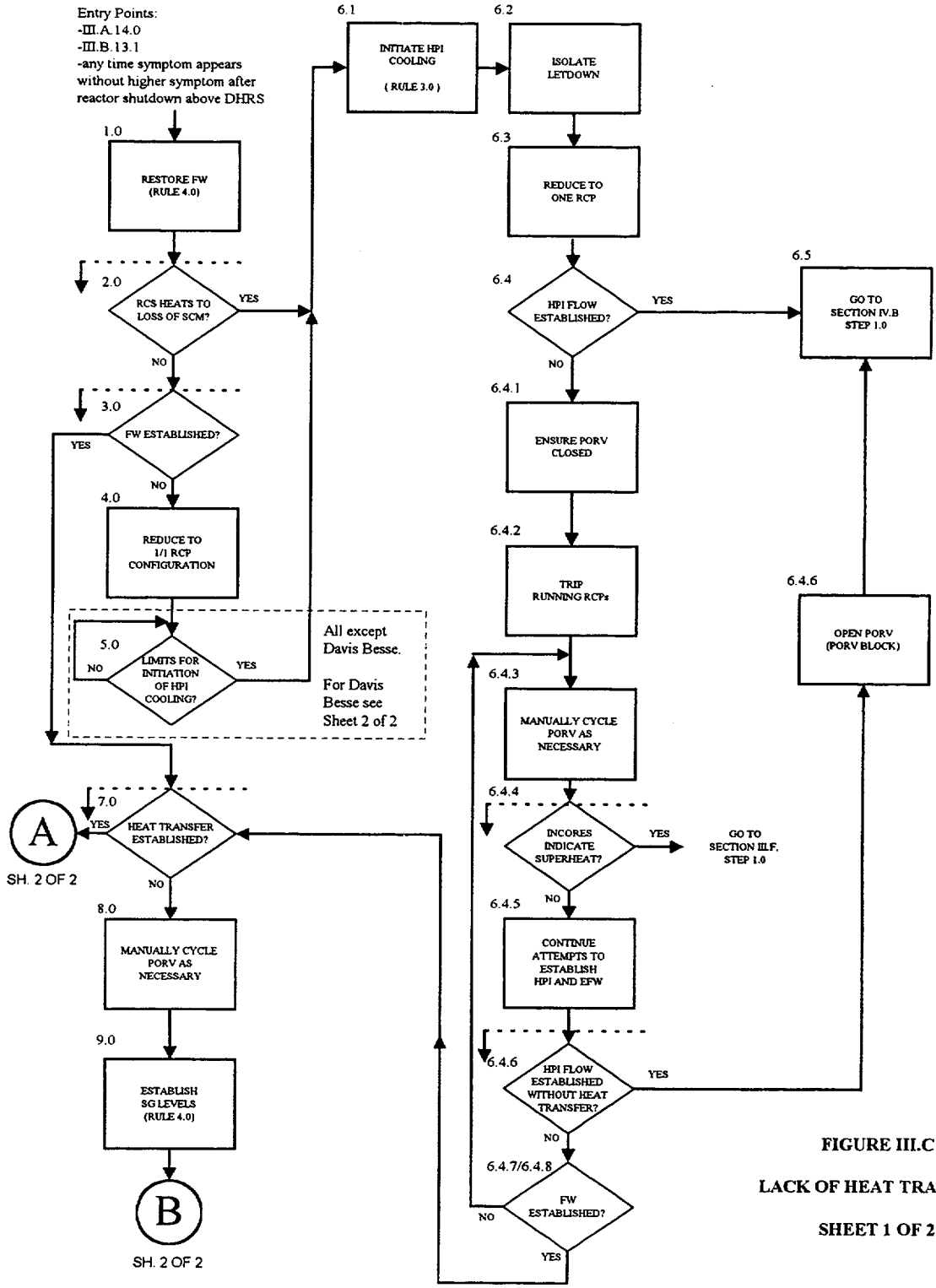


FIGURE III.C

LACK OF HEAT TRANSFER

SHEET 1 OF 2

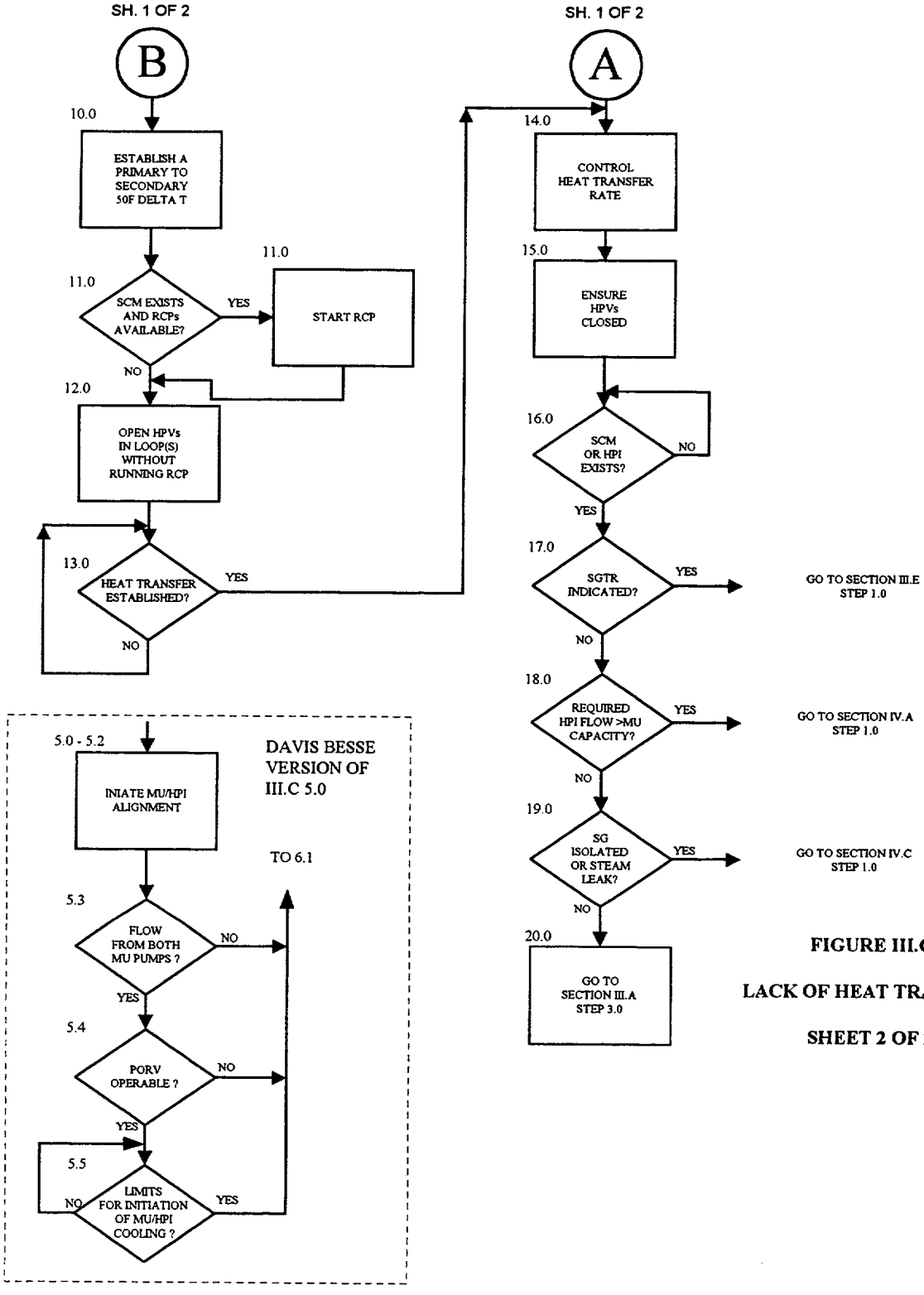


FIGURE III.C

LACK OF HEAT TRANSFER

SHEET 2 OF 2

Section III.D
EXCESSIVE HEAT TRANSFER

1.0 CONTROL RCS INVENTORY.

2.0 IF AT ANY TIME RC TEMPERATURE APPROACHES [core lift limit], THEN REDUCE TO <4 RCP OPERATION.

3.0 IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

4.0 IF AUTOMATIC SECONDARY PLANT PROTECTION HAS ACTUATED OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER RESPONSE.

5.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

6.0 IF EXCESSIVE HEAT TRANSFER HAS NOT BEEN TERMINATED, THEN PERFORM THE FOLLOWING:

6.1 IF an MSSV is leaking AND both of the following conditions exist:

- RCS cooldown rate is less than [T.S. limit]
- Proper level(s) can be maintained in affected SG(s)

THEN perform the following:

6.1.1 Maintain the SG(s) available (do not continue to isolate).

6.1.2 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

6.1.3 Go to step 8.0.

6.2 Sequentially control/isolate steam and feed on affected SG(s) as necessary to stop overcooling.

7.0 ESTABLISH HEAT TRANSFER AS FOLLOWS:

7.1 IF one or both SG(s) available, THEN perform the following:

7.1.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

7.1.2 Stabilize RCS P-T using available SG(s) to minimize reheat (Rule 4.0).

7.1.3 Go to step 8.0.

7.2 IF core cooling adequate due to break/HPI flow, THEN go to Section IV.A, step 1.0.

NOTE

Trickle feed should not be attempted using the MFW nozzles unless RCP(s) running.

7.3 IF steam leak location not detrimental to personnel or key equipment, THEN establish trickle feed to one or both SG(s) (Rule 4.0).

7.3.1 IF trickle feed is established, THEN perform the following:

- Control RCS pressure (Section V.B).
- Adjust feed flow rate to control primary to secondary heat transfer.
- Adjust RCP combination to control RCS heat input if desired.

7.4 IF Inadequate Heat Transfer, OR Excessive Heat Transfer exists, THEN stop feed flow and go to step 18.0.

8.0 CONTROL RCS INVENTORY.

9.0 IF PTS IS INVOKED, THEN LIMIT RCS PRESSURE PER RULE 3.0 (Section V.B).

10.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

11.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

12.0 IF ANY SG IS DRY, THEN MAINTAIN MINIMUM SCM.

13.0 MAINTAIN SG TUBE TO SHELL ΔTs WITHIN TENSILE AND COMPRESSIVE LIMITS.

14.0 IF SGTR INDICATED, THEN GO TO SECTION III.E, STEP 1.0.

15.0 IF REQUIRED HPI FLOW > NORMAL MAKEUP CAPACITY EXISTS, THEN GO TO SECTION IV.A, STEP 1.0.

16.0 IF A SG IS ISOLATED OR HAS AN UNISOLABLE STEAM LEAK, THEN GO TO SECTION IV.C, STEP 1.0.

17.0 GO TO SECTION III.A, STEP 3.0.

NOTE

SCM may be lost when the PORV is opened and does not require transfer to III.B.

18.0 ESTABLISH HPI COOLING.

18.1 Initiate MU/HPI cooling.

18.2 Isolate letdown.

18.3 Reduce to one RCP and run as long as SCM exists and SG tube-shell ΔT limits are not exceeded.

18.4 IF HPI flow cannot be established, THEN perform the following:

18.4.1 Ensure the PORV is closed (close PORV block if PORV cannot be closed).

NOTE

Trickle feed should not be attempted using the MFW nozzles unless RCP(s) running.

18.4.2 Reestablish trickle feed to at least one SG (Rule 4.0).

18.4.3 Limit RCS pressure per Rule 3.0 as appropriate.

18.4.4 IF AT ANY TIME incore thermocouple temperatures indicate superheat, THEN go to Section III.F, step 1.0.

18.4.5 WHEN HPI flow is established, THEN continue.

18.4.6 Stop trickle feed flow.

18.4.7 Open the PORV (and PORV block if necessary).

19.0 GO TO SECTION IV.B, STEP 1.0.

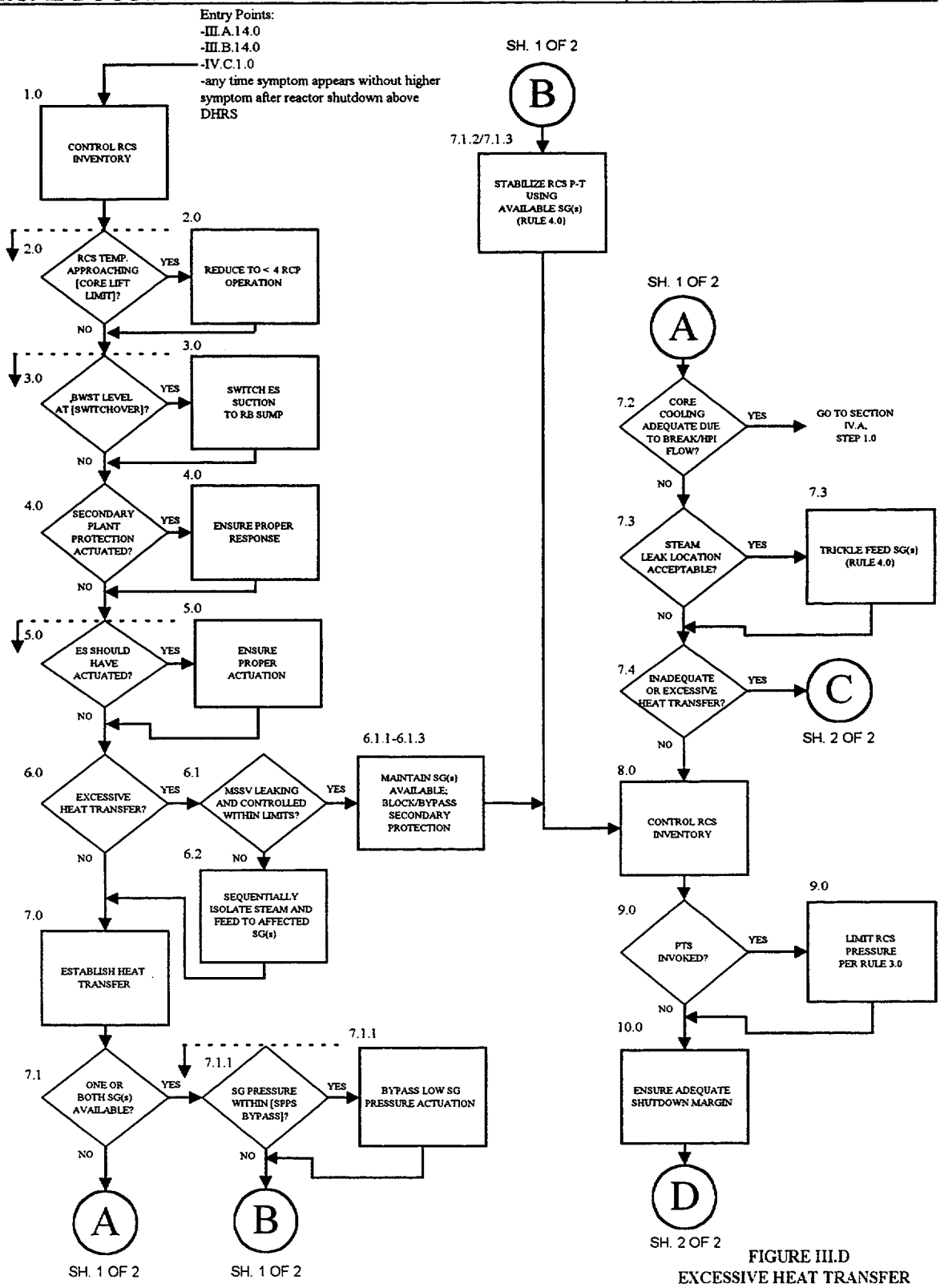


FIGURE III.D
EXCESSIVE HEAT TRANSFER
SHEET 1 OF 2

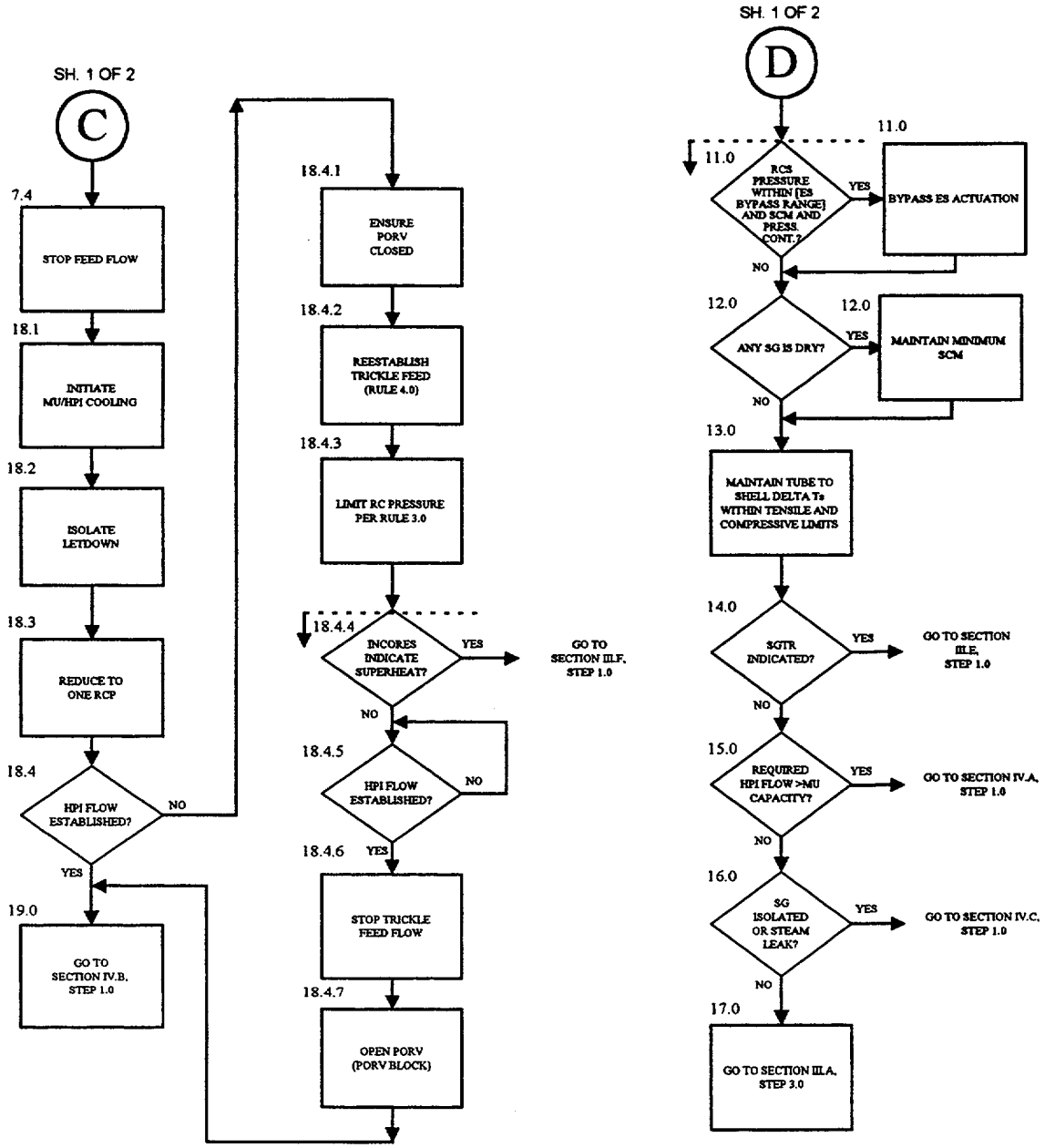


FIGURE III.D
EXCESSIVE HEAT TRANSFER
SHEET 2 OF 2

Section III.E

STEAM GENERATOR TUBE RUPTURE

1.0 CONTROL PRESSURIZER LEVEL

2.0 IDENTIFY AFFECTED SG(s).

2.1 Isolate non-essential steam loads from the affected SG(s) as time permits.

3.0 IF THE REACTOR IS TRIPPED, THEN GO TO STEP 6.0.

4.0 SHUTDOWN THE REACTOR.

4.1 Perform a controlled reactor shutdown to prevent lifting MSSVs.

4.2 IF the reactor trips during shutdown, THEN go to step 5.0.

4.3 At < [reactor power that will prevent lifting MSSVs when reactor is tripped] perform [actions to trip turbine and reactor]. Do not continue until the reactor is tripped.

5.0 IMMEDIATELY PERFORM THE ACTIONS OF SECTION III.A, STEPS 1.0-2.0 AND CONTINUE WITH SECTION III.E STEP 6.0.

6.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

7.0 REDUCE RCS PRESSURE TO MAINTAIN MINIMUM SCM, AND IF APPLICABLE RCP NPSH, WITHOUT EXCEEDING [pressurizer emergency cooldown rate] (Rule 3.0).

8.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

9.0 STEAM AVAILABLE SGs TO ESTABLISH DESIRED COOLDOWN RATE.

9.1 IF required to prevent exceeding [SG overfill setpoint] or [radiation limit], THEN use emergency cooldown rate limit to 500°F.

9.2 Maintain SG level as appropriate per Rule 4.0.

10.0 PERFORM [actions required for control room habitability].

11.0 IF SCM EXISTS AND RCP(s) AVAILABLE, THEN ENSURE FORCED CIRCULATION (Section V.A).

12.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

13.0 WHEN RCS PRESSURE < 1000 PSIG, THEN CONTINUE.

14.0 IF BOTH SGs ARE AVAILABLE AND CONTINUED STEAMING OF THE MOST AFFECTED SG NOT REQUIRED, THEN STOP FEEDING AND STEAMING THE MOST AFFECTED SG.

15.0 MAINTAIN SG TUBE TO SHELL ΔTs WITHIN TENSILE AND COMPRESSIVE LIMITS.

16.0 BEGIN MAKEUP TO THE BWST.

17.0 IF AT ANY TIME STEAMING WILL NOT PREVENT SG OVERFILL, THEN PERFORM THE FOLLOWING:

17.1 Use SG drains, if available, to maintain SG level below [overfill setpoint].

17.2 IF steaming and draining cannot prevent SG overfill, THEN isolate the affected SG(s).

17.3 IF at least one SG still available for heat transfer, THEN go to step 18.0.

NOTE

SCM may be lost when the PORV is opened and does not require transfer to III.B.

17.4 Initiate HPI cooling (Rule 3.0).

17.5 Maintain RCS pressure and isolated SG pressures < 1000 PSIG by use of [primary and secondary release paths](Rule 2.0).

17.6 Reduce to one RCP and run as long as SCM exists and SG tube-shell ΔT limits are not exceeded.

17.7 Go to Section IV.B, step 1.0.

18.0 IF AT ANY TIME [radiation limit] IS APPROACHED, AND BOTH SGs ARE AVAILABLE, THEN TERMINATE STEAMING OF THE MOST AFFECTED SG.

19.0 REDUCE TO < 4 RCP OPERATION PRIOR TO [core lift limit].

20.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for CFT isolation] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN CLOSE THE CFT ISOLATION VALVES.

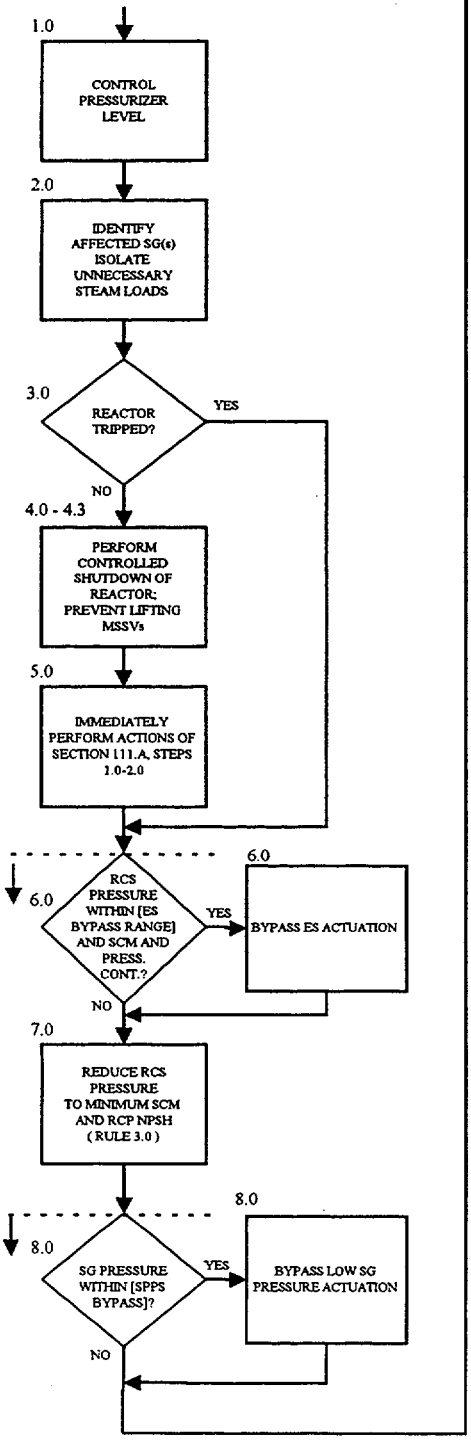
21.0 IF INDICATIONS OF AN RV HEAD VOID EXIST AND SCM EXISTS, THEN REDUCE COOLDOWN RATE TO < 50°F/HR.

22.0 IF INDICATIONS OF A LOCA EXIST, THEN GO TO SECTION IV.A, STEP 1.0.

23.0 COOLDOWN TO DHRS OPERATION.

24.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

Entry Points:
-III.A.15.0
-III.B.15.0
-III.C.17.0
-III.D.14.0
-IV.A.9.2
-IV.B.28.6
-tube rupture indications during power operation
-any time symptom appears without higher symptom after reactor shutdown above DHRS



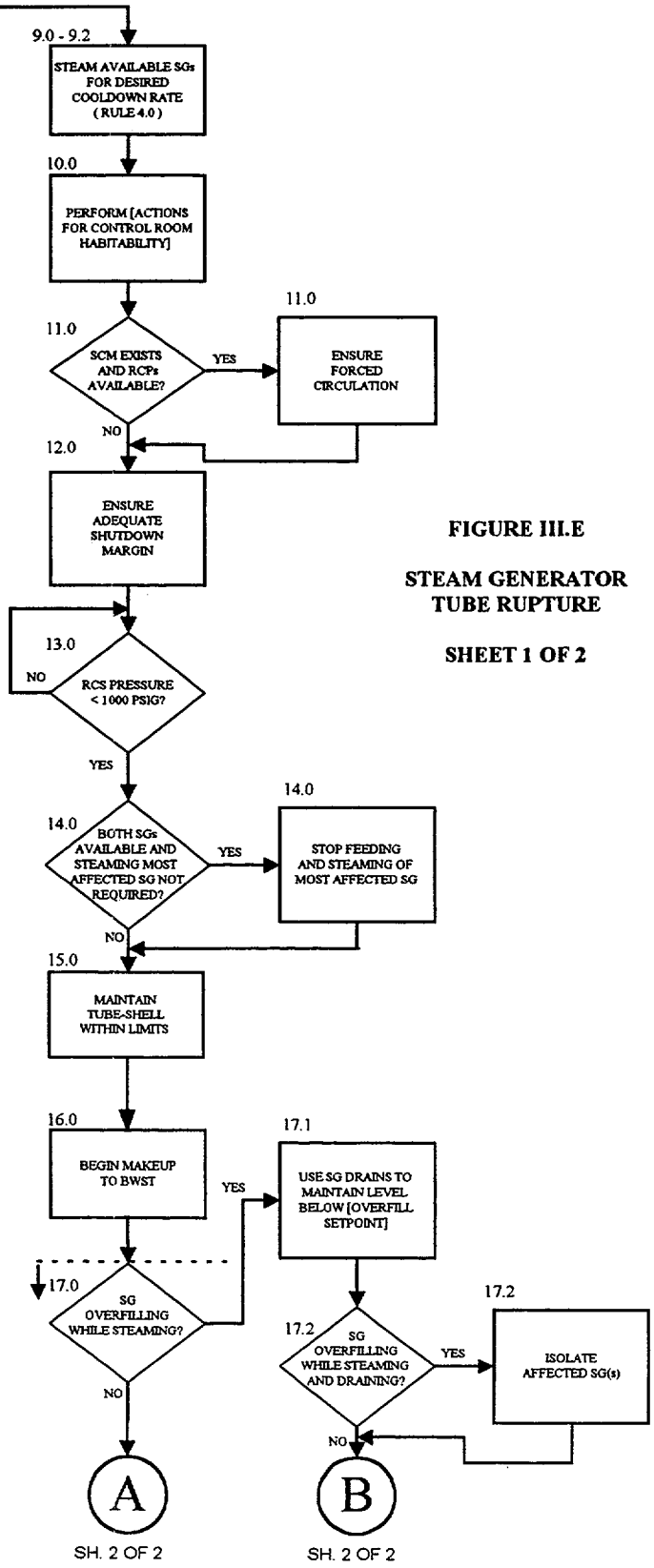


FIGURE III.E

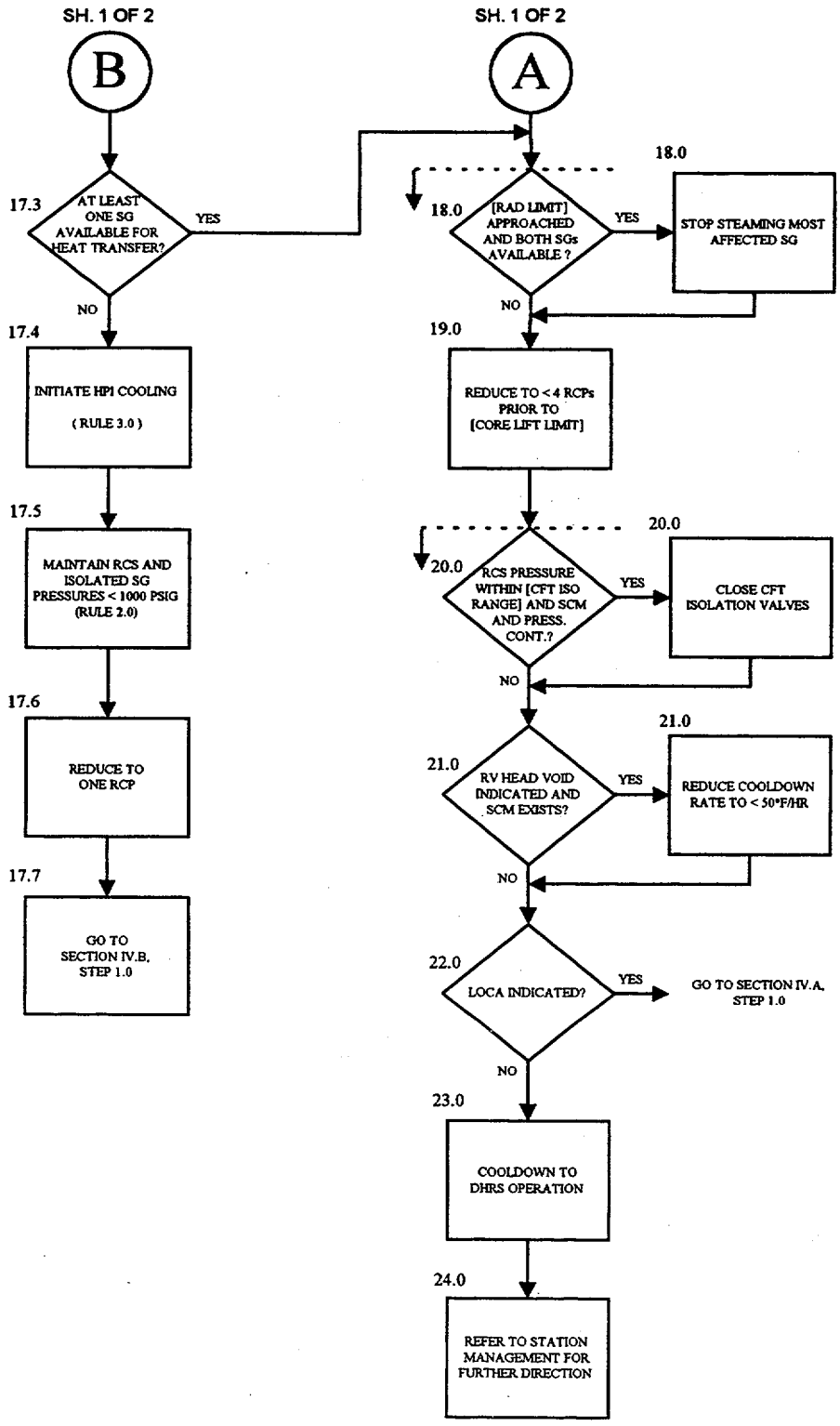
STEAM GENERATOR TUBE RUPTURE

SHEET 1 OF 2

FIGURE III.E

STEAM GENERATOR TUBE RUPTURE

SHEET 2 OF 2



Section III.F

INADEQUATE CORE COOLING

CAUTION

ICC conditions should not exist unless multiple equipment and system failures have occurred. Some of the equipment used in this section may be the same equipment that has failed. It is expected that attempts to restore equipment operation will continue throughout this section.

It is also expected that progression to the next region, including transition to severe accident management, will occur whenever conditions requiring the transition exist.

1.0 INITIATE HPI/LPI/CF.

1.1 (Rules 1.0 and 2.0).

1.2 Maintain full HPI/LPI flow.

1.3 Ensure CFT isolation valves are open.

2.0 IF AT ANY TIME FULL FLOW FROM AT LEAST ONE HPI(MU) PUMP EXISTS, THEN OPEN THE PORV AND PORV BLOCK VALVE AND LEAVE THEM OPEN.

3.0 IF AT ANY TIME RCS PRESSURE INCREASES TO THE PORV SETPOINT, THEN PERFORM THE FOLLOWING:

3.1 Open the PORV.

3.2 IF step 2.0 does not apply, THEN close the PORV WHEN RCS pressure decreases to 100 PSI above SG pressure OR 100 PSI above the next higher ICC region curve, WHICHEVER OCCURS FIRST.

4.0 INCREASE SG LEVELS TO [loss of SCM setpoint].

CAUTION

<u>DO NOT</u> reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

5.0 LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

5.1 <u>IF AT ANY TIME</u> SG pressure within [allowable range for secondary plant protection system bypass], <u>THEN</u> bypass low SG pressure actuation.

5.2 Depressurize SG(s) to achieve secondary T_{sat} about 100°F lower than T_{sat} for existing RCS pressure.

5.3 <u>IF AT ANY TIME</u> heat transfer is established, <u>THEN</u> continue to depressurize SG(s) as necessary to achieve saturated RCS conditions as fast as possible.

6.0 ENSURE RB ISOLATION AND COOLING.

7.0 <u>IF AT ANY TIME</u> BWST LEVEL DROPS TO [RB sump switchover level], <u>THEN</u> PERFORM THE FOLLOWING:

7.1 Establish HPI piggyback operation in accordance with [plant-specific guidance].

7.2 Switch LPI suction to the RB sump (Section V.C).

7.3 Monitor and control H_2 in accordance with [plant specific method].

8.0 PERFORM [actions required for control room habitability].

9.0 TAKE ACTION BASED ON FIGURE 1.

9.1 Determine average incore thermocouple temperature and RCS pressure.

9.2 Determine which region of Figure 1 that the RCS is in based on step 9.1.

9.3 Using the region determined in step 9.2, take action as follows:

REGION	ACTION
1	Go to Section IV.A, step 1.0.
2	Continue with steps 1.0-9.0 above.
3	Go to step 10.0.
Severe Accident	Go to step 17.0.

REGION 3

CAUTION

DO NOT reduce SG pressure less than the pressure required for operation of the turbine-driven EFW pump unless another feed source or steam supply is available.

10.0 FURTHER LOWER SG PRESSURE TO INDUCE HEAT TRANSFER.

10.1 IF AT ANY TIME SG pressure within [allowable range for secondary plant protection system bypass], THEN bypass low SG pressure actuation.

10.2 Depressurize SG(s) to 400 PSIG or less to achieve approximately 100°F decrease in secondary T_{sat}.

10.3 IF AT ANY TIME heat transfer is established, THEN continue to depressurize SG(s) as necessary to achieve saturated RCS conditions as fast as possible.

11.0 OPEN ALL HPVs.

12.0 ENSURE RB H_2 MONITOR(S) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

13.0 IF THE RCS HAS RETURNED TO SATURATION CONDITIONS, THEN GO TO SECTION IV.A, STEP 1.0.

14.0 IF CF OR LPI AVAILABLE, THEN OPEN PORV AND LEAVE IT OPEN.

15.0 IF AT ANY TIME THE RCS ENTERS THE SEVERE ACCIDENT REGION, THEN GO TO STEP 17.0.

16.0 WHEN THE RCS RETURNS TO SATURATION CONDITIONS, THEN GO TO SECTION IV.A, STEP 1.0. UNTIL THEN, CONTINUE ATTEMPTS TO RESTORE ECCS AND SG HEAT TRANSFER.

TRANSITION TO SAG

17.0 TRIP RUNNING RCPs.

18.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

CAUTION

The RCS P-T has entered the Severe Accident Region (Figure 1). The reactor core is highly oxidized and may become badly damaged in a short time. Core conditions are now beyond the scope of GEOG guidance. Further direction for accident mitigation will be provided by Station Management based on [severe accident guidelines]. Following use of [severe accident guidelines] and severe accident mitigation, DO NOT return to the GEOG for additional guidance.

The PORV may be open at this point if either CF or LPI is available. If so, the PORV should remain open until directed otherwise by Station Management. The HPVs are open at this point and should remain open until directed otherwise by Station Management.

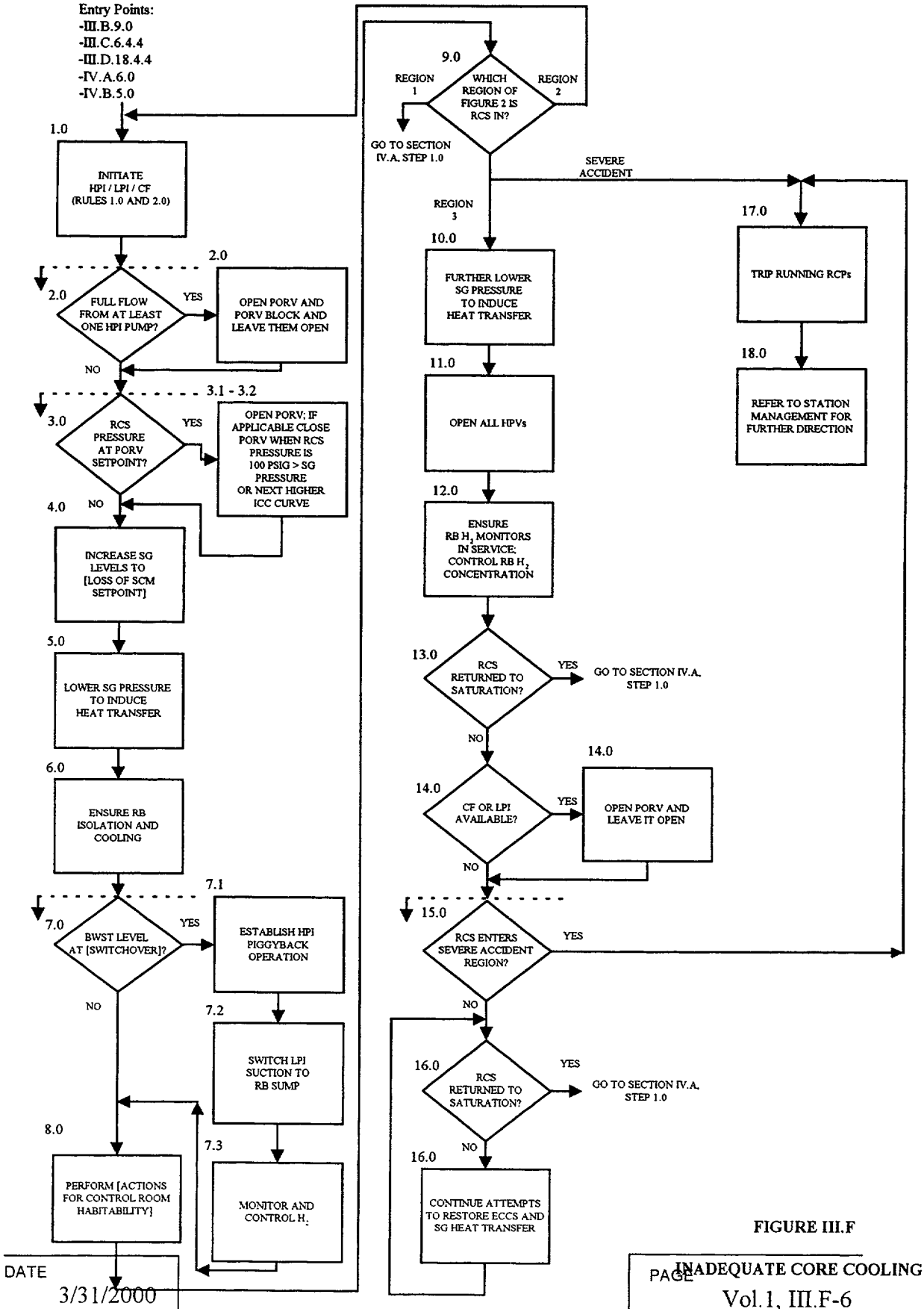


FIGURE III.F

INADEQUATE CORE COOLING

Section IV.A
LOCA COOLDOWN

1.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

2.0 IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

3.0 IF ONLY ONE LPI PUMP IS AVAILABLE, THEN CROSS-CONNECT LPI TO PROVIDE FLOW TO BOTH INJECTION LINES.

4.0 ENSURE RB ISOLATION AND COOLING.

5.0 PERFORM [actions required for control room habitability].

6.0 IF AT ANY TIME INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, THEN GO TO SECTION III.F, STEP 1.0.

7.0 IF AT ANY TIME RCS PRESSURE < LPI OPERATIONAL PRESSURE AND LPI FLOW EXISTS, THEN GO TO STEP 20.0.

8.0 CONTROL HPI (Rules 2.0 and 3.0).

9.0 IF AT ANY TIME SCM IS RESTORED WITH RCS PRESSURE > LPI SHUTOFF AND HPI REQUIRED IS < NORMAL MAKEUP CAPACITY, THEN PERFORM THE FOLLOWING:

9.1 IF there is no primary to secondary heat transfer, THEN open the PORV and PORV block valve and go to Section IV.B, step 1.0.

9.2 IF a SGTR exists, THEN go to Section III.E, step 1.0.

9.3 Go to Section III.A, step 3.0.

10.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

11.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

12.0 IF AT ANY TIME A SGTR HAS OCCURRED AND THE AFFECTED SG APPROACHES OVERFILL, THEN PERFORM THE FOLLOWING:

12.1 IF steaming will not prevent SG overfill, THEN use SG drains, if available, to maintain SG level below [overfill setpoint].

12.2 IF steaming and draining cannot prevent SG overfill, THEN isolate the affected SG(s).

12.3 Maintain RCS and isolated SG pressures < 1000 PSIG by use of [primary and secondary release paths] (Rule 2.0).

13.0 IF AT ANY TIME [SGTR radiation limit] IS APPROACHED AND BOTH SGs ARE AVAILABLE, THEN TERMINATE STEAMING OF THE MOST AFFECTED SG.

14.0 IF THE PORV IS OPEN, THEN GO TO SECTION IV.B, STEP 1.0.

15.0 IF AT ANY TIME THE RCS BEGINS TO REPRESSURIZE, THEN PERFORM THE FOLLOWING:

15.1 IF SG(s) are not available, THEN open the PORV and PORV block and go to Section IV.B, step 1.0.

15.2 Cycle the PORV as necessary to maintain the RCS pressure.

15.3 Ensure appropriate level and feed flow in available SG(s) (Rule 4.0).

16.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

17.0 REDUCE TO < 4 RCP OPERATION PRIOR TO [core lift limit].

18.0 ESTABLISH APPROPRIATE COOLDOWN RATE.

18.1 IF the core exit is saturated, THEN establish desired cooldown rate using available SGs.

18.2 IF the core exit is subcooled, THEN limit the cooldown rate per technical specifications or to 50°F/hr (if a head void exists), whichever is lower.

18.3 Maintain SG tube to shell ΔTs within tensile and compressive limits.

19.0 IF THE RCS IS SUBCOOLED, THEN MAINTAIN MINIMUM SCM AND IF APPLICABLE, RCP NPSH (Rules 2.0 and 3.0).

20.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for CFT isolation] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN CLOSE THE CFT ISOLATION VALVES.

21.0 ENSURE RB H_2 MONITOR(S) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

22.0 IF AT ANY TIME CONDITIONS PERMIT, THEN TERMINATE HPI (Rule 2.0).

23.0 IF AT ANY TIME LPI FLOW > [minimum flow rate], THEN THE FOLLOWING MAY BE PERFORMED:

23.1 SG cooling terminated.

23.2 RCPs secured.

24.0 IF AT ANY TIME LPI FLOW > [minimum flow rate] OR RCS PRESSURE < 140 PSIG THEN CLOSE THE CFT ISOLATION VALVES AND HPVs.

25.0 IF AT ANY TIME THE RCS IS SUBCOOLED AND PTS IS INVOKED, THEN THROTTLE LPI TO MAINTAIN MINIMUM SCM.

26.0 IF AT ANY TIME THE RCS IS SATURATED AND [boron dilution criteria exist], THEN ESTABLISH POST-LOCA BORON CONTROL.

27.0 IF AT ANY TIME RBS IN OPERATION AND [termination criteria exist], THEN STOP RBS.

28.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

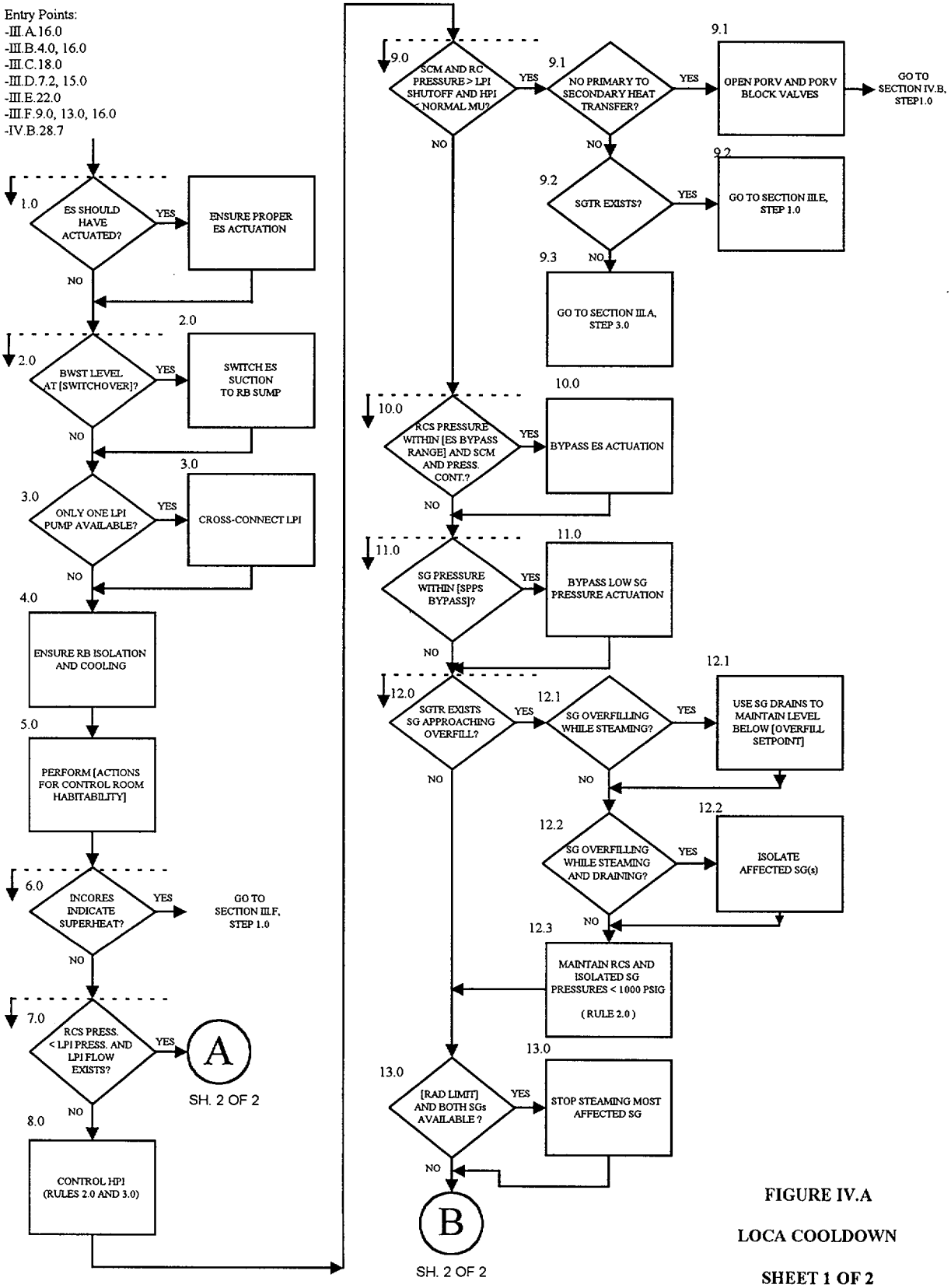


FIGURE IV.A

LOCA COOLDOWN

SHEET 1 OF 2

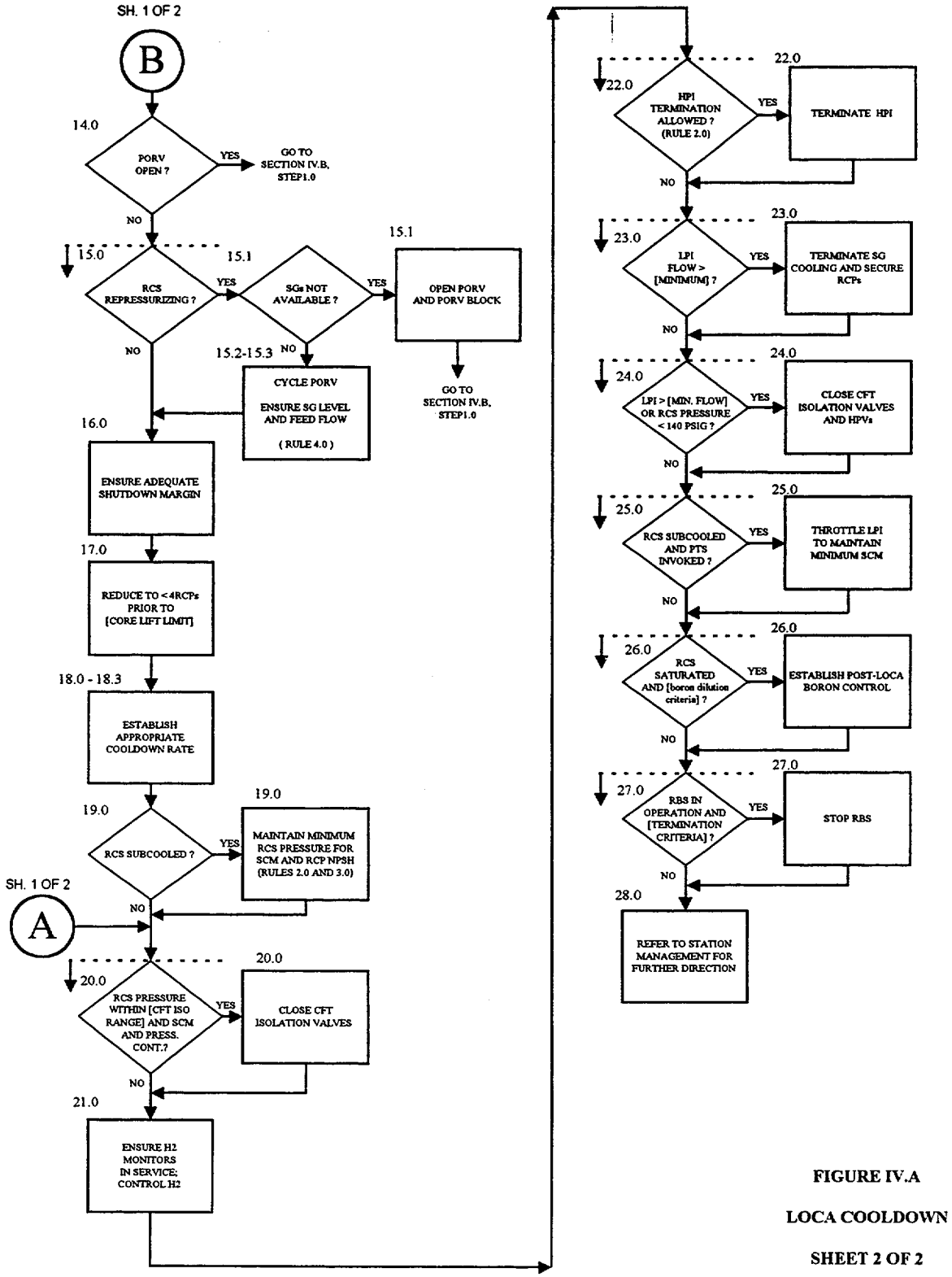


FIGURE IV.A

LOCA COOLDOWN

SHEET 2 OF 2

Entry Points:
-reactor trip
-reactor trip limit reached
-symptom occurs while shutdown above DHRS
-III.B.18.0
-III.C.20.0
-III.D.17.0
-IV.A.9.3

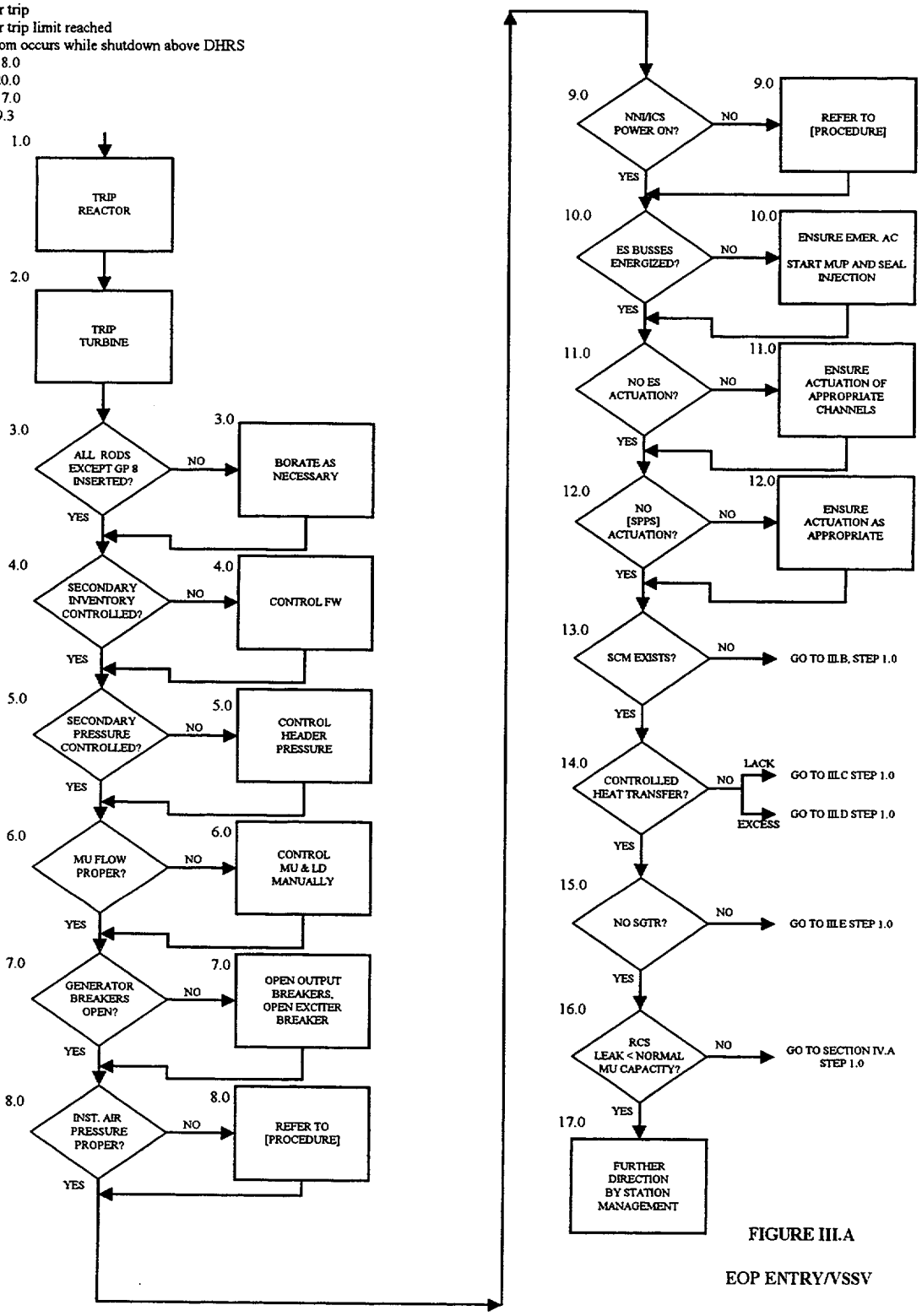


FIGURE III.A

EOP ENTRY/VSSV

Section IV.B
HPI COOLDOWN

1.0 IF AT ANY TIME ES ACTUATES OR SHOULD HAVE ACTUATED, THEN ENSURE PROPER ACTUATION.

2.0 IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).

3.0 ENSURE RB ISOLATION AND COOLING.

4.0 PERFORM [actions required for control room habitability].

5.0 IF AT ANY TIME INCORE THERMOCOUPLE TEMPERATURES INDICATE SUPERHEAT, THEN GO TO SECTION III.F, STEP 1.0.

6.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

7.0 CONTROL HPI (Rules 2.0 and 3.0).

8.0 IF AT ANY TIME AN ISOLATED SG WILL OVERFILL DUE TO TUBE LEAKAGE, THEN MAINTAIN RCS AND SG PRESSURES < 1000 PSIG BY USE OF [primary and secondary release paths].

9.0 ENSURE PRESSURIZER HEATERS ARE OFF.

10.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

11.0 ENSURE RB H_2 MONITOR(S) IN SERVICE AND CONTROL RB H_2 CONCENTRATION IN ACCORDANCE WITH [plant specific method].

12.0 IF AT ANY TIME A SG BECOMES AVAILABLE FOR HEAT TRANSFER PRIOR TO ESTABLISHING DHR COOLING, THEN GO TO STEP 20.0.

13.0 WHEN SCM EXISTS, THEN CONTINUE.

14.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

15.0 IF RCPs ARE AVAILABLE, THEN START A RCP (Section V.A).

16.0 MAINTAIN MINIMUM SCM AND IF APPLICABLE RCP NPSH.

17.0 IF AT ANY TIME RCS PRESSURE IS WITHIN [allowable range for CFT isolation] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN CLOSE THE CFT ISOLATION VALVES.

18.0 COOLDOWN TO DHRS OPERATION.

19.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

RE-ESTABLISHING HEAT TRANSFER TO A SG

20.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

21.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS AND PRESSURES IN THE AVAILABLE SG(s) (Rule 4.0).

22.0 IF SCM EXISTS AND RCPs ARE AVAILABLE, THEN START A RCP, PREFERABLY IN A LOOP WITH FW (Section V.A).

23.0 IF AT ANY TIME PRIMARY TO SECONDARY HEAT TRANSFER IS ESTABLISHED, THEN GO TO STEP 28.0.

24.0 LOWER SG PRESSURE TO ACHIEVE ~50°F PRIMARY-SECONDARY ΔT.

25.0 OPEN HPV(s) IN LOOP(s) WITHOUT RUNNING RCPs.

26.0 LOWER SG PRESSURE TO ACHIEVE ~100°F PRIMARY-SECONDARY ΔT.

27.0 IF HEAT TRANSFER IS NOT RESTORED TO AT LEAST ONE SG, THEN GO TO STEP 13.0.

CAUTION

Care must be exercised in controlling HPI flow when the PORV is closed to prevent large RCS pressure increases, especially if PTS has been invoked.

28.0 IF HEAT TRANSFER HAS BEEN RESTORED TO AT LEAST ONE SG, THEN PERFORM THE FOLLOWING:

28.1 IF AT ANY TIME SCM exists, THEN establish makeup and letdown.

28.2 Establish a slightly decreasing RCS temperature and pressure.

28.3 Close the PORV (and PORV block valve if necessary).

28.4 Ensure HPVs are closed.

28.5 IF SCM exists AND RCS leakage < normal makeup capacity, THEN stop HPI.

28.6 IF SGTR indicated on SG(s) in use, THEN go to Section III.E, step 1.0.

28.7 IF HPI can not be terminated, THEN go to Section IV.A, step1.0.

28.8 Stabilize RCS P-T.

28.9 Establish a pressurizer bubble.

28.10 Further direction by station management.

Entry Points:
-III.B.13.3
-III.C.6.5
-III.D.19.0
-III.E.17.7
-IV.A.9.1, 14.0, 15.1

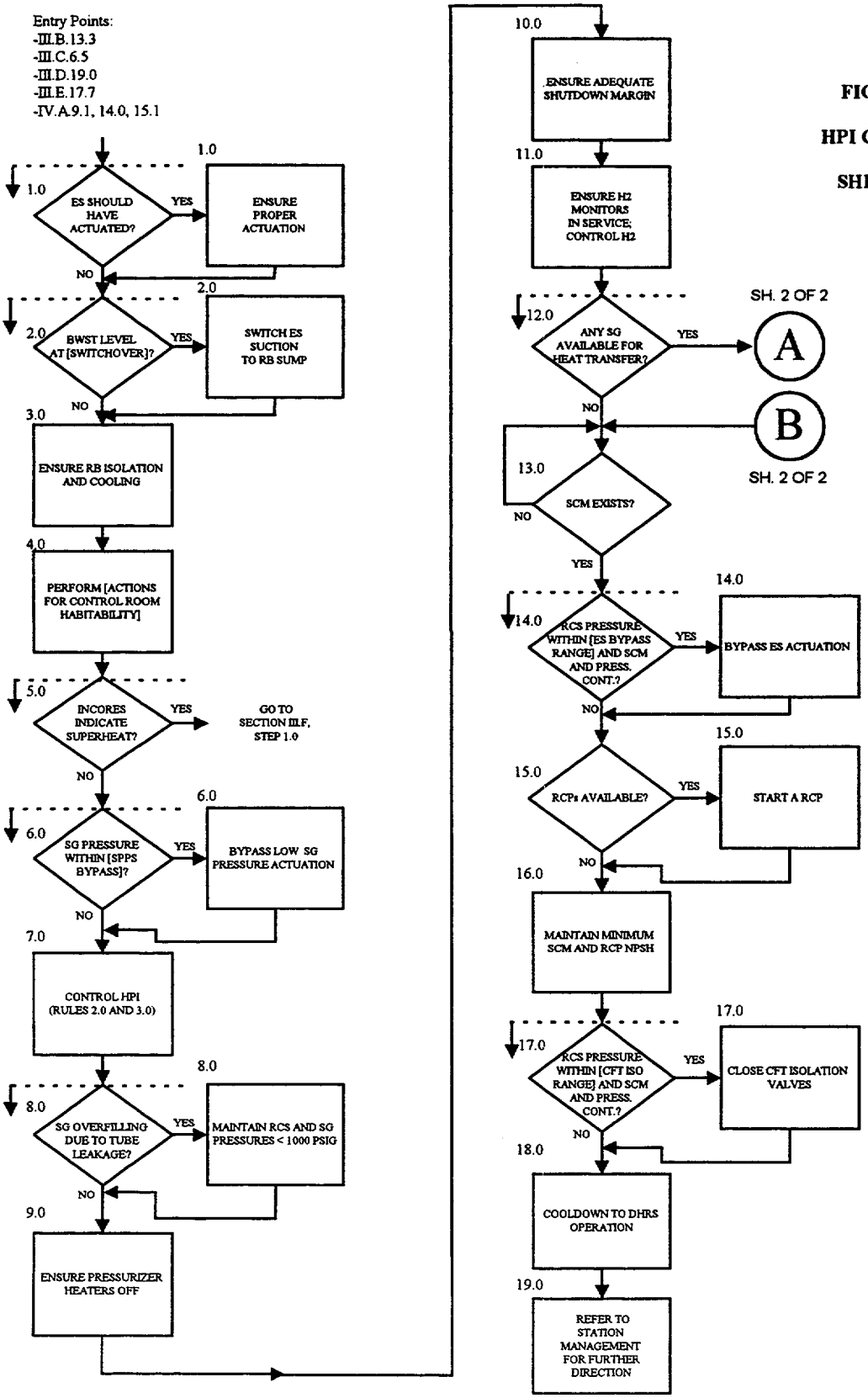


FIGURE IV.B

HPI COOLDOWN

SHEET 1 OF 2

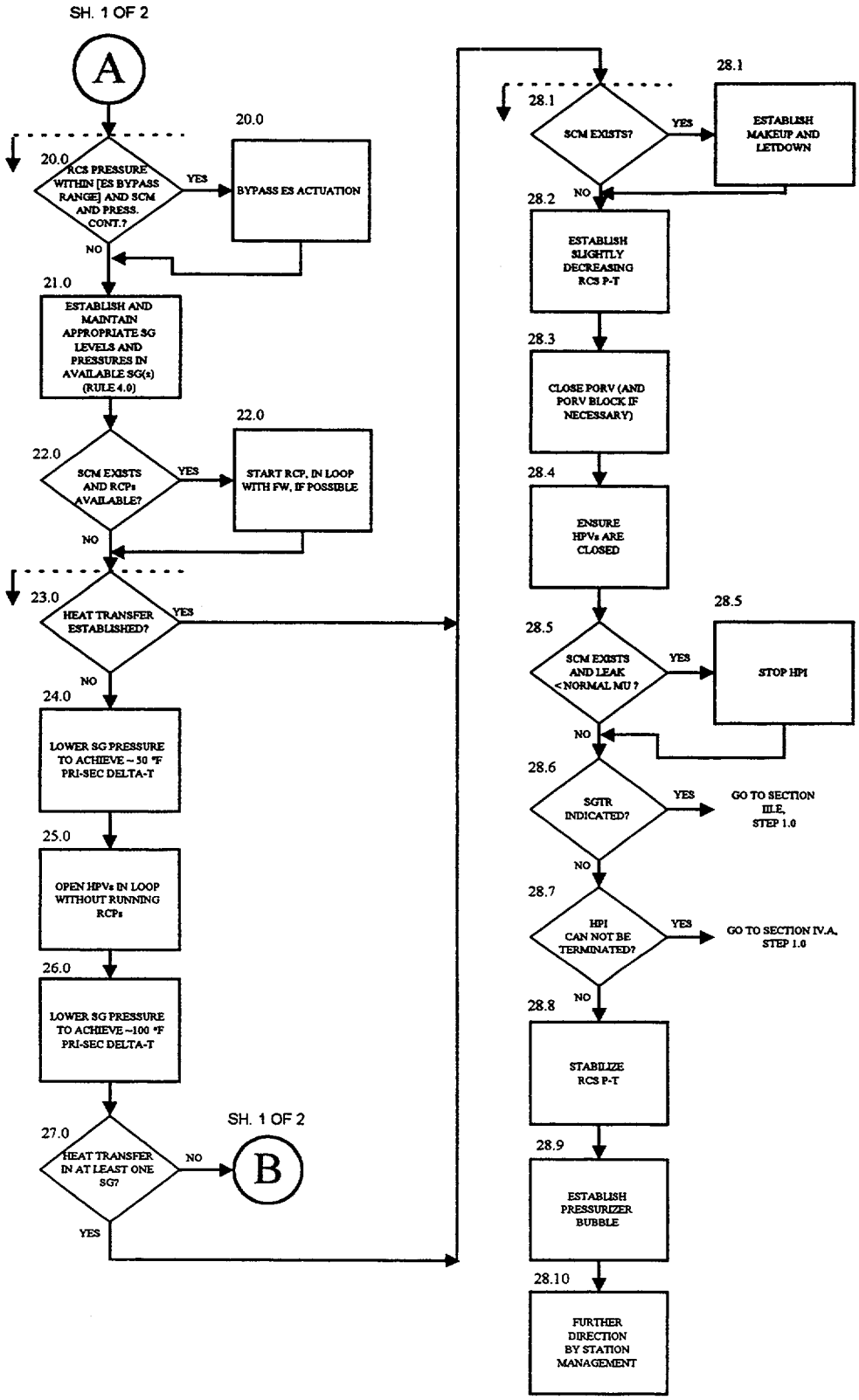


FIGURE IV.B

HPI COOLDOWN

SHEET 2 OF 2

Section IV.C
FORCED COOLDOWN

NOTE

If during the performance of the cooldown the condition forcing the cooldown ceases to exist, e.g., a steam leak is isolated, then the cooldown may be terminated. Further direction will be provided by station management.

1.0 IF AT ANY TIME THE COOLDOWN RATE CANNOT BE CONTROLLED WITHIN THE TECH SPEC LIMIT, THEN GO TO SECTION III.D, STEP 1.0.

2.0 ESTABLISH AND MAINTAIN APPROPRIATE SG LEVELS AND PRESSURES IN THE AVAILABLE SG(s) (Rule 4.0).

3.0 IF AT ANY TIME RC TEMPERATURE APPROACHES [core lift limit], THEN REDUCE TO <4 RCP OPERATION.

4.0 IF AT ANY TIME RCS PRESSURE WITHIN [allowable range for ES bypass] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN BYPASS ES ACTUATION.

5.0 IF AT ANY TIME SG PRESSURE WITHIN [allowable range for secondary plant protection system bypass], THEN BYPASS LOW SG PRESSURE ACTUATION.

6.0 CONTROL HPI (Rules 2.0 and 3.0).

7.0 IF RCPs ARE AVAILABLE, THEN ENSURE FORCED CIRCULATION (Section V.A).

8.0 MAINTAIN MINIMUM SCM AND IF APPLICABLE RCP NPSH.

9.0 MAINTAIN SG TUBE TO SHELL ΔTs WITHIN TENSILE AND COMPRESSIVE LIMITS.

10.0 ESTABLISH APPROPRIATE COOLDOWN RATE. IF INDICATIONS OF A HEAD VOID EXIST, THEN ATTEMPT TO MAINTAIN COOLDOWN RATE < 50°F/HR.

11.0 ENSURE ADEQUATE SHUTDOWN MARGIN.

12.0 IF AT ANY TIME RCS PRESSURE IS WITHIN [allowable range for CFT isolation] AND SCM EXISTS AND RCS PRESSURE IS BEING CONTROLLED, THEN CLOSE THE CFT ISOLATION VALVES.

13.0 IF AT ANY TIME RBS IN OPERATION AND [termination criteria exist], THEN STOP RBS.

14.0 IF AT ANY TIME [LTOP] APPLIES, THEN IMPLEMENT [LTOP actions].

15.0 COOLDOWN TO DHRS OPERATION.

16.0 REFER TO STATION MANAGEMENT FOR FURTHER DIRECTION.

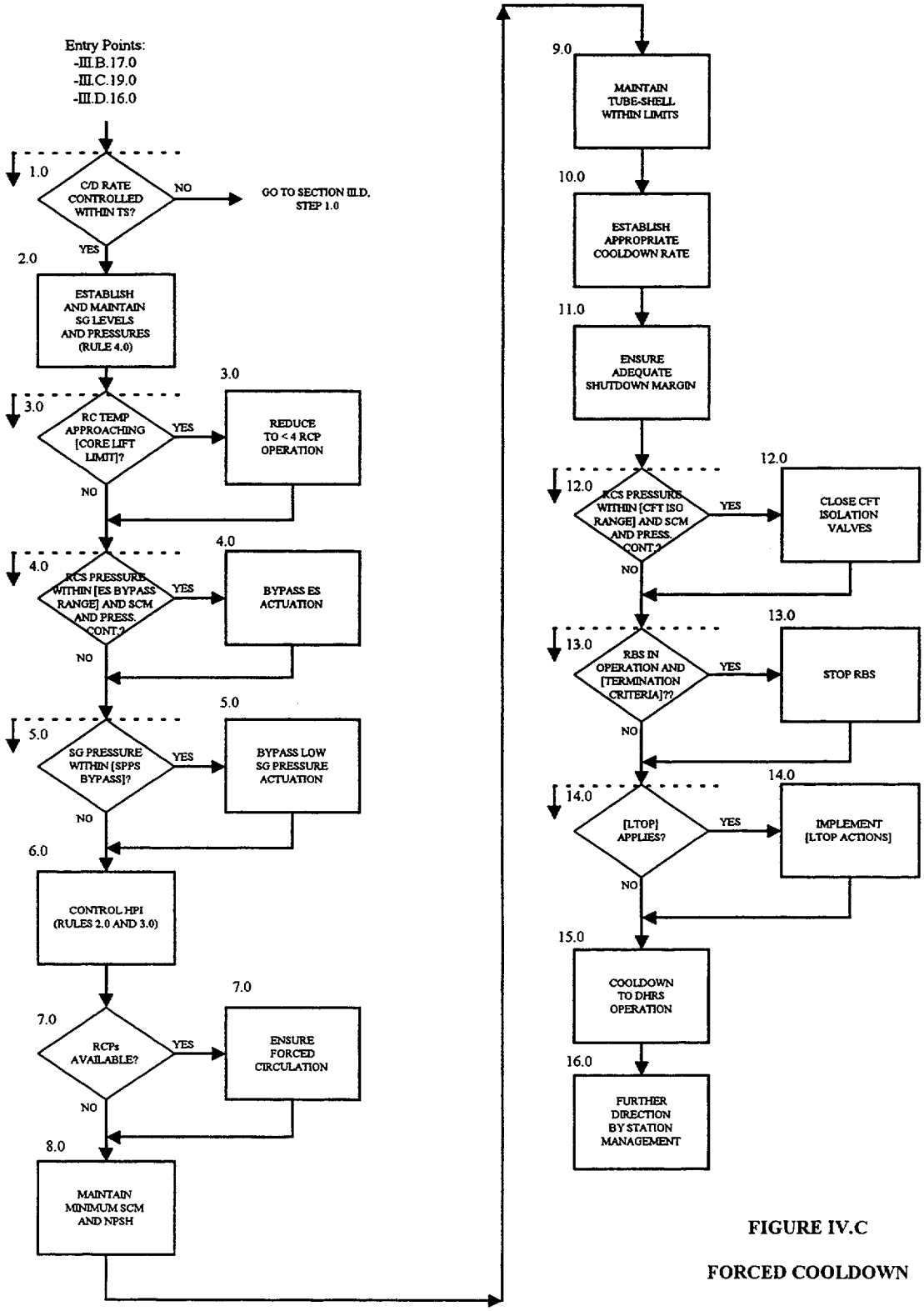


FIGURE IV.C

FORCED COOLDOWN

Section V.A
RCP RESTART

CAUTION

Verify acceptability of RCP restart in accordance with potential boron dilution restrictions prior to implementing this section.

1.0 ENSURE RCP SERVICES ESTABLISHED.

2.0 ESTABLISH DESIRED RCS CONDITIONS.

3.0 ESTABLISH DESIRED SG CONDITIONS.

4.0 ENSURE HPVs ARE CLOSED.

5.0 START DESIRED RCP(s).

6.0 IF SCM IS LOST, THEN IMPLEMENT RULES 1.0 AND 2.0.

7.0 CONTROL PRIMARY-SECONDARY HEAT TRANSFER.

Section V.B
RCS PRESSURE CONTROL

1.0 IF RCS PRESSURE IS HIGHER THAN DESIRED, THEN PERFORM ONE OR MORE OF THE FOLLOWING, AS APPLICABLE:

1.1 Throttle MU/HPI (Rule 2.0).

1.2 Place pressurizer heaters in OFF.

1.3 IF RCP(s) running, THEN use manual spray control.

1.4 Increase letdown flow.

1.5 Cycle the PORV or pressurizer vent as necessary.

1.6 Use auxiliary spray control.

2.0 IF RCS PRESSURE IS LOWER THAN DESIRED, THEN PERFORM ONE OR MORE OF THE FOLLOWING, AS APPLICABLE:

2.1 Increase MU/HPI flow.

2.2 IF RCP(s) running, THEN ensure spray valve or spray block valve is closed.

2.3 Reduce letdown flow.

2.4 Energize pressurizer heaters.

2.5 IF HPI cooling is not in progress, THEN ensure PORV or PORV block valve is closed.

2.6 Ensure pressurizer vent valve is closed.

2.7 Ensure auxiliary spray secured.

3.0 CONTROL RCS PRESSURE WITHIN THE P-T LIMITS.

3.1 IF RCS leak exists, THEN maintain minimum SCM and if applicable RCP NPSH.

3.2 IF RCS pressure is controlled AND SCM exists, THEN perform the following:

3.2.1 Bypass ES actuation when RCS pressure drops below [ES bypass permissive setpoint].

3.2.2 Close the CFT isolation valves when RCS pressure within [allowable range for CFT isolation].

3.3 IF the RCS will be taken solid, THEN limit RCS pressure increase by one or more of the following, as applicable:

3.3.1 Throttle MU/HPI (Rule 2.0).

3.3.2 Increase letdown flow.

3.3.3 Place pressurizer heaters in OFF.

3.3.4 Cycle the PORV or pressurizer vent as necessary.

Section V.C
SUMP SWITCHOVER

1.0 PERFORM [actions required prior to switchover].

2.0 ALIGN HPI AS REQUIRED (Rule 2.0).

2.1 IF HPI termination criteria are satisfied, THEN terminate HPI prior to loss of BWST suction AND go to step 3.0.

2.2 Align LPI pump discharge of running LPI pump(s) to suction of associated running HPI pump(s).

3.0 THROTTLE RBS AND LPI AS NECESSARY TO ENSURE ADEQUATE NPSH ON TRANSFER TO THE SUMP.

4.0 WHEN BWST REACHES [sump switchover setpoint], THEN PERFORM THE FOLLOWING:

4.1 Align LPI suction to the RB sump.

4.2 IF unable to establish sump suction to an LPI pump, THEN secure that LPI/HPI train prior to losing BWST suction.

4.3 Close LPI and HPI BWST suction valves.

5.0 PERFORM [post-switchover actions and checks].

Section VI
RULES

1.0 Loss of SCM Rule

Whenever SCM is lost, perform the following:

1.1 Trip all RCPs immediately.[1]

1.2 Initiate full flow[2] from at least two HPI pumps.

1.3 Initiate and control EFW flow per Rule 4.0.

1.4 Ensure full flow from two LPI pumps when RCS pressure permits.

NOTES

1. If RCPs not tripped within two minutes after a loss of SCM, then RCP operation (one RCP in each loop preferred) must be maintained until SCM restored or until LPI flow established. If a RCP trips, the other RCP in that loop must be started immediately.

   If SCM is lost, immediately following RCP restart, then the RCPs do not need to be tripped immediately but must be tripped if SCM is not restored within two minutes.

2. Full HPI flow may require flow balancing or isolation of a broken HPI line accomplished by plant specific methods. The intent is to ensure minimum flows required for LOCA are met.

2.0 HPI Throttling/Termination Rule

2.1 HPI flow may not be throttled unless SCM exists.[1]

2.2 HPI flow must be throttled to prevent violating the RV P-T limit.

2.3 HPI flow may not be terminated if any of the following conditions exist:

a. The core outlet temperature is superheated.

b. The core outlet temperature is saturated and LPI flow is less than [minimum flow rate].[5]

c. The core outlet temperature is subcooled and RCS injection required is greater than the makeup system capacity and LPI flow does not exist.

2.4 HPI flow may be terminated if any of the following conditions exist:

a. The core outlet temperature is subcooled and RCS injection required (makeup and contraction) is within the capacity of normal makeup.

b. The core outlet temperature is subcooled and LPI flow exists and HPI has been throttled to [minimum allowable pump flow] and the RCS P-T is not increasing.[3]

c. The core outlet temperature is saturated and LPI flow >[minimum flow rate] exists.[3,4,5]

2.5 HPI flow must be throttled to prevent exceeding [pump runout].[2]

2.6 HPI flow must be maintained greater than [minimum allowable pump flow].

NOTES

1. HPI may not be throttled, even with SCM, if HPI cooling is in progress until core exit thermocouple temperatures are decreasing, except to prevent violating the RV P-T limit.

2. When reducing flow to prevent pump runout, care should be taken to not reduce flow more than necessary to prevent exceeding the limit.

3. In these cases, HPI should not be terminated until switchover to RB sump suction is required.

4. When the core outlet temperature is saturated and LPI flow exists, the PORV may be opened in an attempt to increase LPI flow to >[minimum flow rate].

5. LPI minimum flow rates, not including instrument error, are:

177FA Plants except ANO-1	1000 GPM in each line
ANO-1 (2 LPI pumps)	2630 GPM per pump
ANO-1 (1 LPI pump)	3020 GPM for pump

3.0 Pressurized Thermal Shock (PTS) Rule

3.1 The PTS guidance must be invoked whenever one of the following criteria are met:

a. RC pump on or natural circulation with HPI off:
Whenever T_{cold} is less than 338°F[1] and the rate of cooldown exceeds the allowed RCS Technical Specification cooldown rate.

b. RC pumps off and HPI on:[2]
Whenever all RC pumps are off and HPI is on.

3.2 If PTS guidance is invoked, then maintain the core outlet temperature and pressure near the SCM limit.

NOTES

1. Temperature values must be adjusted for plant specific instrument and process errors.

2. HPI on is defined as one or more HPI pumps on while taking suction from the BWST and injecting through one or more of the HPI lines. For Davis Besse, this also means one or more MU pumps on while taking suction from the BWST during MU/HPI cooling.

4.0 Feedwater/SG Control Rule

4.1 Whenever SCM is lost, SG level(s) must be raised to the [loss of SCM setpoint] using EFW or MFW as follows:

a. EFW must be provided continuously at ≥ the [minimum fill rate (EFIC)] or at ≥ the [minimum total flow rate] until the [loss of SCM setpoint] is reached. EFW should not be throttled unless necessary[1].

	Loss SCM Setpoint[2]	Minimum Total EFW Flow Rate[2]	Minimum Fill Rate(EFIC)
Davis Besse	100 inches SUR	N/A[3]	N/A
ANO-1 and CR-3	73% OR	400 GPM	2 inches/minutes
ON-1,2 and 3	79% OR	400 GPM	N/A
TMI-1	70% OR	400 GPM[4]	N/A

b. MFW using EFW nozzles must be provided at a total MFW flow rate ≥ 600 GPM (300,000 lbm/hr)[2] until the [loss of SCM setpoint] is achieved[5].

c. MFW using MFW nozzles must be provided to achieve the [loss of SCM setpoint] within 25 minutes of loss of SCM[6].

4.2 EFW pump flow must be maintained less than [pump runout].

4.3 Establish and control at the appropriate SG level setpoint ([low level limit setpoint], [NC setpoint], or [loss of SCM setpoint]).

4.4 When manually restoring feed flow to a dry SG (intact or trickle feed[7]), initially limit the flow rate as follows:

EFW nozzles, RCP on : ≤ 450 GPM
EFW nozzles, RCPs off : ≤ 200 GPM
MFW nozzles : : ≤ 200,000 lbm/hr

Once heat transfer has been restored in the SG, feed rates can be adjusted as necessary to control the cooldown and SG tube-shell ΔT.

If the minimum flow rate required by 4.1 applies and conflicts with these values, then the criteria of 4.1 supercede the criteria of 4.4.

NOTES

1. EFW manual flow control should only occur if either the automatic EFW control system is not functioning properly or if the SG becomes uncoupled (loss of heat transfer). Even under manual control, throttling should not be performed unless necessary. For level rate control systems, if the system does not initially feed due to a level error (actual level higher than target level), this is considered as not functioning properly for the purpose of this rule. Also, for the purpose of this rule, a SG becoming uncoupled is defined as EFW flow greater than the total minimum EFW flow causing the SG pressure to decrease substantially below RCS pressure.

2 These values do not include instrument errors.

3. Davis Besse need only feed to 100 inches SUR level to achieve the loss of SCM setpoint. Because of this relatively low level, there is little time or need to throttle EFW before reaching the setpoint. For this reason, there is no minimum total EFW flow rate limit for Davis Besse and Davis Besse should not throttle EFW flow.

4. TMI-1 should not throttle EFW flow if only one motor-driven EFW pump is available.

5. EFW nozzle flow rates, while using MFW, could be substantially greater than those associated with EFW. For this reason, a total MFW flow rate approximately equivalent to normal full decay heat EFW flow rate (e.g., ~ 800 GPM) should be used. Throttling below this flow rate should not be performed unless necessary, e.g., MFW flow rate is causing the SG pressure to decrease substantially below RCS pressure. In any case, total MFW flow rate through the EFW nozzles must remain ≥ the prescribed limit until the [loss of SCM setpoint] is achieved.

6. When using MFW through the MFW nozzles, condensation heat transfer area sufficient to remove decay heat is not available until the [loss of SCM setpoint] is achieved. Achieving this level by 25 minutes after loss of SCM assures that PCTs remain within acceptable limits.

7. Trickle feed (feeding a SG with an unisolable steam leak) should not be attempted unless the steam leak is known to be in a location that is not detrimental to personnel or key equipment or no other method of core cooling is available. Trickle feed using MFW nozzles should not be attempted unless RCP(s) running.

5.0 Reactivity Control Rule

Whenever[1] an unexpected increase in neutron flux is observed with rods inserted, perform the following:

5.1 Stop any dilution activities in progress.

5.2 Initiate emergency boration until adequate SDM is established.

5.3 Stabilize RCS temperature.

NOTES

1. One exception is the case where a rapid cooldown is being performed due to a loss of SCM with HPI unavailable. In this case, the cooldown and depressurization of the RCS is more important, and a significant return to power should not occur.

Figure 1 - ICC P-T CURVES