ENCLOSURE 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

IN THE MATTER OF

COMBUSTION ENGINEERING OWNERS' GROUP

EMERGENCY PROCEDURE GUIDELINES

CONTENTS

ACRONYMS

AC	Alternating current
ADV	Atmospheric dump valve
AFW	Auxiliary feedwater
ATWS	Anticipated transient without scram
CE	Combustion Engineering
CEA	Control element assembly
CEN	Combustion Engineering document designation
CET	Core exit temperature (or thermocouple)
CIAS	Containment isolation actuation signal
CSAS	Containment spray actuation signal
CSP	Containment spray pump
CSS	Containment spray system
CVC	Chemical volume control
CVCS	Chemical volume control system
ECCS	Emergency core cooling system
EOP	Emergency operating procedure
EPGs	Emergency procedures guidelines (usually the CE version)
FRG	Functional recovery guideline
FSAR	Final safety analysis report
HPI	High pressure injection
HPSI	High pressure safety injection
H_2	Hydrogen
ICC	Inadequate core cooling
LOCA	Loss of coolant accident
LOF	Loss of feedwater
LOFC	Loss of forced circulation
LOOP	Loss of offsite power
LPIS	Low pressure injection system
LTOP	Low temperature overpressurization
LVL	Level
MSIS	Main steam isolation system
MSIV	Main steam isolation valve
NC	Natural circulation
NPSH	Net positive suction head
NRC	Nuclear Regulatory Commission
NSSS	Nuclear steam supply system
NUREG	Nuclear Regulatory Commission document designation
ORG	Optimum recovery guideline
PLCS	Pressurizer level control system
PORV	Power operated relief valve, pertains to the pressurizer as used here
PPCS	Pressurizer pressure control system
PRESS	Pressure
P-T	Pressure-temperature
PTS	Pressurized thermal shock
PWR	Power
PZR	Pressurizer
RAS	Recirculation actuation signal

ACRONYMS (Continued)

RCP	Reactor coolant pump
RCS	Reactor coolant system
RT	Reactor trip
RWT	Refueling water tank
Rx	Reactor
SB	Small break
SCS	Shutdown cooling system
SDC	Shutdown cooling
SER	Safety evaluation report
SG	Steam generator
SGTR	Steam generator tube rupture
SI	Safety injection
SIS	Safety injection system
SIAS	Safety injection actuation signal
SIT	Safety injection tank
SLB	Steam line break
SSD	Safety sequence diagrams
SYS	System
T_{ave}	RCS average temperature
TBS	Turbine bypass system
T_c	Cold leg temperature of the RCS
T_h	Usually the hot leg temperature of the RCS
TMI	Three Mile Island
ΔT	Usually $T_h - T_c$
USI	Unresolved safety issue

1 SUMMARY

In response to Item I.C.1 of NUREG-0737, "Clarification of TMI Action Plan Requirements" (Ref. 2), the owners of Combustion Engineering designed nuclear power reactors developed generic guidelines to assist in the preparation of operating procedures for the mitigation of transients and accidents. A pre-implementation review of those guidelines was required by Item I.C.1. This Safety Evaluation Report (SER) documents that review.

1.1 Background

Confinement of the radioactive material in the active core of a nuclear power plant protects the public from exposure to radiation. Confinement is provided by three consecutive barriers:

(1) the fuel cladding,
(2) the reactor coolant system pressure boundary, and
(3) the containment.

The Emergency Operating Procedures (EOPs) define the actions which the operators will use to cope with any condition that potentially jeopardizes any of these barriers. The EOPs should contain sufficient instructions for the plant to be brought to one of the following conditions (in order of preference):

(1) a state in which non-emergency procedures apply,

(2) cold shutdown, or

(3) any controlled stable condition which prevents or minimizes release of radioactive material and which the operators can be anticipated to maintain for a sufficient time that support personnel can logically and carefully plan future operations.

If, in any of the above conditions, the barriers are again jeopardized, then the operators should use the EOPs to cope with the condition.

The Emergency Operating Procedure Guidelines (Guidelines) provide the technical basis for the preparation of the EOPs, including a description of all the major operator actions. The content of the Guidelines and the criteria to be met in development of Guidelines are covered in NUREG-0737 (Ref. 2). The Staff has evaluated the Combustion Engineering generic Guidelines using the criteria from these references. This Safety Evaluation Report (SER) documents the Staff's evaluation.

1.2 CE Emergency Operating Procedures Guidelines

Preparation of Emergency Operating Procedures (EOPs) for the nuclear plants involves several steps, including preparation of:

(1) generic technical guidelines, which are prepared for a group of plants with a similar design, and contain the information necessary to mitigate the consequences of transients and accidents and to restore safety functions;

(2) plant-specific technical guidelines, which provide information for a particular plant and provide the planned method for developing plant-specific EOPs; and

(3) EOPs, which are the plant procedures that direct operator actions necessary to mitigate the consequences of transients and accidents that have caused plant parameters to exceed reactor protection system set points or engineered safety feature set points, or other established limits.

The CE Emergency Procedure Guidelines (EPGs) (Refs. 1 and 8) are the generic technical guidelines for CE plants. The EPGs are being developed by the CE Owners Group in response to NUREG-0660 and NUREG-0737, Item I.C.1. The approach represented in the EPGs is keyed to the following safety functions:

(1) Reactivity control
(2) Reactor Coolant System (RCS) inventory control
(3) RCS pressure control
(4) Core heat removal
(5) RCS heat removal
(6) Containment isolation
(7) Containment temperature and pressure control
(8) Combustible gas control
(9) Indirect radioactivity release control
(10) Maintenance of vital auxiliaries

The status of the safety functions is to be continuously evaluated by comparison of plant instrumentation readings to acceptance criteria. Operator response is keyed to the behavior of these functions. It is not necessary to diagnose the event which caused the plant perturbation prior to or during treatment of the functions, although event diagnosis remains a high priority for the operating crew.

The EOPs are to be entered upon reactor trip, an immediate assessment of the functions is to be made, and immediate actions are to be taken to restore functions that do not meet tests for being within satisfactory bounds. Next, the operator is to attempt to diagnose the event. Then, the operator is to apply either an optimum procedure for treatment of a diagnosed event, or a functional recovery procedure that does not require knowledge of the specific event. The EPGs contain the basic information for the development of these procedures in the form of optimum recovery guidelines (ORGs) for a limited number of events and a functional recovery guideline (FRG). The ORGs, which cover reactor trip, LOCA, steam generator tube rupture, steam line break, loss of feed, and loss of forced circulation, are designed to present the guidance needed to bring the plant to a safe, stable condition in an optimum manner. The objective is to optimize recovery with respect to parameters such as radioactive material release, RCS leakage, and post event recovery time. If for any reason, information in the ORG is not adequate to bring the plant to a safe, stable condition in an acceptable manner, then the FRG information is available. The FRG is designed to present the guidance needed to maintain plant safety while progressing to a safe, stable condition. The FRG information is applicable for conditions such as multiple failures, consequential failures, events that do not fit within optimum guidance, unclear diagnosis, or at the operator's option. The FRG guidance information is also to be followed if the guidance described in an ORG is found to be ineffective.

1.3 Staff Evaluation

We believe this approach is effective, responsive to the referenced NUREGs, and to the needs for treatment of emergency conditions. The EPG is a positive step toward improved coverage of emergency conditions. The EPG is acceptable as a basis for implementation of plant-specific emergency guidelines which are to be used for preparation of EOPs for CE plants. The EPG should be implemented in accordance with the requirements of NUREG-0737, Supplement 1 (Ref. 7).

Since the EPGs have not been fully developed and have not yet covered all of the events identified in NUREG-0737 and NUREG-0660, EPG development should be continued and the present EPGs should be supplemented during a program to provide more comprehensive coverage of emergency conditions as outlined in NUREGs-0737 and -0660.

More information on the coverage of emergency conditions and the EPG evaluation is provided in Section 4 of this SER.

2 INTRODUCTION

2.1 Purpose

The CE Emergency Procedure Guidelines (EPG) (Refs. 1 and 8) are to be used to "... direct the actions necessary for mitigation of plant events that necessitate a reactor protective system actuation or an engineered safety feature actuation."* The EPG is entered upon encountering "...any off-normal event which actuates or requires a reactor trip immediately to properly mitigate the event." This is a logical initial step toward improvement of emergency operating procedures.

2.2 Content and Organization of Emergency Procedure Guidelines

The technical portion of the EPGs may be grouped into three categories:

(1) Initial actions, which cover the initial operator response following entry into the EPGs, and direct further treatment of the emergency condition.

(2) Optimal recovery guidelines (ORG), which address a specific set of symptoms. Each set of symptoms usually corresponds to a specific event or class of events (e.g., LOCA, SGTR) causing the transient or accident.

(3) The functional recovery guideline (FRG), which has the objective of providing operator guidance without the need to diagnose an event to maintain the plant in a safe configuration.

Item 1, the actions taken immediately following entry into the EPG, are summarized in Table 2-1. These serve to guide the operator in assessing the plant status as well as to take rapid initial corrective actions. Completion of the standard post trip actions may also provide the operator with a diagnosis of what caused the event. If not, the next step can be a brief diagnosis process to guide future action. Following this, an entry is made into either the ORG or the FRG.

The ORG and FRG represent CE's division of emergency events into two types. In the first, operators can ascertain the type of event by recognizing its correlated symptom set from control board indications, their knowledge of the plant, and recent operating history. For these events, where an accurate diagnosis

*The reader is reminded that the EPGs contain the major actions the operator will follow in the EOPs, but do not include plant-specific actions and detail such as valve designations or the specific operation tasks required to accomplish the actions. Hence, reference to major actions the operator will take in the EOPs and reference to actions described in the EPGs correspond. For simplicity, the remainder of this document is written as though the operator follows the EPGs directly. The reader should remember that the operator will follow the EOPs, and that the EPGs describe the actions, not necessarily the actual procedure in detail.

SAFETY FUNCTION	CRITERIA	IMMEDIATE ACTIONS
a) REACTIVITY CONTROL	a) Rx PWR DECREASING AND b) [NEGATIVE STARTUP RATE] AND c) NO MORE THAN ONE CEA BOTTOM LIGHT NOT LIT OR BORATED PER TECH SPEC	IF NOT a) MANUALLY TRIP THE REACTOR OR b) OPEN THE Rx TRIP BREAKERS OR c) [DEENERGIZE THE CEA MOTOR GENERATOR] OR d) [PLANT SPECIFIC METHODS] AND e) IF MORE THAN 1 CEA NOT INSERTED BORATE THE PLANT IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS
b) [MAINTENANCE OF VITAL AUXILIARIES]	a) MAIN TURBINE TRIPPED AND b) GENERATOR OUTPUT BREAKER OPEN AND c) [STATION LOADS TRANSFERRED OFFSITE] AND d) [PLANT SPECIFIC]	IF NOT a) TRIP THE TURBINE b) OPEN GENERATOR OUTPUT BREAKERS c) TRANSFER LOADS OFFSITE OR VERIFY DIESEL STARTED d) [PLANT SPECIFIC]
c) RCS INVENTORY CONTROL	a) [35]" < PZR LVL < [245]" AND THE RCS > [20°F] SUBCOOLED CAUTION DO NOT RUN RCPS IF PRESSURIZER PRESSURE IS < [1300] PSIA FOLLOWING AN SIAS UNTIL RCP RESTART CRITERIA ARE MET.	IF NOT a) VERIFY PROPER OPERATION OF PLCS OR b) IF PRESSURIZER PRESSURE DECREASES TO [1600 PSIA], [OR IF CONTAINMENT PRESSURE INCREASES TO 4 PSIG]; VERIFY THAT AN SIAS HAS BEEN INITIATED.
d) RCS PRESSURE CONTROL	a) [1700] PSIA < PZR PRESS < [2350] PSIA	IF NOT a) VERIFY PROPER OPERATION OF PPCS OR b) IF PRESSURIZER PRESSURE DECREASES TO [1600 PSIA], [OR IF CONTAINMENT PRESSURE INCREASES TO 4 PSIG], VERIFY THAT AN SIAS HAS BEEN INITIATED, IF NOT, MANUALLY INITIATE SIS OPERATION
e) CORE HEAT REMOVAL	a) S/G LEVEL IS EITHER: i) WITHIN THE ZERO POWER LEVEL BAND WITH FEEDWATER AVAILABLE TO MAINTAIN THE LEVEL OR ii) BEING RESTORED BY A FEEDWATER FLOW > [150] GPM AND b) RCS T_{ave} < [545] °F AND c) S/G PRESS > [800] PSI	IF NOT a) VERIFY [MAIN OR AUXILIARY FEED] IS CONTROLLING S/G LEVEL AND STEAM DUMP SYS. OPERATING OR b) IF S/G PRESSURE DECREASES TO [500] PSI, VERIFY THE MSIS CLOSES [THE MSIV's]
f) RCS HEAT REMOVAL	a) $T_H - T_C$ < [10]°F AND b) SUBCOOLED MARGIN > [20]°F SUBCOOLING	IF NOT a) VERIFY AT LEAST ONE RCP IS RUNNING & THE ASSOCIATED S/G IS REMOVING HEAT OR b) VERIFY NATURAL CIRCULATION
g) CONTAINMENT ISOLATION	a) CONTAINMENT PRESSURE < [0.5] PSIG AND b) NO CONTMNT. AREA RAD MONITORS ALARMING AND c) NO STEAM PLANT RADIATION MONITORS	IF NOT a) EVALUATE THE NEED TO ISOLATE ALL OR SOME CONTAINMENT PENETRATIONS OR b) IF CONTAINMENT PRESS > [4] PSIG, VERIFY CIAS c) REFER TO SGTR EPG
h) CONTAINMENT TEMPERATURE & PRESSURE	a) CONTAINMENT PRESSURE < [0.5] PSIG AND b) CONTAINMENT TEMPERATURE < [215]°F	IF NOT a) [VERIFY PROPER FUNCTIONING OF CONTAINMENT COOLERS] OR b) IF CONTAINMENT PRESSURE > [10] PSIG, VERIFY CONTAINMENT SPRAY IS RUNNING WITH HEADER FLOW > [1500] GPM

can be made, it is highly desirable to provide guidance which is selected and sequenced to strategically address that symptom set (e.g., LOCA, steam generator tube rupture). Since these types of events are well analyzed and understood, it is possible to write the emergency procedure guideline to optimize the recovery path. For ease of use, these events have been grouped into classes of events, e.g., large and small break LOCAs are covered by one guideline.*

In the second kind of emergency event, the operator is presumed unable to identify the correct symptom set for the disturbance. This may be due to errors in symptom assessment by the operator, multiple failures in the plant, the occurrence of an unanalyzed failure or instrumentation failures which distort the symptom picture.

The CE Owners approach to providing operator guidance is keyed to the behavior of safety functions. They define a safety function as a condition or an action that prevents core damage or minimizes radioactive material release to the general public. Taken together, the safety functions are intended to provide for a minimization of radioactive material release and for plant safety.

Ten safety functions are identified to mitigate events and contain radioactivity. These safety functions are divided into four classes as follows:

1. Core melt prevention safety functions

   a. Reactivity Control

   b. Reactor Coolant System Inventory Control

   c. Reactor Coolant System Pressure Control

   d. Core Heat Removal

   e. Reactor Coolant System Heat Removal

2. Containment Integrity Safety Functions

   a. Containment Isolation

   b. Containment Temperature and Pressure Control

   c. Combustible Gas Control

*This is paraphrased material taken directly from Reference 1. We have also paraphrased and condensed EPG material freely when doing so assisted in preparation of the SER. Figures taken from the EPG may be identified by the CEN reference.

3. <u>Indirect Radioactivity Release Control</u>

4. <u>Maintenance of Vital Auxiliaries</u>

The Safety Function Status Check is a key to the effectiveness of the CE guidelines. Figure 2-1 for the Reactor Trip (RT) ORG is typical of all the guidelines. The status checks are consulted on a continuing basis anytime the operator is in the respective ORG, and provide the operator with a continuing assessment of plant conditions and response to manual actions. As long as the plant is responding in a satisfactory manner, as indicated by the checks, the treatment is continued. If at any time any safety function response is inadequate, the ORG is to be immediately exited, and future guidance provided by the FRG.

Each ORG consists of the following sections:

a. Bases: background information and operator actions

b. Symptoms: conditions the operator may typically observe

c. Recovery actions: operator guidance beginning at the point of completion of initial actions

d. Precautions: general guidance applicable to treatment of the symptoms set

e. Charts and diagrams: reference material for use by the operator.

The FRG consists of:

1. Bases: similar to the bases section of the ORG

2. Safety function status check: the entry point into the FRG which includes identification of success paths, acceptance criteria, possible identification of the problem, and identification of resource tree

3. Resource assessment trees: identification of plant resources organized into success paths for the treatment of each safety function

4. Recovery action guidelines: operator guidance for each of the success paths shown in the resource trees

5. Long term actions: guidance for operator action of a long term nature including aid in assessment of plant status and whether the plant should be taken to a cold shutdown condition.

The FRG contains both instructions for the restoration of safety functions to acceptable limits and information pertinent to what plant resources are available to correct safety function deficiencies. Operator actions are organized as follows:

FIGURE 2-1
SAFETY FUNCTION STATUS CHECK
Reactor Trip

The safety functions listed below and their respective criteria are those used to confirm the adequacy of the LOCA mitigation. Additional safety functions shall be monitored as appropriate to evaluate overall plant status.

SAFETY FUNCTION	CRITERIA
1) Reactivity Control	a) Reactor power decreasing AND b) [Negative startup rate] AND c) No more than 1 CEA bottom light NOT lit or borated per Tech Specs
2) RCS Inventory Control	a) [35"] < pressurizer level < [245"] AND b) Charging and letdown are being operated manually or automatically to maintain or restore pressurizer level AND c) the RCS ≥ [20°F] subcooled
3) RCS Pressure Control	a) [1700 psia] < pressurizer pressure < [2350 psia] AND b) Heater and spray are being operated manually or automatically to maintain or restore pressurizer pressure with limits of P/T curves, Figure 4-5
4) Core Heat Removal	a) $T_H - T_C$ < [10]°F AND b) Subcooled margin ≥ [20°F] subcooled
5) RCS Heat Removal	a) S/G level is either: i) within the zero power level band with feedwater available to maintain the level OR ii) being restored by a feedwater flow ≥ [150] gpm AND b) RCS T_{ave} is < [545°F]

FIGURE 2-1 (continued)
SAFETY FUNCTION STATUS CHECK
Reactor Trip

The safety functions listed below and their respective criteria are those used to confirm the adequacy of the LOCA mitigation. Additional safety functions shall be monitored as appropriate to evaluate overall plant status.

SAFETY FUNCTION	CRITERIA
6) Containment Isolation	a) Containment pressure < [.5 psig] AND b) No containment area radiation monitors alarming AND c) No steam plant activity monitors alarming
7) Containment Temperature and Pressure Control	a) Containment pressure < [.5 psig] AND b) Containment temperature < [215°F]
8) Containment Combustible Gas Control	a) H_2 < [x]%

Safety Function	Treatment Path
1. Reactivity	a. CEA Trip b. Boration using charging pumps c. Boration using ECCS pumps d. CEA drive down
2. RCS Inventory Control	
a. Low Inventory	a. Charging pumps b. ECCS pumps
b. High Inventory	a. Manual control of letdown
3. RCS Pressure Control	
a. Low Pressure	a. Pressurizer heaters b. CVCS charging, no ECCS c. ECCS pumps
b. High Pressure	a. Manual control of pressurizer b. RCPs running with steam discharge through ADVs, or TBS c. Natural circulation, steam discharge through ADVs and TBS d. [PORVs]* with ECCS operating
4. RCS and Core Heat Removal	a. RCPs running, no ECCS b. Natural circulation, no ECCS c. Steam generators* and ECCS d. ECCS and [PORVs] e. Shutdown cooling system
5. Containment Isolation	a. Manual isolation
6. Containment Temperature and Pressure	a. Containment fan cooling system, no containment spray b. Containment spray and/or containment fans
7. Containment Combustible Gas Control	a. [Plant-specific information]

The operator takes each safety function in turn, and follows through the associated treatment paths starting with the one in use, and progressing until a successful path is encountered. A continuous assessment of safety functions is performed in the FRG in a manner similar to that performed in the ORG so that the operator knows the safety status of the plant at any time, and conditions which occur that need attention are immediately identified.

*[] as used in the EPG, brackets indicate a plant-specific item. In this case, not all CE plants have PORVs.

3 STAFF EVALUATION

3.1 Guideline Entry and Initial Actions

3.1.1 EPG Summary

The CE Emergency Procedure Guidelines (EPG) (Reference 1) are to be used to "direct the actions necessary for mitigation of plant events that necessitate a reactor protective system actuation or an engineered safety feature actuation." The entry point to the EPG is the Standard Post Trip Actions section, which is entered upon encountering any off-normal event which actuates or requires a reactor trip (RT).

The standard post trip actions are summarized in Table 2-1. This represents the initial actions upon entry into the EPG. Given an RT condition, the process is independent of what has occurred. It constitutes a check of the significant safety functions pertinent to plant safety, and provides initial operator actions in regard to the condition of those functions. This quickly provides the operator with:

1. A summary of the plant safety condition
2. Short-term action that must be taken to restore plant safety, if any is needed
3. An initial determination of whether a simple uncomplicated reactor trip has taken place, or whether a significant safety function has been affected.

The first item in Table 2-1 is a check of reactivity control since control of heat generation rate is the most important initial consideration if conditions require RT. Checking of vital auxiliaries is next since proper functioning of the electrical system is essential to fulfillment of succeeding functions. A check is then made of RCS inventory and pressure control to assure enough RCS water under conditions which indicate the core is being cooled. If the RCS is in a subcooled condition, then there is no immediate concern with the ability of the RCS to remove heat from the core. Next, the heat removal checks provide additional information on the RCS and information regarding condition of the steam generators, the primary means of RCS heat removal. Immediate actions relate to restoration of the function if a deficiency is encountered.

Containment condition is checked next. A check is made to verify isolation and to determine whether actions are needed to establish or maintain the isolation. The check on temperature and pressure is to assure preservation of the containment building boundary, and the immediate actions are those that should be taken to restore proper conditions, if necessary.

All of these checks and any needed operations are taken prior to moving further into the guideline. If all of the checks on safety functions are met, then the initial diagnosis is that an uncomplicated reactor trip has occurred, and the operator proceeds to the Reactor Trip Recovery Guideline. If the criteria are not met, then something more than a reactor trip probably has taken place. In this case, a transfer is made to either an ORG or the FRG. The transfer may be made directly if the operator has already recognized the procedure that should be used, or diagnostic aids may be employed to assist in the decision.

3.1.2 Staff Findings

We find guideline entry and initial actions acceptable for development and implementation of plant-specific technical guidelines. However, an effort should be undertaken to broaden entry criteria and provide interface information pertinent to other plant procedures.

The identified safety functions are acceptable for initial assessment of the NSSS condition, and actions taken in response to functions which fail to meet the criteria provide an adequate immediate response to difficulties that may exist. The process also provides event diagnostic information which allows the option of proceeding directly to an ORG or to the FRG when the initial assessment and actions have been completed.

There is no mention of inventory or vessel level instrumentation in the safety function status checks nor as part of the EPG guidance. The purpose of this instrumentation, which is required under Item II.F.2 of NUREG-0737 (Ref. 2), cannot be achieved unless its use is included in the EPGs. Since this instrumentation is required in the near term and is already installed and operable in some plants, we require that the EPG be revised to include use of liquid level instrumentation with interaction via the safety function status checks and actual inventory needs of the RCS. Plants which have not completed installation of reactor vessel inventory tracking (liquid level) instrumentation may use the current version of the EPG as the basis for interim emergency procedures relating to reactor vessel voiding.

3.2 Diagnostics

3.2.1 EPG Summary

CE has provided examples of aids to assist operators in selecting an appropriate procedure following a reactor trip. The strategy is to provide the operator with a tool which allows a prompt selection using a limited number of key symptoms. The preference is to use an ORG if the event can be diagnosed since each ORG is designed to provide optimum recovery from specific sets of conditions. If the event cannot be diagnosed, an ORG is inappropriate, or the operator chooses, the FRG is used. Use of the FRG does not require diagnosis of the specific event. It is applicable to single and multiple failure events and is designed to restore safety functions to within acceptable criteria.

The diagnostic aids provided in the EPG are not intended for complicated, multiple failure events with possibly confusing symptoms. Such events are treated in the FRG.

An inappropriate transfer to an ORG should not cause difficulty due to the inherent self-correction process, which is based upon a continuous check of the safety functions. If the selected ORG is adequately treating the symptoms, then the ORG is continued. If the treatment is inadequate, because either new symptom information appears that is not covered by the selected ORG, the operator made a mistake, or because the observed symptoms are not responding properly, then a transfer is made to a more appropriate ORG or to the FRG. The checking process is continued as long as the EPG is in use.

3.2.2 Staff Findings

Provision of a simplistic diagnostic is acceptable because the selected treatment is continued only as long as it is effective in correction of observed plant problems. The acceptability of the diagnostic is due to the continuous safety function parameter checking included in each ORG and in the FRG.

3.3 <u>Optimum Recovery Guideline for Reactor Trip</u>

3.3.1 ORG Summary

A reactor trip may result from the following:

1. High reactor power.
2. Low pressurizer pressure.
3. Low reactor coolant flow.
4. Low steam generator level.
5. Low steam generator pressure.
6. High pressurizer pressure.
7. Thermal margin/low pressure.
8. High containment pressure.
9. Turbine trip.
10. [Core protection calculator]* trip.
11. [Automatic or manual turbine trip at full power conditions]*.
12. Manual action.

The response recommended in reaction to an RT is summarized in Figure 3.3-1. It consists of the following steps:

1. Verify completion of standard post trip actions.
2. Continually verify satisfactory safety function behavior by using Figure 3.3-2.
3. Transfer to the FRG if any safety function is not satisfied.

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*Indicates a plant-specific item. Presented values are typical.

FIGURE 3.3-1
REACTOR TRIP

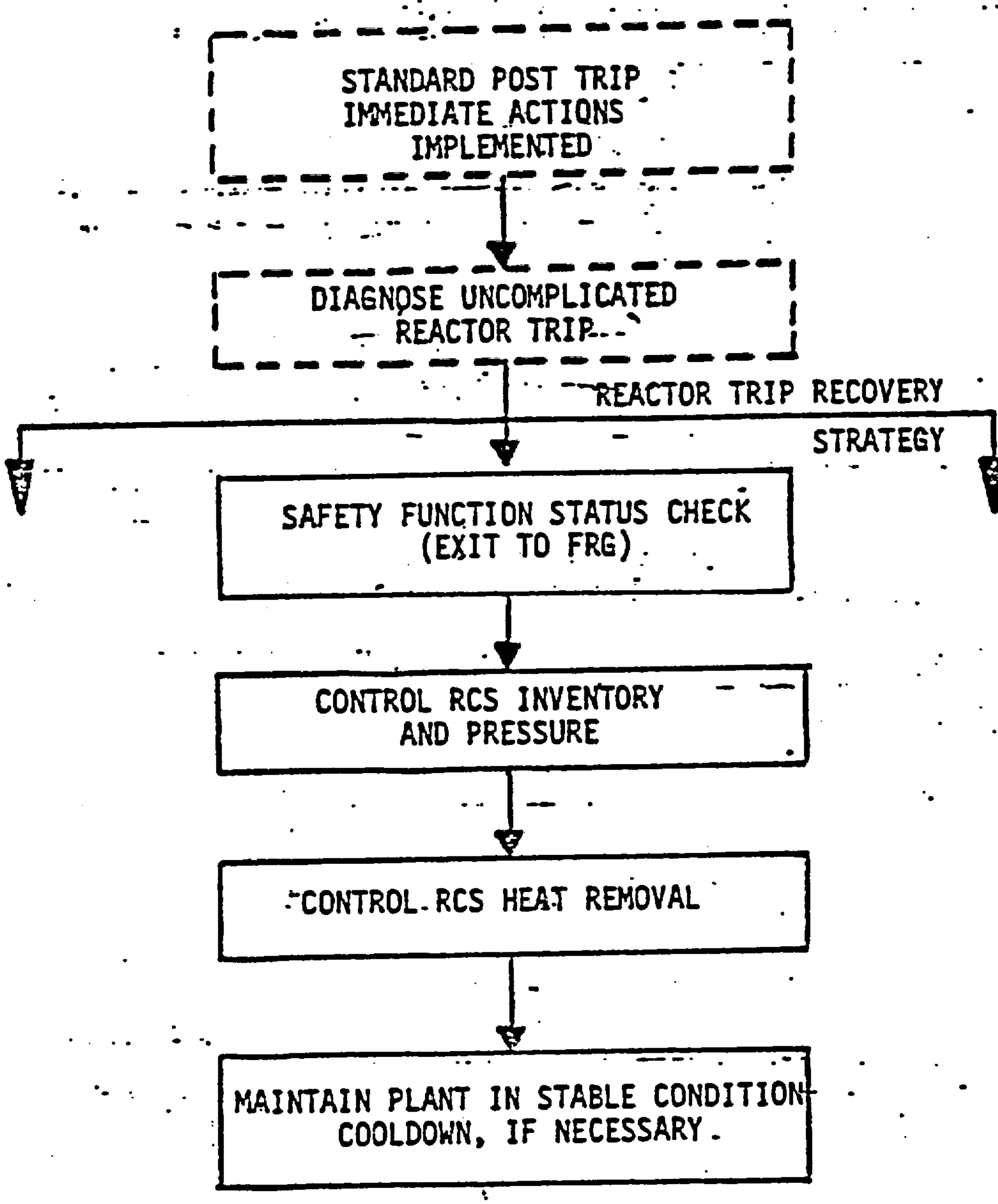

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FIGURE 3.3-2
SAFETY FUNCTION STATUS CHECK
Reactor Trip

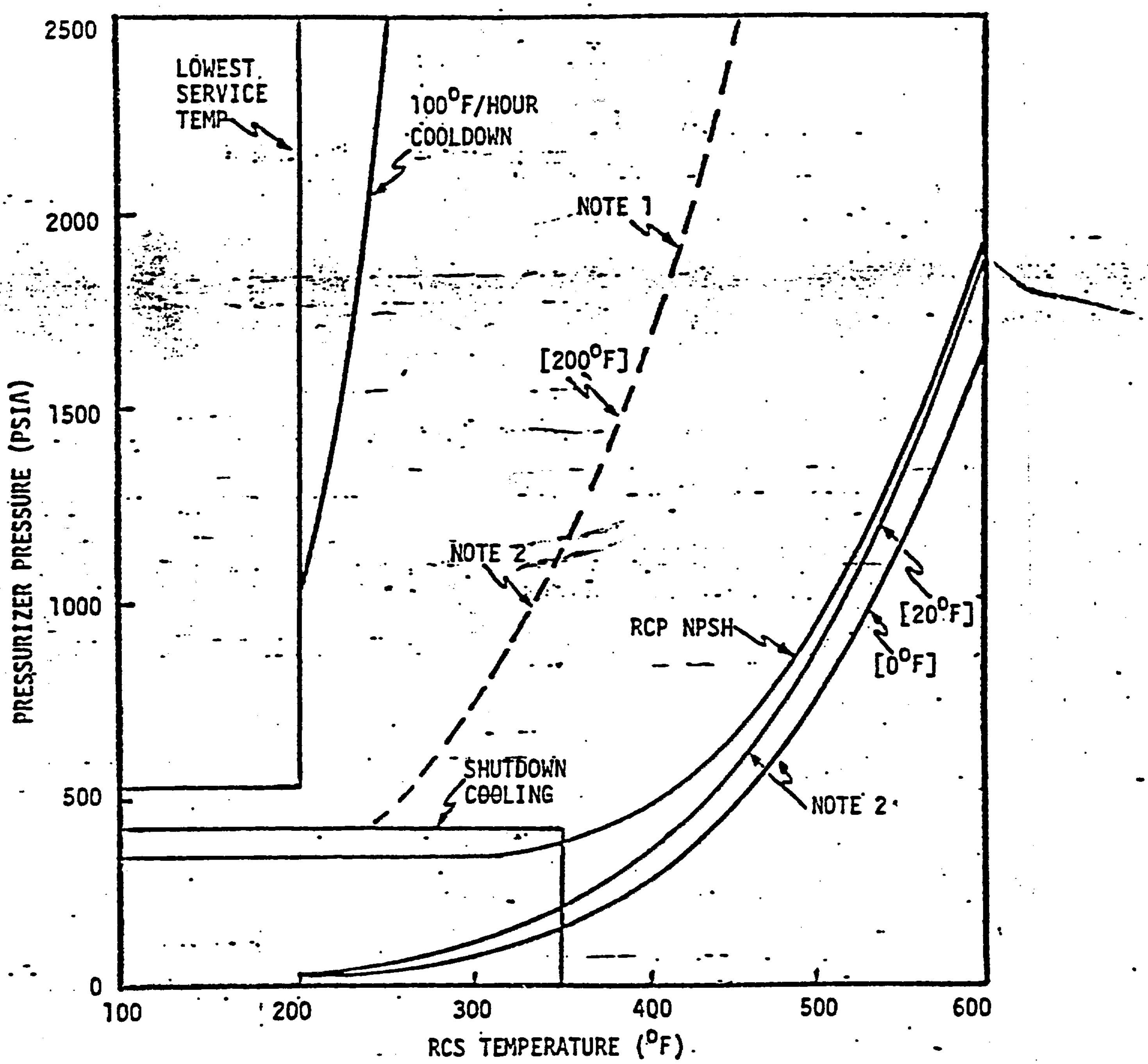
The safety functions listed below and their respective criteria are those used to confirm the adequacy of the LOCA mitigation. Additional safety functions shall be monitored as appropriate to evaluate overall plant status.

SAFETY FUNCTION	CRITERIA
1) Reactivity Control	a) Reactor power decreasing AND b) [Negative startup rate] AND c) No more than 1 CEA bottom light <u>NOT</u> lit or borated per Tech Specs
2) RCS Inventory Control	a) [35"] < pressurizer level < [245"] AND b) Charging and letdown are being operated manually or automatically to maintain or restore pressurizer level AND c) the RCS ≥ [20°F] subcooled
3) RCS Pressure Control	a) [1700 psia] < pressurizer pressure < [2350 psia] AND b) Heater and spray are being operated manually or automatically to maintain or restore pressurizer pressure with limits of P/T curves, Figure 4-5
4) Core Heat Removal	a) T_H-T_C < [10]°F AND b) Subcooled margin ≥ [20°F] subcooled
5) RCS Heat Removal	a) S/G level is <u>either</u> : i) within the zero power level band with feedwater available to maintain the level OR ii) being restored by a feedwater flow ≥ [150] gpm AND b) RCS T_{ave} is < [545°F]

FIGURE 3.3-2 (continued)
SAFETY FUNCTION STATUS CHECK
Reactor Trip

SAFETY FUNCTION		CRITERIA
6) Containment Isolation	a)	Containment pressure < [.5 psig]
		AND
	b)	No containment area radiation monitors alarming
		AND
	c)	No steam plant activity monitors alarming
7) Containment Temperature and Pressure Control	a)	Containment pressure < [.5 psig]
		AND
	b)	Containment temperature < [215°F]
8) Containment Combustible Gas Control	a)	H_2 < [x]%

FIGURE 3.3-3
TYPICAL POST ACCIDENT PRESSURE-TEMPERATURE LIMITS



NOTE: (1) THIS CURVE IS IN EFFECT ANY TIME THE RCS HAS EXPERIENCED A COOLDOWN IN EXCESS OF TECH SPEC LIMITS FOR GREATER THAN 10 MINUTES.

(2) THESE CURVES MUST BE ADJUSTED FOR INSTRUMENT INACCURACIES

(3) THESE ARE ONLY TYPICAL CURVES. THEY DO NOT APPLY TO ANY SPECIFIC PLANT.

4. Verify or control RCS pressure within the limits of Figure 3.3-3.

5. Verify or control pressurizer level.

6. Verify or control steam generator pressure at [900 psig].

7. Restore and maintain steam generator level in the hot zero power band.

8. Maintain the plant in a stabilized condition, evaluate plant conditions, conduct a plant cooldown if necessary.

3.3.2 Staff Findings

Based on the above, we find the treatment of RT to be acceptable. The safety functions are sufficient to assess conditions following an RT and to provide a transfer to suitable guidance should something other than a simple RT have taken place. The guidance contained in this ORG is sufficient for control of the NSSS for a simple RT insofar as the emergency guidance is concerned for a power operation condition.

3.4 Optimum Recovery Guideline for LOCA

3.4.1 ORG Summary

The strategy for treatment of LOCA conditions is summarized in Figure 3.4-1. The major steps consist of the following:

1. Verify completion of standard post trip actions.

2. Confirm the LOCA diagnosis via Figure 3.4-2.

3. Verify that the Figure 3.4-3 safety functions are being satisfied.

4. If necessary, go the steam generator tube rupture (SGTR) ORG, steam line break (SLB) ORG, or FRG.

5. Continually verify that all safety functions are being satisfied. If not, implement the FRG.

6. Maximize safety injection and charging flow.

7. Attempt to isolate the leak.

8. Perform the following steps anytime the specified RCS conditions exist:

    a. If RCS pressure reaches 1300 psia following SIAS, stop RCPs.

    b. Restart one RCP per loop if all of the following are satisfied:

        (1) At least one steam generator (SG) is available for removing heat

        (2) Pressurizer level is greater than [100"] and constant or increasing

FIGURE 3.4-1
LOSS OF COOLANT ACCIDENT
STRATEGY CHART

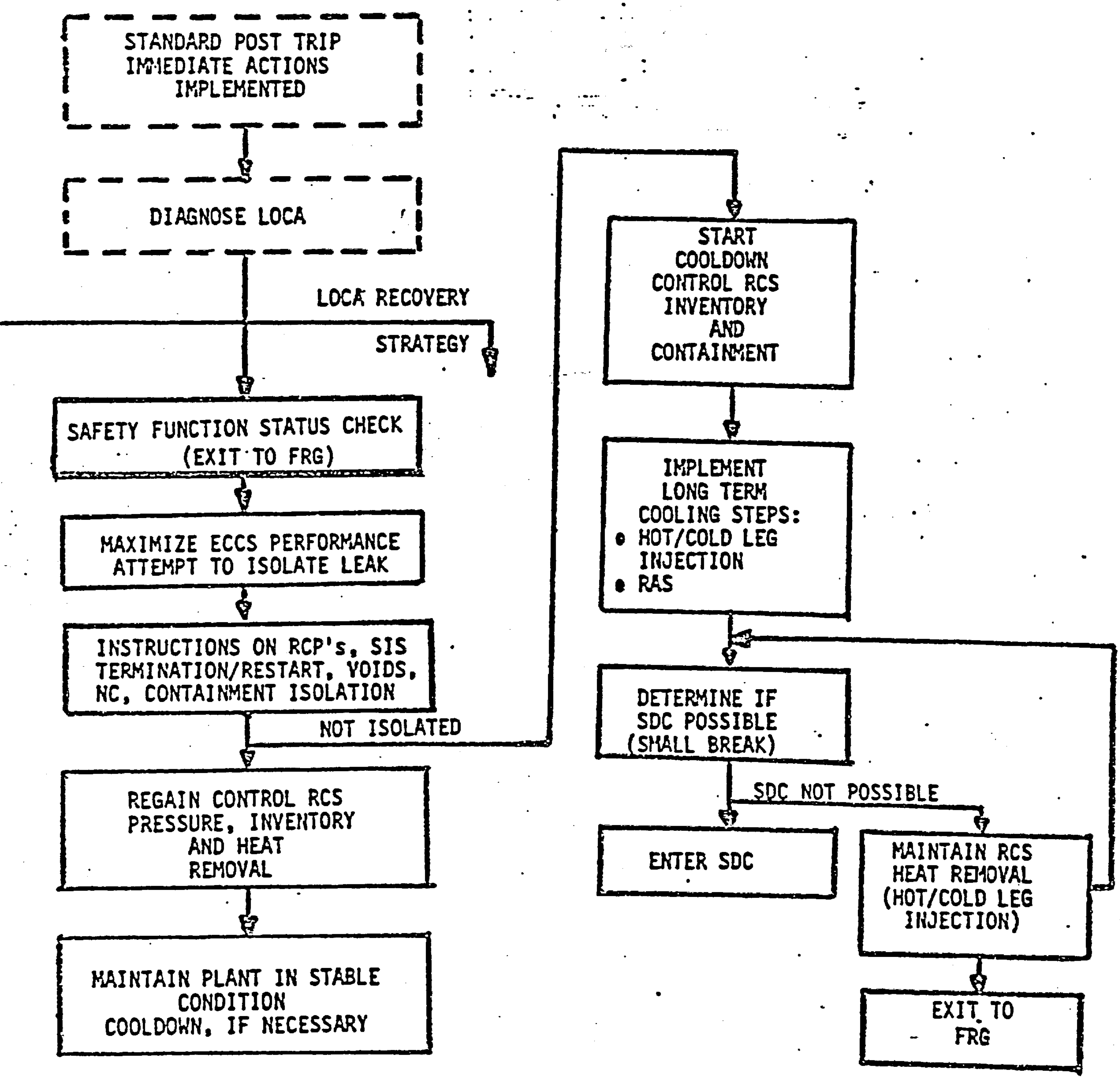


FIGURE 3.4-2
BREAK IDENTIFICATION CHART

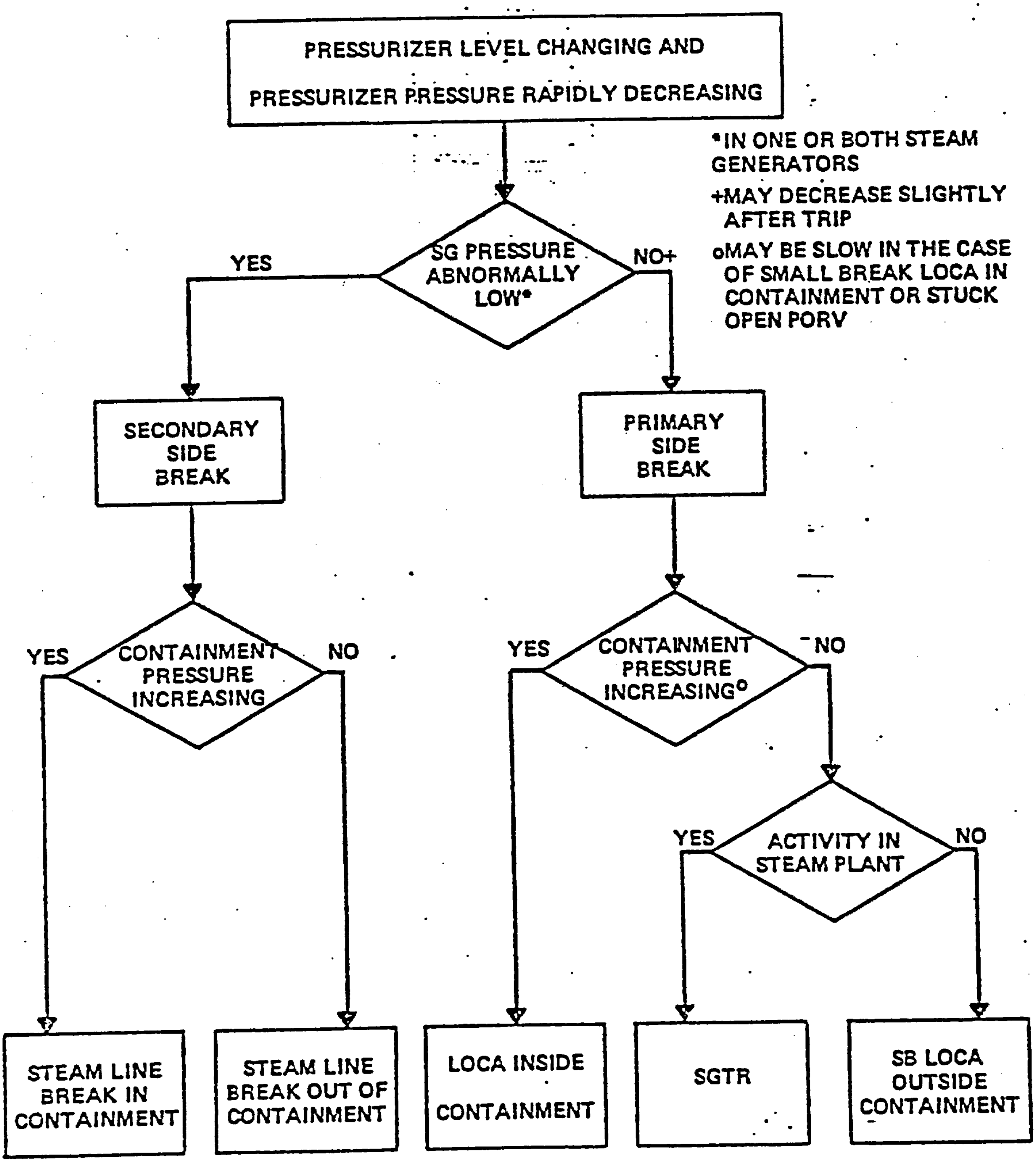


FIGURE 3.4-3

SAFETY FUNCTION STATUS CHECK
Loss of Coolant Accident

The safety functions listed below and their respective criteria are those used to confirm that those LOCA required to place the plant in a safe stable condition are being performed. Additional safety functions shall be monitored as appropriate to evaluate overall plant status.

SAFETY FUNCTION	CRITERIA
1) Reactivity Control	a) Reactor power decreasing AND b) [Negative startup rate] AND c) No more than 1 CEA bottom light NOT lit or borated per Tech Specs
2) RCS Inventory Control	a) If pressurizer level is between [35"] and [245"]: i) charging and letdown are being operated manually or automatically to maintain or restore pressurizer level AND ii) the RCS $\geq$ [20°F] subcooled OR b) [at least one charging pump and] and at least one SIS pump are operating and the SIS pump(s) are injecting water into the RCS per Figure 5-15 unless the SIS termination criteria are met.
3) RCS Pressure Control	a) If pressurizer pressure > [1600] psia, either heaters and pressurizer spray or charging and SIS pumps are being operated manually or automatically to maintain or restore pressurizer pressure within P/T limits Figure 5-14. OR b) If pressurizer pressure < [1600] psia, [at least one charging pump and] at least one SIS pump are operating and the SIS pump(s) are injecting water into the RCS per Figure 5-15, unless the SIS termination criteria are met.
4) Core Heat Removal	a) T_H RTDs or Core exit thermocouples < [800]°F AND b) Not steadily increasing for more than [15 min].

FIGURE 3.4-3 (continued)

SAFETY FUNCTION STATUS CHECK
Loss of Coolant Accident

The safety functions listed below and their respective criteria are those used to confirm that those LOCA required to place the plant in a safe stable condition are being performed. Additional safety functions shall be monitored as appropriate to evaluate overall plant status.

SAFETY FUNCTION	CRITERIA
5) RCS Heat Removal	a) At least one S/G level is either: i) within the zero power level band with feedwater available to maintain the level OR ii) being restored by a feedwater flow $\geq$ [150 gpm] AND b) RCS T_{ave} is $\leq$ [545°F] and controlled OR c) At least one charging and at least one SIS pump are operating and injecting water into the RCS per Figure 5-15, unless the SIS termination criteria are met.
6) Containment Isolation	a) Containment pressure < [4 psig] AND b) No containment area radiation monitors alarming OR CIAS should be present or manually initiated AND c) No steam plant activity monitors alarming
7) Containment Temperature and Pressure	a) Containment pressure < [10 psig] AND Containment temperature < [240°F] OR b) Containment spray flow > [1500 gpm]
8) Containment Combustible Gas Control	a) H_2 < [x%]

(3) RCS is at least [20°F] subcooled

(4) [Other RCP criteria as applicable].

c. If RCPs are stopped with inventory and pressure controlled, and with SGs in use for heat removal, then maintain natural circulation (NC) in at least one loop. The single phase criteria for NC are:

(1) Loop hot to cold leg temperature difference less than normal full power temperature difference

(2) Cold leg temperature constant or decreasing

(3) Hot leg temperatures stable (not steadily increasing) or decreasing

(4) No abnormal differences between the hot leg and core exit temperatures.

If the RCPs are stopped with the SGs in use for heat removal, but inventory and pressure of the RCS are not controlled so that two phase NC plus flow through the break is the heat removal process, then the operator is to:

(1) Verify SIS (safety injection system) operation

(2) [Verify the core exit temperature is less than 800°F]

(3) Verify at least one SG level is within the zero power band with feedwater available or that the level is being restored.

d. SIS may be throttled or stopped if all of the following are satisfied:

(1) RCS is at least [20°F] subcooled

(2) Pressurizer level is greater than [100"] and constant or increasing

(3) At least one SG is available

(4) If the criteria cannot be maintained without SI, the SIS must be restarted.

e. Verify containment isolation at [4] psig or [other plant specific criteria]. (Be alert to loss of RCP cooling water and loss of other auxiliaries which may occur.)

9. If the leak has been isolated:

a. Assure pressurizer pressure and level are maintained

b. Assure RCS cooling is maintained via the SGs

c. If conditions require plant cooldown, follow normal operating instructions.

10. If the break has not been isolated:

a. Commence a rapid cooldown to less than [300°F] at a rate within Technical Specification Limits.

b. If RCPs are stopped with inventory and pressure controlled, and with SGs in use for heat removal, then maintain NC in at least one loop. The criteria for single phase NC are:

(1) Loop hot to cold leg temperature difference less than normal full power ΔT

(2) Cold leg temperatures constant or decreasing

(3) Hot leg temperatures stable (not steadily increasing) or decreasing

(4) No abnormal differences between the hot leg and core exit temperatures.

If the RCPs are stopped with the SGs in use for heat removal, but inventory and pressure of the RCS are not controlled so that two phase NC plus flow through the break is the heat removal process, then the operator is to:

(1) Verify SIS operation

(2) [Verify the core exit temperature is less than 800°F]

(3) Verify at least one SG level is within the zero power band with feedwater available or that the level is being restored.

c. Maintain pressurizer level if possible unless it is necessary to go solid to restore RCS subcooling.

d. If refueling water tank level falls to [10%], verify or initiate recirculation.

e. Monitor and control containment conditions.

f. At [2-4 hours] after start of the LOCA, align the [SIS] for simultaneous hot and cold leg injection.

g. Enter shutdown cooling if allowable when RCS is below [300 psig] and [300°F].

h. If shutdown cooling system operation is not possible, continue simultaneous hot and cold leg injection and maintain RCS heat removal by (listed in order of preference):

(1) Turbine bypass system

(2) Atmospheric dump valves

(3) [Using alternate methods of secondary feedwater supply while discharging steam to the condenser or atmosphere].

(4) [Open the pressurizer PORV to obtain once-through cooling].

i. If neither steps g nor h are possible, implement the FRG.

In addition, the operator is cautioned to maintain post accident pressure and temperature within the limits of Figure 3.3-3 to avoid potential pressurized thermal shock problems.

3.4.2 Staff Findings

The Figure 3.4-2 diagnostic may provide a guideline correction if this ORG was entered in error. If not, the safety function status check of Figure 3.4-3 provides assurance that the FRG will be used if errors and multiple failures occur.

The treatment of such items as natural convection, RCS voids, RCP operation, and the safety function status checks are clearly written, consistent and acceptable for treatment of LOCA. In general, the only differences between this section and other sections of the EPG are due to the unique demands of the event under consideration. This attention to consistency is a positive aspect to treatment of emergency conditions.

We have not reviewed the acceptability of the proposed RCP trip, restart, and operate criteria. The acceptability of the criteria is to be determined by the licensees and applicants based on the ability to meet the guidance of Reference 6 which addresses this issue. The staff plans to inspect selected licensees to determine compliance with the guidance in the referenced letter. At that time, specific procedures for RCP trip will be examined as part of the inspection.

Based on the above, we find the ORG for LOCA to be acceptable for preparation of plant specific technical guidelines.

Longer term improvement should be provided to cover the following items.*

1. <u>RCP operation</u>. There are conditions where "jogging" or "bumping" of the RCPs may be beneficial, and extreme conditions where running of RCPs may be appropriate, such as with two phase RCS conditions. Such RCP operation should be considered to maximize the reasonable options available to the operator.

2. <u>Charging pump operation</u>. Use of all charging pumps is indicated early in the ORG. They should also be used later in the event under some circumstances. For example, only one pump is required in the safety function status check when all may be needed at high RCS pressure, which may be above the HPI shut-off head. A restart instruction may be appropriate for those plants where charging pumps must be manually restarted upon loss of offsite power (LOOP). The items also apply in the FRG.

*Note that several of the areas are applicable to other sections of the EPG.

3. Containment. Guidelines for control of containment should be included in the EPG. Consideration should be given to items such as the following during guidelines development:

   a. Guidelines for operator action which contain instructions to reduce containment hydrogen concentration and/or preserve containment integrity by venting, and which may therefore release large quantities of radioactive material, should be based upon a realistic appraisal of containment capability and purge/vent system operability under accident conditions. This guidance should be reviewed and approved by NRC because such venting would be expected to involve an unreviewed safety question as defined in 10 CFR 50.59. The guidance should specify limits for operator actions.

   b. Guidelines for reactivation of the containment spray system should be addressed with respect to its influence on hydrogen flammability and flame propagation. The envelope of containment conditions (H_2, steam, air concentrations) for which combustion would not jeopardize containment integrity should be considered. (See also item a, above).

   c. Selection of H_2 concentrations for control actions that are close to limits should be justified with respect to instrumentation accuracy, uniformity of mixing, and accuracy with which the limits are known.

   d. Instructions for operation of H_2 recombiners should be included or referenced.

   e. Guidelines for operator action to manually initiate containment isolation, and in particular, to isolate lines which provide direct communication between the containment atmosphere and the environment, should be considered.

   f. Guidelines for operator action to preserve containment cooling capability or RCP cooling capability should be considered in light of the potential for inadvertent isolation or to reinstate cooling following automatic or operator initiated isolation.

   These comments apply to all ORGs and the FRG whenever containment conditions are affected.

4. Steam line filling. Overfill of the SG secondary side with water entering the steam line should be covered.

5. High point vents. Although the NUREG-0737, Item II.B.1 requirement has been addressed in the EPGs, there are areas beyond the requirement for relief of gas where the high point vent valves may be useful. Consideration should be given to opening high point vent valves when the PORV is opened for once through cooling, either as a part of LOCA guidance or in the FRG. Use of high point vent valves under extreme or unusual conditions should also be considered. (For example, in control of pressure rather than using the PORV, or for pressure control in those plants that do not have a PORV.)

6. LOCA outside containment. Operator guidance for LOCA outside containment should be improved to account for loss of coolant that is unavailable for recirculation and to assure that all practical actions are taken to control external release of radioactive material.

3.5 Optimum Recovery Guideline for Steam Generator Tube Rupture

3.5.1 ORG Summary

The strategy for treatment of a SGTR is summarized in Figure 3.5-1. The major steps consist of the following:

1. Essentially the same as steps 1-5 of the LOCA treatment (SER Section 3.4.1). The safety function status check differs in that there is no condition for transfer to the FRG upon encountering abnormal plant radioactivity since this symptom is one of the characteristics of a SGTR.

2. Verify RCS hot leg temperature is less than [545°F] or cool down the RCS to less than [545°F] by using the turbine bypass system* or the atmospheric dump valves.

3. Identify and isolate the SG with the tube rupture.

4. Verify the correct SG was isolated and if not, correct isolation. If both SGs are affected, isolate the one with the highest radioactivity (leak rate).

5. Same as for LOCA, items 8a - 8d.

6. If the isolated SG is overfilling and SIS termination criteria are met, stop the HPSI pumps.

7. Prevent overfilling of the affected SG by periodic draining or dump steam to the condenser.

8. Monitor for RCS voiding.

9. Instructions for elimination of voids.

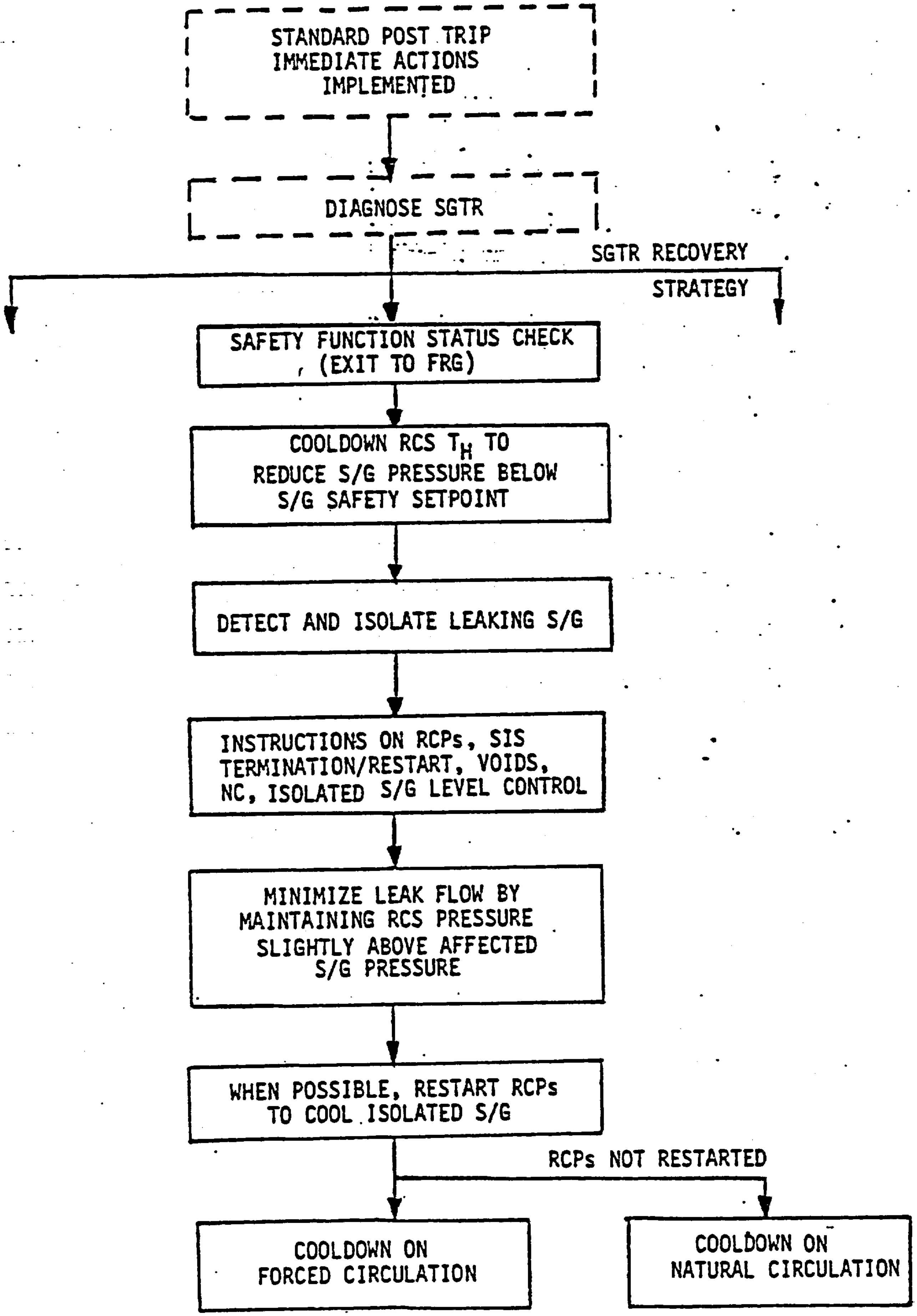
10. Sample RCS boron concentration and add boron to raise the entire RCS to the shutdown margin concentration.

11. Decrease and control RCS pressure to slightly above the affected SG pressure and below [1000 psig] using main spray, auxiliary spray or by throttling HPSI.

12. Conduct plant cooldown in accordance with Technical Specification limits with forced circulation (preferred) or natural circulation by using the turbine bypass system or the unaffected (or least affected) SG by way of atmospheric dump.

*The first listed item is preferred (rule applied throughout the EPG).

FIGURE 3.5-1
STEAM GENERATOR TUBE RUPTURE



13. If NC must be used, remove heat from the isolated SG by feed and bleed using main or auxiliary feedwater and SG blowdown or [by other plant specific methods].

3.5.2 Staff Findings

Those aspects of SGTR which are similar to LOCA are similarly treated (see Section 3.4). In addition, the unique aspects of SGTR such as SG filling, control of the pressure difference between the RCS and the SG secondary side, and control to minimize external releases, are acceptable covered. Therefore, we find the treatment of SGTR to be acceptable for preparation of plant-specific guidelines.

Longer term improvement and extension should address the following:

1. Multiple SGTRs. Additional consideration should be given to options which do not require steaming of SGs with broken tubes.

2. Influence of potential releases. The guidelines should be modified to take into account the severity of potential contamination and release to the environment. For example, if potential contamination does not appear to be severe, limited steaming of the ruptured SG may be the best route. Conversely, if potential contamination appears to be very high via steaming, other options with respect to operation of the NSSS and acceptance of contamination within the containment may be in order. These options should be available to the operator.

3. SI Maximization. The LOCA treatment contained guidance to maximize SI and charging flow into the RCS until the termination criteria for HPSI were satisfied. This guidance has been eliminated from the SGTR instructions (and some other EPG sections as well). It should be included under every situation where RCS inventory control is not established.

4. Use of SG level as cooling test. Further consideration should be given to whether an inadequate level in the good SG, with sufficient inventory in the broken SG, constitutes a satisfactory condition for the RCS.

5. Voiding. The EPG guidance with respect to void elimination correctly indicates that voids may be tolerated in the RCS under some conditions. It further indicates that the tests provided for determining the existence of voiding are good for a closed (no uncontrolled leakage) RCS, and that the tests can establish the presence of voids in the case of a SGTR by comparing expected closed RCS behavior trends to the case with the SGTR. The validity of this approach should be reconsidered, particularly for unknown SGTR leak rates and with respect to small changes in secondary side pressure during the test. Consideration should also be given to the need for the information and the delay in depressurization for purposes of testing for voids.

6. Cooldown with RCPs operating. Emphasis in the SGTR ORG is on NC cooldown. The case with RCPs operational should be reviewed and appropriate revisions, if any, should be made to the guidelines. Areas of interest include SG thermal stratification effects, potential for change in RCS boron concentration, and cooldown of an isolated SG.

7. SG cooling. The method for SG cooling with NC flow in the RCS during cooldown is to both feed the SG via normal feed paths and to drain via the SG blowdown line. This method is viable only if there is significant mixing of water throughout the SG secondary side. Justification should be provided that the method is workable under the conditions which exist during the SGTR event.

8. Time required for cooldown. Complete assessment of the viability of the SGTR guidance requires an understanding of the time required for cooldown. This includes consideration of elimination of voids in the upper head or other components of the RCS without the use of RCPs, cooling of SGs in the recommended feed and bleed manner with a one SG cooldown to cold shutdown conditions, and conduct of the cooldown with prevention of RCS voiding if this is an option available to the operator. Analyses of SGTR with these considerations should be provided.

9. RCP operation. Section 3.4.2 comments are applicable.

10. Steamline filling. Section 3.4.2 comments are applicable.

11. High point vents. Section 3.4.2 comments are applicable.

12. Containment. Section 3.4.2 comments are applicable.

3.6 Optimum Recovery Guideline for Steam Line Break

3.6.1 ORG Summary

The strategy for treatment of a SLB is summarized in Figure 3.6-1. Significant steps consist of the following:

1. Essentially steps 1-5 of the LOCA guidance.

2. Identify the affected SG by comparison of steam pressure, cold leg temperature differences and feedwater flow.

3. Attempt to isolate the affected SG.

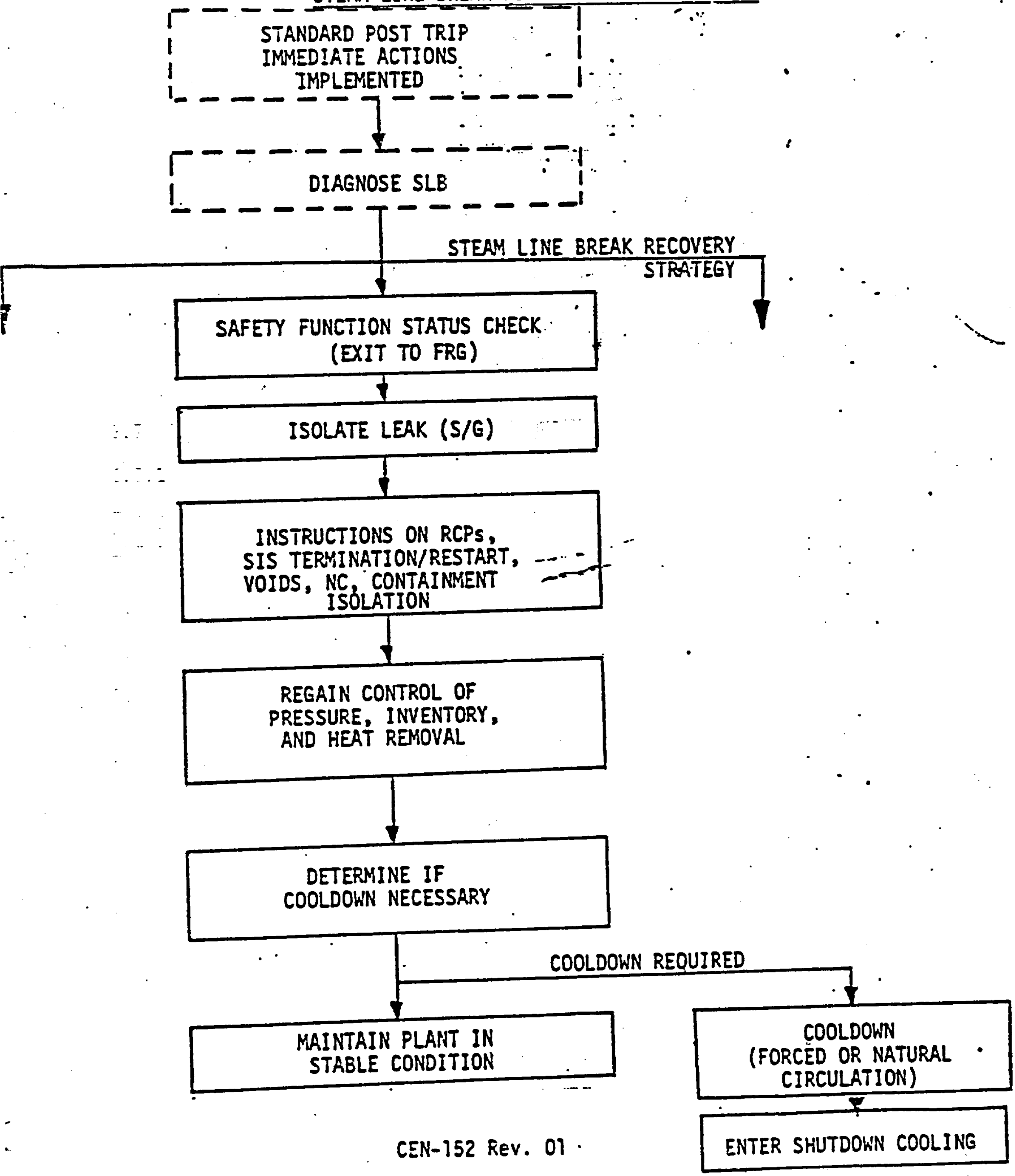
4. If both SGs have breaks, attempt to isolate the SG with the larger break, if it can be determined, and attempt to maintain an orderly cooldown using one SG.

5. Essentially the same as LOCA 8a-8d except for comments regarding cooling through the break, which have been deleted.

6. Monitor for RCS voiding.

FIGURE 3.6-1

STEAM LINE BREAK RECOVERY STRATEGY CHART



7. Perform void elimination operations if desired or necesary.

8. Verify containment isolation at [4 psig] or [other plant specific criteria].

9. If containment pressure falls below [7 psig] following operation of the CSS, containment spray may be terminated.

10. Operate turbine bypass valves or atmospheric steam dump valves to stabilize RCS temperature.

11. Verify or control pressure and level in the pressurizer.

12. Verify that SG level in the unaffected SG is being restored or maintained.

13. Evaluate need for plant cooldown, and if needed, continue.

14. Borate per Technical Specification limitations. Continue boration during cooldown to preserve shutdown margin.

15. If RCP restart criteria are met, restart at least one RCP and, if possible, one in each loop, to establish cooling of the isolated SG and conduct a plant cooldown.

16. Cool down to less than [300°F] at a rate within Technical Specification limits by using the turbine bypass system or the atmospheric dump valves.

17. During cooldown, maintain RCS conditions within acceptable limits by controlling RCS pressure via use of pressurizer heaters and spray, charging and letdown, or HPSI pumps and [PORVs].

18. Depressurize the RCS to below [300 psia].

19. Other followup steps pertaining to cooldown.

3.6.2 Staff Findings

Control of the affected SG, treatment of RCS conditions, and cooldown guidance are sufficient for the SLB ORG to be acceptable for preparation of plant-specific technical guidelines.

The following items should be addressed on a long-term basis:

1. Both SGs involved. A difficulty with this ORG is the use of SG level in the safety function status check. If one SG is involved, the requirement is for feed to the other SG, where feed rate must exceed a minimum value. If both are involved, then the operator is to assume the one with the smaller break is intact, and feed it in an attempt to regain level, again in excess of a minimum value. This feed to the SG may increase an already severe overcooling event. The same approach to attempt to regain SG level is supplied in the FRG. This potential overcooling problem should receive

further consideration, and guideline changes should be provided, as appropriate.

2. Diagnosis of other failures. Follow-up guidance should be provided with respect to failures which occur concurrent with or following an SLB, with particular attention paid to an isolated SG condition. Guidance should be developed to mitigate such multiple failures, with particular attention to assuring transfer to the FRG where appropriate, and assuring the necessary guidance is provided in the FRG. SGTR is of particular concern, where determination of the rupture may be delayed due to isolation and the FRG is silent regarding the unique aspects of SGTR combined with SLB.

3. RCP operation. Section 3.4.2 comments are applicable.

4. Steam line filling. Section 3.4.2 comments are applicable.

5. High point vents. Section 3.4.2 comments are applicable.

6. SG cooldown. Section 3.5.2 comments are applicable.

7. Containment. Section 3.4.2 comments are applicable.

3.7 Optimum Recovery Guideline for Loss of Feed

3.7.1 ORG Summary

The guidance for optimum treatment of a feed loss is summarized in Figure 3.7-1. The safety function status check list is similar to that for the other ORGs. The major steps in the ORG are:

1. Verify post trip actions initiated.

2. Verify all safety functions satisfied.

3. Determine whether the feedwater loss is due to a feedwater line break or a feedwater system abnormality.

4. If the loss of feedwater is due to a feedwater line break, attempt to isolate the break, and, if unsuccessful, implement the SLB ORG for further treatment. If the feedwater line break has been isolated or a feedwater system abnormality exists, continue with the LOF ORG.

5. Continually verify the safety functions.

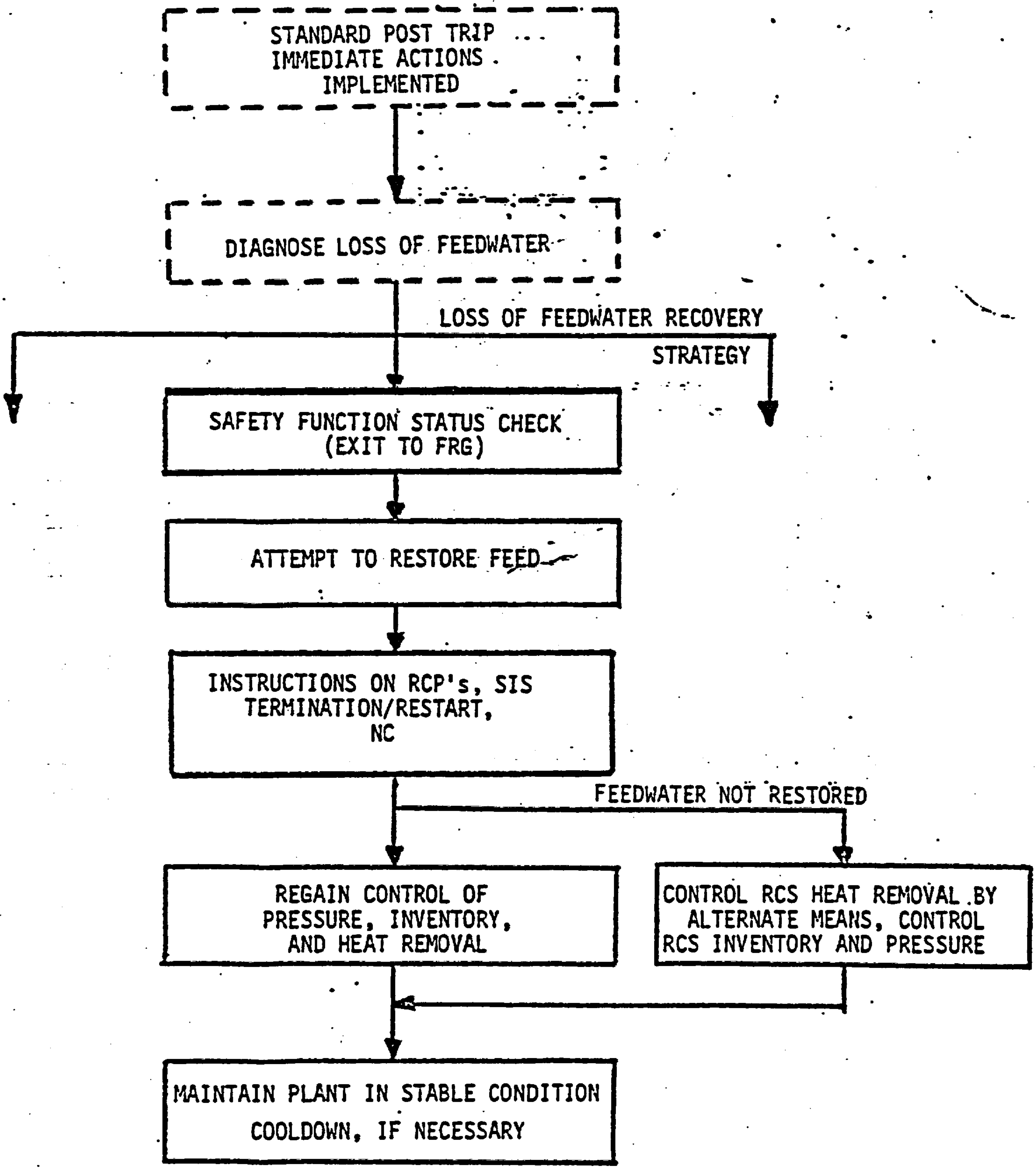
6. Implement the FRG if any safety function is not satisfied.

7. Attempt to restore a feedwater system.

8. [If the auxiliary feedwater system (AFW) is started, take steps (provided in the ORG) to prevent feedring damage].

9. Instructions which cover SIS, RCPs, NC (as described in SLB ORG except for RCP trip).

FIGURE 3.7-1
LOSS OF FEEDWATER



10. If feedwater has been restored:

    a. Verify turbine bypass or atmospheric dump valves controlling SG pressure

    b. Maintain or restore SG level in the hot zero power band.

    c. If AFW is being used, ensure adequate condensate inventory.

    d. Verify or control pressurizer pressure and level.

    e. Maintain the plant in a stabilized condition and evaluate the need for cooldown. If conditions require cooldown, proceed to Shutdown Cooling System (SCS) initiation conditions via normal operating instructions.

11. If all feedwater is lost, conduct the following:

    a. Stop all RCPs

    b. Isolate SG blowdown, secondary sampling and any non-vital steam discharge

    c. Continue actions to regain feedwater

    d. [Other plant specific SG heat removal actions if available.]

    e. [Establish once through cooling by] starting HPSI pumps and [opening the PORVs]

    f. [Other plant specific methods if available for RCS heat removal]

    g. If feedwater is regained, use turbine bypass or atmospheric dump valves to dump steam. Stop once-through-cooling.

    h. Attempt to maintain the RCS within acceptable post accident pressure and temperature limits using pressurizer heaters and main spray, auxiliary spray, or HPSI and [PORVs]

    i. Maintain plant in a stabilized condition and evaluate the need for a plant cooldown. If required, conduct a plant cooldown within Technical Specification Limits and enter shutdown cooling.

3.7.2 Staff Findings

Operator guidance for loss of feedwater considers restoration of feed and alternate feed and RCS cooling methods, in addition to those aspects of prior ORGs which are applicable. Because of this, the ORG for loss of feedwater is acceptable for preparation of plant-specific technical guidelines.

The following items should be addressed on a long term basis:

1. <u>Inventory control</u>. Measures to conserve inventory and the appropriate instructions should be considered.

2. <u>Feed and Bleed</u>. Operation in the feed and bleed mode, including the best RCS injection location and restrictions for use of feed and bleed, should be further addressed. Of particular concern are any restrictions regarding when the operator initiates feed and bleed cocling. (If it is initiated too late, it may be ineffective.)

3. <u>Charging pump operation</u>. Instructions to operate all charging pumps should be provided if there is an RCS inventory control problem or if in the feed and bleed mode of cooling, particularly at pressures where SI flow rate is limited due to the shut off head of the SI pumps. See also Sections 3.4.2 and 3.5.2.

4. <u>High point vents</u>. See Section 3.4.2.

5. <u>Containment</u>. See Section 3.4.2.

3.8 <u>Optimum Recovery Guideline for Loss of Forced Circulation</u>

3.8.1 ORG Summary

The guidance for dealing with a simple loss of RCPs without complications is summarized in Figure 3.8-1. The instructions are generally as follows:

1. Verify standard post trip actions

2. Verify all safety functions satisfied

3. If any safety functions are not satisfied, implement the FRG

4. Continually verify that safety functions are satisfied

5. If so, continue with this guideline. If not, implement the FRG.

Steps 6-10 are to be implemented anytime the specified conditions exist.

6. Restart one RCP in each loop if desired when restart criteria are met

7. If RCPs are restarted, go to RT ORG

8. If all RCPs have been stopped, monitor NC behavior

9. Monitor for RCS voiding

10. Conduct void elimination steps if desired (steps provided)

11. Verify or control pressurizer pressure and level

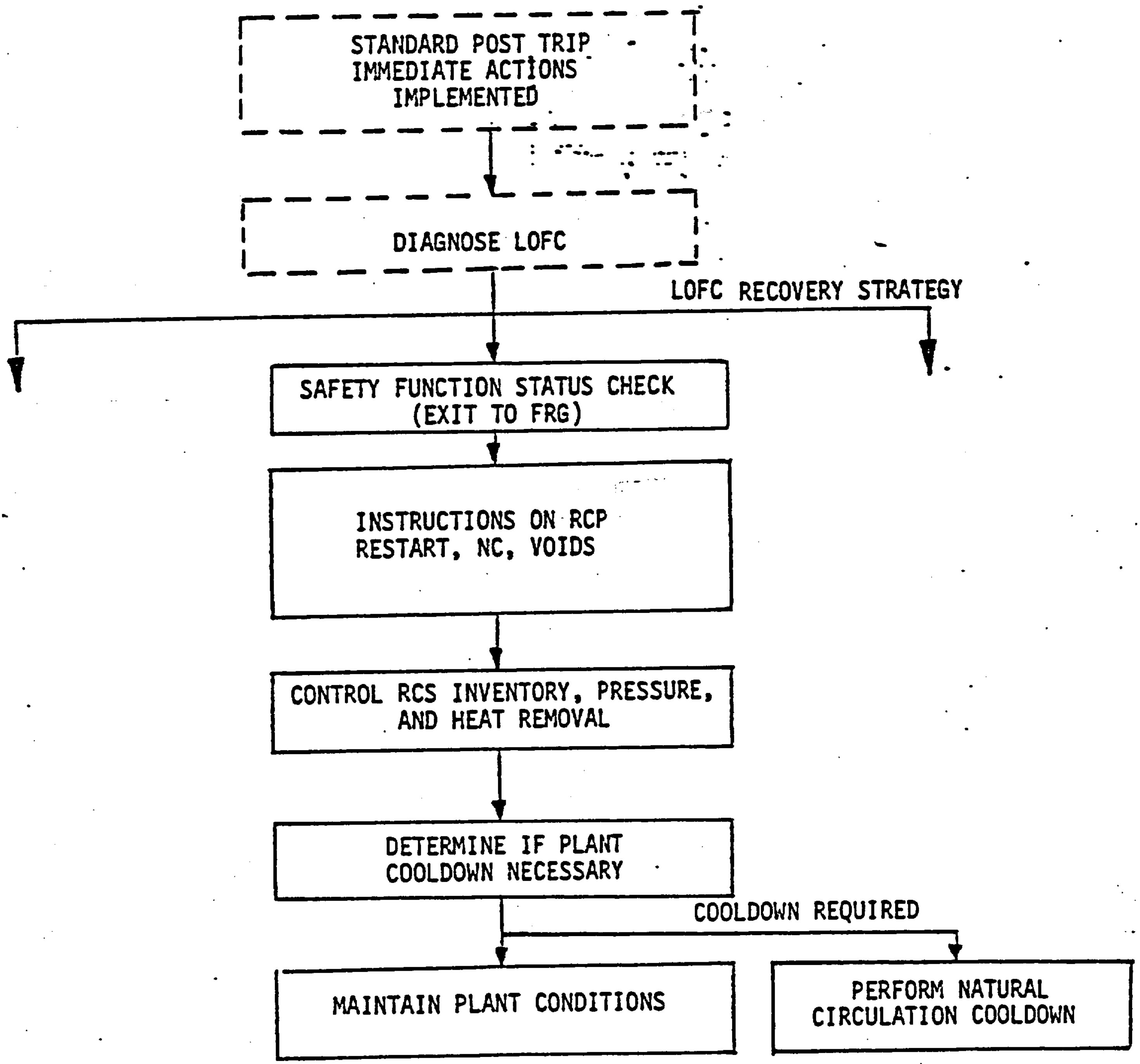
12. Maintain RCS cooling via SG(s)

13. Evaluate need for plant cooldown. If not required, maintain plant in a stabilized condition

14. Cooldown if required under NC conditions (instructions provided).

FIGURE 3.8-1

LOSS OF FORCED CIRCULATION STRATEGY CHART



3.8.2 Staff Findings

This ORG contains sufficient guidance for loss of forced circulation, such as void monitoring, natural circulation cooldown, maintenance of SG cooling, and inventory control, that the simple LOFC condition is acceptably treated. The continuous safety function review provides assurance that alternate operator guidance will be applied if needed. Hence, we find the ORG for loss of forced circulation acceptable for preparation of plant-specific guidelines. In the longer term, consideration should be given to providing instructions pertinent to the SI system since it may be actuated in the following circumstances:

1. Spurious
2. Due to low RCS level (manual)
3. Due to low RCS pressure
4. For void elimination
5. Location in the LOFC ORG by errors

3.9 FUNCTIONAL RECOVERY GUIDELINE

3.9.1 Entry and Initial Actions

3.9.1.1 Summary

The FRG is entered upon any of the following:

1. Reactor trip and unusual concurrent symptoms with no apparent diagnosis or cause.
2. Any condition or pattern of symptoms which the operator considers serious and for which abnormal or emergency guidance cannot be identified.
3. Actions taken in an ORG are not satisfying the criteria in the ORG safety function status check.

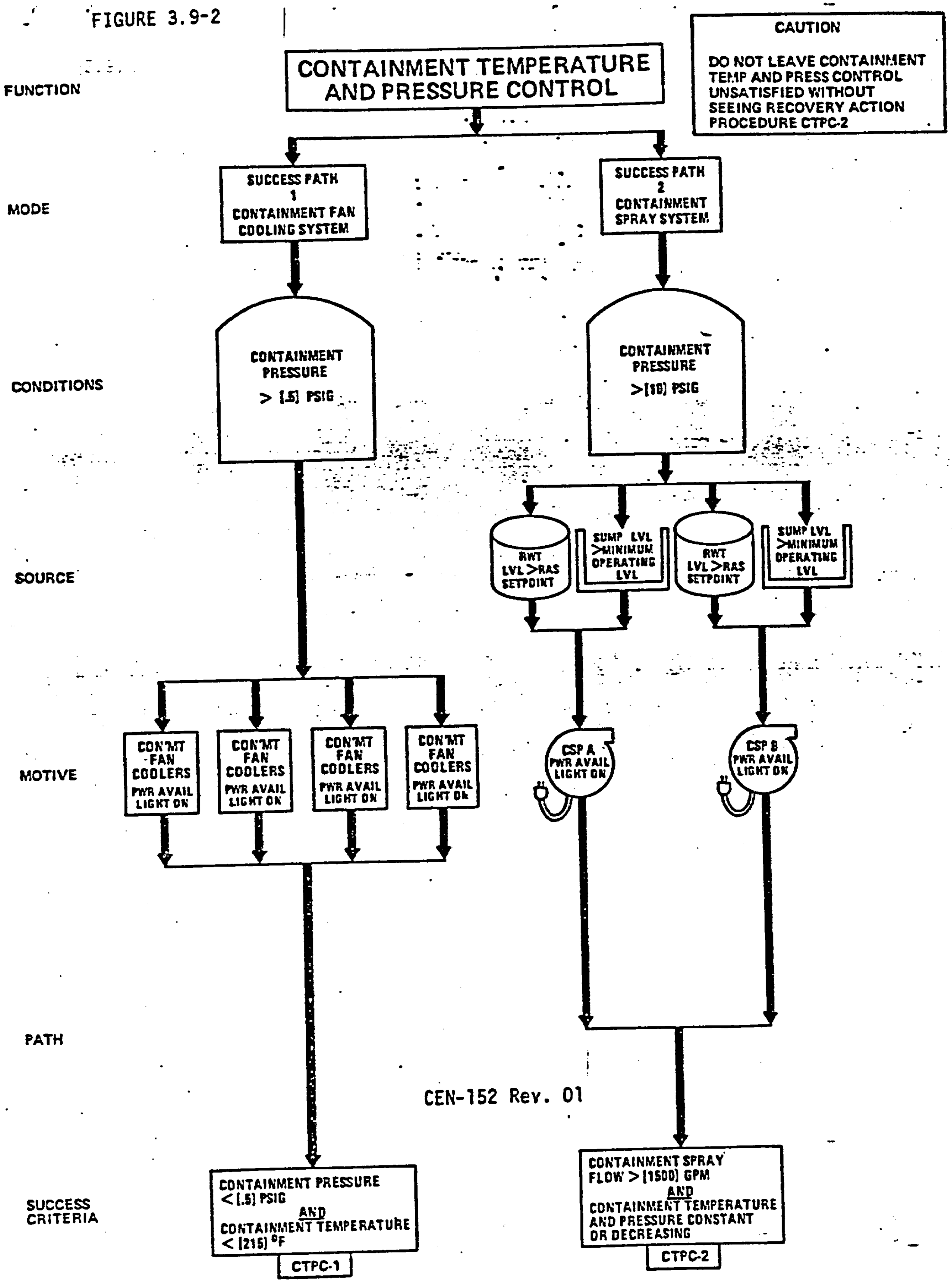
Upon entry, the following actions are taken:

1. Verify standard post trip actions complete.
2. Use Figure 3.9-1 to identify the success path currently in use for each safety function and then check the criteria for each path.
3. Continuously verify that all safety functions are being satisfied or identify those in jeopardy by use of Figure 3.9-1.
4. For each safety function that is not satisfied, identify plant resources or success paths which can be used for corrections. (Figure 3.9.2 is typical of the information provided to identify resources.)

FIGURE 3.9-1 SAFETY FUNCTION STATUS CHECK

SAFETY FUNCTION	SUCCESS PATH CURRENTLY IN USE	CRITERIA	IF CRITERIA NOT MET IMPLIED PLANT CONDITIONS	RESOURCE TREE
1. REACTIVITY CONTROL	A) CEA TRIP	A) NO MORE THAN 1 CEA BOTTOM LIGHT NOT LIT AND RX POWER DECREASING OR RX POWER < $10^{-[X]}$% AND CONSTANT OR DECREASING	RX NOT SHUTDOWN AND EXCESSIVE HEAT PRODUCTION	TREE A
	B) BORATION USING CHARGING PUMPS	B) RX POWER < $10^{-[X]}$% AND CONSTANT OR DECREASING OR BORON ADDITION RATE > [40] GPM AND CORE POWER DECREASING		
	C) BORATION USING ECCS PUMPS	C) RX POWER < $10^{-[X]}$% AND CONSTANT OR DECREASING OR BORON ADDITION RATE > [40] GPM AND CORE POWER DECREASING		
	D) CEA DRIVE DOWN	D) NO MORE THAN 1 CEA BOTTOM LIGHT NOT LIT AND RX POWER DECREASING OR RX POWER < $10^{-[X]}$% AND CONSTANT OR DECREASING		
2. RCS INVENTORY CONTROL A) LOW INVENTORY	A) CHARGING PUMPS	A) PRESSURIZER LEVEL > [26"] AND CONSTANT OR INCREASING AND SUBCOOLING > [20]°F (BY CET)	PLCS MALFUNCTIONING OR RCS BOUNDARY BREACH OR EXCESSIVE RCS COOLING	TREE B
	B) ECCS PUMPS	B) ECCS DELIVERY CONSISTENT WITH FIGURE 18-11		
B) HIGH INVENTORY	A) MANUAL CONTROL OF LETDOWN	A) [26"] < PRESSURIZER LEVEL < [246"] AND SUBCOOLING ≥ [20]°F (BY CET)	EXCESSIVE WATER ADDITIONS OR EXCESSIVE HEAT ADDITION	
3. RCS PRESSURE CONTROL A) LOW PRESSURE	A) PRESSURIZER HEATERS	A) [20]°F < RCS SUBCOOLING < [200]°F	PPCS MALFUNCTIONING OR RCS BOUNDARY BREACH OR EXCESSIVE RCS COOLING	TREE C
	B) CVCS CHARGING, NO ECCS	B) RCS SUBCOOLED ≥ [20]°F (BY CET) AND RCS PRESSURE WITHIN LIMITS P-T CURVE (FIGURE 18-10)		
	C) ECCS PUMPS	C) ECCS DELIVERY CONSISTENT WITH FIGURE 18-11		
B) HIGH PRESSURE	A) MANUAL CONTROL OF PRESSURIZER SPRAY B) RCPS RUNNING WITH STEAM DISCHARGE THROUGH ADV'S OR TBS C) NATURAL CIRC. STEAM DISCHARGE THROUGH ADV'S OR TBS D) PORVs WITH ECCS OPERATING	A) B) C) D) RCS PRESSURE < [2340] PSIA AND CONSTANT OR DECREASING WITHIN P-T CURVE LIMITS (FIGURE 18-10)	PPCS MALFUNCTIONING OR EXCESSIVE RCS INVENTORY OR EXCESSIVE RCS HEAT ADDITION	
4. RCS AND CORE HEAT REMOVAL	A) RCP's RUNNING, NO ECCS	A) AT LEAST ONE S/G LEVEL IS EITHER A) WITHIN THE ZERO POWER LEVEL BAND WITH FEEDWATER AVAILABLE TO MAINTAIN THE LEVEL OR B) BEING RESTORED BY A FEEDWATER FLOW > [160] GPM AND T_H-T_C < [10]°F AND T_{AVE} < [545]°F AND [20]°F < RCS SUBCOOLING < [200]°F	LOSS OF FORCED CIRCULATION OR INADEQUATE NATURAL CIRC OR COOLANT SATURATED OR VOIDS OR INADEQUATE S/G HEAT SINK	TREE D
	B) NATURAL CIRCULATION, NO ECCS	B) [20]°F < SUBCOOLING < [200]°F (BY CET) AND T_H-TC < [50]°F AND AT LEAST ONE S/G LEVEL IS EITHER A) WITHIN THE ZERO POWER LEVEL BAND WITH FEEDWATER AVAILABLE TO MAINTAIN THE LEVEL OR B) BEING RESTORED BY A FEEDWATER FLOW > [160] GPM		
	C) STEAM GENERATORS AND ECCS	C) ECCS DELIVERY CONSISTENT WITH FIGURE 18-11 AND CET < [900]°F OR DECREASING AND AT LEAST ONE S/G LEVEL IS EITHER A) WITHIN THE ZERO POWER LEVEL BAND WITH FEEDWATER AVAILABLE TO MAINTAIN THE LEVEL OR B) BEING RESTORED BY A FEEDWATER FLOW > [160] GPM		
	D) ECCS AND PORVs	D) ECCS DELIVERY CONSISTENT WITH FIGURE 18-11 AND CET < [900]°F OR DECREASING AND RCS PRESS < [1300] PSIG OR DECREASING		
	E) SHUTDOWN COOLING SYSTEM	E) SCS PARAMETERS NORMAL		
5. CONTAINMENT ISOLATION	A) MANUAL ISOLATION	A) NO STEAM PLANT ACTIVITY ALARMS AND NO CONTAINMENT RADIATION ALARMS AND CONTAINMENT PRESSURE < [4] PSIG OR AT LEAST ONE CONTAINMENT ISOLATION VALVE FOR EACH CONTAINMENT PENETRATION NOT REQUIRED IS CLOSED	LARGE STEAM BREAK IN CNTMNT OR LARGE RCS BREAK IN CNTMNT	TREE E
6. CONTAINMENT TEMPERATURE & PRESSURE	A) CONTAINMENT FAN COOLING SYSTEM NO CONTAINMENT SPRAY	A) CONTAINMENT PRESSURE < [.5] PSIG AND CONTAINMENT TEMPERATURE < [215]°F	LARGE STEAM BREAK IN CNTMNT OR LARGE RCS BREAK IN CNTMNT	TREE F
	B) CONTAINMENT SPRAY AND/OR CONTAINMENT FANS	B) CONTAINMENT SPRAY FLOW > [1900] GPM AND CONTAINMENT TEMPERATURE & PRESSURE CONSTANT OR DECREASING		
7. CONTAINMENT COMBUSTIBLE GAS CONTROL	A) [PLANT SPECIFIC INFO]	A) H_2 < [X]%	RCS BOUNDARY BREAK	TREE G

FIGURE 3.9-2



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5. If the first success path (on the left of each tree) is being used for all the safety functions on Figure 3.9-1 and the criteria for that path are satisfied, implement the Reactor Trip Recovery guideline.

6. Perform the recovery action guidelines associated with the identified success paths.

7. Once each safety function is being satisfied, refer to Long Term Actions.

3.9.1.2 Staff Findings

The significant safety functions are appraised immediately upon entry into the FRG and guidance for improvement of any difficulties is provided. Thus, we find the FRG entry and initial actions acceptable for preparation of plant-specific technical guidelines.

The following items should be addressed on a long term basis:

1. Multiple failures involving SGTR. The FRG should provide guidance for monitoring safety functions for the cases of SGTR, SGTR in both SGs, and when other simultaneous or sequential failures occur (such as SLB, LOOP, station blackout (loss of all AC), SG overfill, and core damage).

2. SI. The criterion for satisfactory SI performance requires that the flow rate be in accordance with expected behavior as a function of pressure. Additional guidance should be provided if the RCS inventory or inventory trends are insufficient for cooling the core.

3. Pressure trending. Substantiation should be provided for the statement in the Safety Function Status check, Figure 10d of the EPG, which is written "If greater than [1300] PSIA, then a decreasing trend indicates that pressure will be below [1300] PSIA soon" for the condition of once through cooling via the PORV. The substantiation should include the condition of loss of feed where the SG's are still being boiled dry with the stated conditions applicable.

4. Consistency. Figure 10d references to containment pressure of [4] PSIG are not consistent with other portions of the EPG, such as the LOCA ORG, where [0.5] is used.

The remainder of the FRG is divided into safety functions that must be satisfied for the plant to be in or progressing toward a satisfactory condition. Each safety function is potentially treated by several action paths. If the first path listed provides a satisfactory response, then that function is satisfied. If not, then the next listed path is to be followed, and so on until all of the safety functions are addressed which require treatment. In the following subsections of this SER, we will list each safety function, followed by a summary of the treatment. Then we will provide a brief discussion of the treatment adequacy for that safety function.

3.9.2 Reactivity Control

3.9.2.1 Summary

Reactivity control actions in the FRG are as follows:

1. Reactivity Control using CEA Insertion, RC-1

   a. Maintain RCS temperature constant (if possible) until reactivity control is satisfied.

   b. Attempt to manually insert the CEAs into the core.

   c. Reactivity control is satisfied if no more than one CEA bottom light is not lit and reactor power is decreasing or if reactor power $<10^{-[x]}$% and constant or decreasing.

2. Reactivity Control using CVCS, RC-2

   a. Maintain RCS temperature constant, if possible, until reactivity control is satisfied.

   b. Commence maximum boration using the CVCS.

   c. Success is achieved if one of the following criteria are met:

      (1) Boron addition rate to the RCS $\geq$[40] gpm and core power is decreasing

      (2) Reactor power $<10^{[-x]}$% and constant or decreasing.

3. Reactivity Control using ECCS, RC-3

   a. Maintain RCS temperature constant, if possible, until reactivity control is satisfied.

   b. If pressurizer pressure decreases to [1600 psia] [or if containment pressure increases to 4 psia] verify or manually initiate SIAS and/or depressurize the RCS to permit ECCS injection.

   c. Success is achieved if the boron addition rate to the RCS $\geq$[40] gpm and core power is decreasing, or if reactor power $<10^{[-x]}$% and constant or decreasing.

4. Reactivity control using CEA drive down, RC-4

   a. Maintain RCS temperature constant, if possible, until reactivity control is satisfied.

   b. [Re-energize the CEA drive mechanisms and manually jog and/or drive the CEA's into the core.]

c. Success is indicated if no more than one CEA light is not lit and reactor power is decreasing, or reactor power $<10^{-[x]}\%$ and constant or decreasing

5. Continuing Actions for Reactivity Control

If the criteria are not met, reactivity control is still in jeopardy. The operator should not leave reactivity control until this function is fulfilled. The operator may, if necessary, pursue other urgent safety functions but must continue to attempt to establish reactivity control using some or all of the following:

a. Attempt to energize or restore other vital auxiliaries to necessary components on the reactivity control success paths.

b. Attempt manual operation of inoperative valves.

c. Attempt to lower plant pressure to permit ECCS pump injection of boric acid. Consideration should be given to the effect on RCS subcooling and core cooling which such an action will cause.

3.9.2.2 Staff Findings

The reactivity control guidance includes maintenance of RCS temperature and alternate methods to control reactivity, including tests for satisfying the treatment. The priority and importance of this safety function is correctly described. Therefore, we find this treatment acceptable for plant-specific guideline preparation.

In the longer term program, additional consideration should be given to ATWS.

These considerations will be identified by the pending Commission rulemaking on ATWS, or by generic requirements resulting from the NRC review of the Salem event.

Item 5.c, above, contains the guidance that an attempt should be made to lower plant pressure. Instructions regarding the accomplishment of pressure reduction should be provided or referenced.

3.9.3 RCS Inventory Control

3.9.3.1 Summary

Inventory control actions may be summarized as follows:

1. RCS Inventory Control Using CVCS, IC-1

   a. Verify or take action so that the PLCS (Pressurizer Level Control System) is functioning to restore pressurizer level.

   b. Verify adequate suction sources if operating charging pumps.

   c. Monitor for RCS voiding.

   d. Success is indicated if [35"] < Pressurizer level < [245"*] and constant or increasing and RCS subcooling > [20]°F (by core exit thermocouples).

2. RCS Inventory Control Using ECCS, IC-2

   a. If pressurizer pressure decreases to [1600] psia [or if containment pressure increases to 4 psia], verify or initiate SIAS.

   b. Stop RCPs if pressurizer pressure decreases to [1300 psia] following SIAS.

   c. ECCS operating instuctions

   d. Monitor the refueling water tank level and perform recirculation actions if required.

   e. Monitor for RCS voiding and perform void elimination steps if desired.

   f. If HPSI pumps are delivering less than [30 gpm] per pump during recirculation, turn off one charging pump and one HPSI pump at a time until the HPSI pumps are delivering more than [30 gpm] per pump.

   g. Success is indicated if the ECCS delivery is consistent with expected flow rates (provided in FRG).

3. Continuing Actions for Inventory Control

   If the criteria are not met, the operator must continue attempting to control RCS inventory while pursuing other jeopardized functions. Further actions are evaluated using the following:

*This need not be met if the CVCS is being used for pressure control due to the need for the RCS to be solid to meet the subcooling requirement.

a. Rate of change of inventory and potential for damage to RCS

b. The urgency of other jeopardized safety functions

c. The feasibility of restoring function to a success path by:

   i) restoring the vital auxiliaries necessary to operate components or systems in the success paths

   ii) manual operation of valves

   iii) use of alternate components to implement a success path.

3.9.3.2 Staff Findings

This is an acceptable interim treatment of RCS inventory for plants which have not completed installation of reactor vessel inventory tracking (liquid level) instrumentation since it accounts for subcooling, voiding, and pressurizer level in such a manner as to provide an acceptable test for real RCS inventory, and alternate inventory replenishment methods are provided. However, the basic EPG should be revised to include use of the reactor vessel inventory tracking instrumentation now required for conformance to NUREG-0737, Item II.F.2. The longer term improvement program should address inadequate injection flow with RCS pressure above the shutoff head of the SI system. (Note that several of the RCS pressure control safety parameter criteria are satisfied for this condition.) The treatment for upper head voiding should also be addressed with respect to when void should be eliminated vs. when it can or should be tolerated; and the effect of starting an RCP on RCS behavior, particularly upper head stress, should be considered.

3.9.4 RCS Pressure Control

3.9.4.1 Summary

RCS pressure control actions are as follows if the RCS pressure is low:

1. RCS Pressure Control Using Pressurizer Heaters, PC-1

   a. Manually control heaters or auxiliary spray to restore pressurizer pressure within desired limits.

   b. Success is indicated by [20]°F $\leq$ RCS subcooling $\leq$ [200]°F.

2. RCS Pressure Control Using Charging System, PC-2

   a. Verify or take action so that pressurizer level is controlled.

   b. Verify adequate suction sources to the charging pumps.

   c. Success is indicated if RCS subcooling $\geq$ [20]°F (by core exit thermocouple, CET) and RCS pressure is within the limits of the post accident P/T curve.

3. RCS Pressure Control Using ECCS, PC-3

   a. Verify or initiate SIAS if pressurizer pressure decreases to [1600 psia], [or if containment pressure increases to 4 psig].

   b. Stop RCPs if pressurizer pressure decreases to [1300 psia] following SIAS.

   c. ECCS and related operations.

   d. Success by this path is indicated if ECCS delivery is as expected for the RCS pressure.

4. If the criteria are not met, then the operator may continue attempting RCS pressure control (while pursuing other jeopardized safety functions) based on:

   a) The urgency of other jeopardized safety functions.

   b) The feasibility of restoring function to a success path.

RCS pressure control actions for high pressure are:

1. RCS Pressure Control Using Pressurizer Spray System, PC-4

   a. Manually control heaters or spray to restore pressurizer pressure within limits.

   b. The action is successful if RCS pressure < [2340] psia and constant or decreasing and within P-T curve limits.

2. RCS Pressure Control Using RCPs and Steam Generators, PC-5

   a. Borate to maintain shutdown margin per Technical Specifications Limits

   b. Control RCS inventory to allow pressurizer level to drop while cooling down in order to effect depressurization. Observe the limits of IC-1.

   c. If RCP operation has been terminated, restart one RCP in each loop if restart criteria are satisfied. Resume an orderly reactor plant depressurization by using the turbine bypass system or atmospheric dump valves.

   d. Instructions to prevent SG feedring damage and to control SG level.

   e. If all feedwater is lost:

      (1) Stop all RCPs

      (2) Stop depressurization

(3) Isolate blowdown, secondary sampling and any nonvital steam discharge

(4) Take actions to regain feedwater system operation

(5) [If other sources of water are available for steam generator heat removal, insert that information].

f. If, in addition to loss of feedwater, pressurizer sprays are not available, go to PC-7, RCS Pressure Control using [PORVs].

g. If the auxiliary feedwater system is being used, ensure an adequate supply of condensate.

h. Success is indicated if RCS pressure < [2340] psia and constant or decreasing and within limits.

3. RCS Pressure Control Using RCS Natural Circulation and Steam Generator, PC-6

a. Borate as necessary to maintain shutdown margin per Technical Specification limits.

b. Control RCS inventory to allow pressurizer level to drop while cooling down in order to effect depressurization. Observe limits of IC-1.

c. If all RCPs have tripped and inventory and pressure are controlled, verify natural circulation flow.

d. Resume/commence an orderly reactor plant depressurization by using the turbine bypass system or, if the condenser or turbine bypass system are not available, by using at least one steam generator atmospheric dump.

e. Periodically verify natural circulation flow.

f. Instructions pertinent to feedring damage prevention and SG level control.

g. If all feedwater is lost:

(1) Stop the depressurization

(2) Isolate SG blowdown, secondary sampling and any nonvital steam discharge

(3) Attempt to regain feedwater system operation

(4) [If other sources of water are available for steam generator heat removal, insert that information.]

(5) If feedwater cannot be regained in at least one operable steam generator, go to PC-7, [RCS pressure control using PORVs].

h. If one SG was isolated, continue circulation by performing the following activities (listed in order of preference):

(1) If possible, restart at least one RCP to establish cooling of the isolated SG.

(2) Feed and bleed the isolated SG with feedwater to cool the SG.

(3) If primary to secondary leakage is suspected and (1) and (2) are unsuccessful, unisolate and steam the affected SG to the condenser to prevent overfilling due to primary to secondary leakage.

i. If the auxiliary feedwater system is being used, ensure an adequate supply of condensate.

j. This path is successful if RCS pressure < [2340] psia and constant or decreasing and within specified limits.

4. [RCS Pressure control using PORVs, PC-7]

a. Start or verify operation of ECCS and charging pumps prior to opening [PORVs].

b. Verify [PORVs] open at [2400] psia. If [PORVs] have not opened, manually open them and reduce pressure to < [2340] psia or to less than the limits of the P/T curve.

c. Success is indicated if pressurizer pressure < [2340] psia and constant or decreasing and within specified limits.

5. Continuing Actions for RCS Pressure Control

If RCS pressure control is still in jeopardy, the operator must continue attempting RCS pressure control while working on other jeopardized safety functions. Measures should be based on the following considerations:

a. Rate of change of pressure and potential for damage to RCS.

b. The urgency of other jeopardized safety functions.

c. The feasibility of restoring function to a success path.

3.9.4.2 Staff Findings

We find this section of the FRG acceptable. A number of pressure conditions and alternate guidance paths to apply potentially available equipment for pressure control are provided, and the success criteria are acceptable.

Several items should be addressed in the long term:

1. <u>High point vent valves</u>. Use of these valves should be evaluated as a means of pressure control. The capacity of the valves is less than that of the PORV, and solid plant operation may be facilitated by a lower capacity valve.

2. <u>Use of spray for pressure control</u>. The guidelines are based on the assumption that the pressurizer has a bubble. Guidance should be provided if there is no bubble. Closely related to this item is the effect of the spray lines if PORV once through cooling is in progress. There should be a caution to assure the lines are closed if, by leaving them open, liquid can bypass the RCS that would otherwise be available to cool the core.

3.9.5 RCS and Core Heat Removal Control

3.9.5.1 Summary

This section of the FRG consists of the following instructions:

1. RCS and Core Heat Removal Using RCPs and Steam Generators, HR-1

   a. If RCP operation is possible, continue in the success path.

   b. Start one RCP in each loop (or reduce the number to one in each loop).

   c. Maintain RCS temperature and pressure by using the turbine bypass systems or by using at least one SG atmospheric dump valve and the feedwater systems.

   d. Instructions to prevent feedring damage and control SG level.

   e. If all feedwater is lost:

      (1) Stop RCPs

      (2) Stop cooldown

      (3) Secure SG blowdown, secondary sampling and any nonvital steam discharge.

      (4) Take actions to regain feedwater system operation.

      (5) [If other sources of water are available for SG heat removal, insert that information]

      (6) If feedwater cannot be regained, go to [HR-4, RCS and Core Heat Removal using ECCS and PORVs].

f. Satisfactory RCS and core heat removal is obtained if all the following are met:

(1) At least one S/G level is within the zero power level band with feedwater available to maintain the level or level is being restored.

(2) $T_h - T_c$ < [10]°F and constant or decreasing

(3) T_{ave} < [545]°F and constant or decreasing

(4) [20]°F ≤ RCS subcooling ≤ [200]°F (by CETs)

2. RCS and Core Heat Removal using NC and SG, HR-2

a. If all RCPs have tripped, and if inventory and pressure are being controlled, verify that NC flow has been established in at least one loop.

b. Resume/commence RCS heat removal and depressurization to meet the success criteria of this recovery action.

c. Start one RCP in each loop if restart criteria are satisfied.

d. If one SG was isolated, continue circulation by:

(1) If possible, restart at least one RCP or preferably one RCP in each loop to establish cooling of the isolated SG.

(2) Feed and bleed the isolated SG with feedwater to cool the SG.

(3) If a SG tube rupture is suspected, unisolate and steam the affected steam generator to the condenser if necessary to prevent overfilling due to primary to secondary leakage.

e. Prevent SG feedring damage and control SG level.

f. If all feedwater is lost:

(1) Stop any cooldown

(2) Isolate SG blowdown, secondary sampling and any nonvital steam discharge.

(3) Take actions to regain feedwater system operation.

(4) [If other sources of water are available for steam generator heat removal, insert that information.]

(5) If feedwater cannot be regained, go to [HR-4, RCS and core heat removal using ECCS and PORVs].

g. The path is a success if all the following are met:

(1) $T_h - T_c$ < [50]°F and constant or decreasing

(2) T_{ave} < [545]°F and constant or decreasing

(3) (20°F) ≤RCS Subcooling < [200°F] by (CET)

(4) At least one S/G level is within the zero power level band with feedwater available to maintain the level or level is being restored.

3. [RCS and Core Heat Removal using ECCS and SGs, HR-3]

a. Stop RCPs if pressurizer pressure decreases to [1300 psia] following an SIAS.

b. Verify SIAS and SI flow if pressurizer pressure decreases to [1600] psia [or if containment pressure increases to 4 psig].

c. Steam the SGs to remove RCS heat using the turbine bypass system or atmospheric dump.

d. If all feedwater is lost:

(1) Stop cooldown

(2) Isolate SG blowdown, secondary sampling and any nonvital steam discharge.

(3) Take actions to regain feedwater system operation.

(4) [If other sources of water are available for steam generator heat removal, insert that information.]

(5) If feedwater cannot be regained in at least one operable SG, go to HR-4, RCS and core heat removal using ECCS and and [PORVs].

e. Verify NC if all RCPs have tripped, inventory and pressure are being controlled, and SGs are being used for heat removal.

f. This path is successful if ECCS delivery is as expected and CET < [800]°F or decreasing and at least one SG level is either within the zero power level band with feedwater available to maintain the level or is being restored.

4. [RCS and Core Heat Removal using ECCS and PORVs, HR-4]

a. Stop RCPs if pressurizer pressure decreases to [1300 psia] following an SIAS.

b. Establish once through cooling (either through the [PORVs] or, if present, through the break in the RCS boundary) by all of the following:

(1) Stopping all RCPs.

(2) Starting both HPSI pumps and all charging pumps available.

(3) Opening the [PORVs].

c. Once through cooling may be stopped if core exit thermocouples < [800°F] and all the following conditions are satisfied:*

a) RCS is at least [20°F] subcooled,

b) Pressurizer level is greater than [100"] and constant or increasing,

c) At least one steam generator is available (feed and steam flow) for removing heat from the RCS.

d. If all the criteria of c above cannot be maintained after the ECCS has been stopped, the ECCS must be restarted.

e. Success is indicated by meeting <u>all</u> of:

(1) ECCS delivery as expected.

(2) Core exit thermocouples < [800°F] or decreasing

(3) RCS pressure < [1300] psia or decreasing

f. If the success criteria are not met, heat removal from the RCS and core is still in potential jeopardy. The guidelines provide instructions to reevaluate the availability of success paths HR-1, 2, and 3. HR-5 may be used if RCS conditions are appropriate.

5. RCS and Core Heat Removal using the SCS system, HR-5

a. If the RCS T_H is cooled to [300°F] and depressurized to [300 psia] and the following criteria are met, initiate shutdown cooling:

(1) Pressurizer level is greater than [100]" and constant or increasing

(2) The RCS is at least [20°F] subcooled

(3) RCS activity level within [appropriate limits]

(4) [Other plant specific information]

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*Reference 8 gives [1800°F], a typographical error.

b. [Isolate, vent, or drain the safety injection tanks (SIT) at 250 psia RCS pressure.]

c. [Initiate the low temperature overpressurization (LTOP) system at 275°F.]

d. This path is successful if SCS parameters are in the normal range.

6. Continuing Actions for RCS and Core Heat Removal

a. If RCS and the core heat removal are still in jeopardy, the operator must pursue heat removal and other jeopardized safety functions simultaneously. If the HPSI and/or LPSI pumps are delivering flow to the RCS according to specification, the FRG provides instructions to evaluate the need and feasibility of transferring additional heat through the SGs by:

(1) restoring vital auxiliaries necessary to feed one or both SGs

(2) using alternate means [e.g. fire water pumps, non-grade A condensate, etc.] to feed SGs.

(3) alternate means of operating steam dumps or turbine bypass valves or other steam outlets.

b. If the HPSI and/or LPSI pumps are not delivering adequate flow to the RCS, the FRG provides instructions to evaluate ways of implementing one of the RCS heat removal success paths by:

(1) restoring necessary vital auxiliaries (control air, electrical, diesel generator, etc.) to regain needed components or subsystems

(2) manual operation of failed remotely operable valves

(3) alternate sources of water for SG or RCS makeup

(4) alternate means of steam discharge from the SGs.

3.9.5.2 Staff findings

We find this section of the FRG to be acceptable for development and implementation of plant-specific technical guidelines. Guidance for a number of combinations of equipment application to restore and/or control heat removal is supplied, depending upon the status of the NSSS and supporting equipment. This includes items not normally included in emergency operating procedures prior to the TMI accident, such as fire pumps, low quality condensate, and alternate success paths other than the normal heat removal means. The inclusion of these additional resources in the ESPs provides additional assurance that the core will be adequately cooled. However, long term improvements should be provided to address adequate SI flow rate, as stated in Section 3.9.3.. Guidelines on SG depressurization should be developed for the situation where the operator is relying on low pressure sources of feedwater. The tradeoff to conserve SG and RCS inventory versus depressurization to allow use of low pressure water sources, the adequacy of actions, and technical complications, due to SG pressure hang-up due to thermal stratification, should be considered.

3.9.6 Containment Control

3.9.6.1 Summary

Several FRGs are presented which pertain to the containment. These are summarized below:

1. Containment Isolation, CI-1

   a. If containment pressure increases to [4 psig], [or if pressurizer pressure decreases to 1600 psig], or if containment radiation levels exceed plant specific limits, verify initiation of or manually initiate containment isolation.

   b. If containment isolation valves are not closed, attempt to close them.

   c. If activity is detected in steam from the SG secondary side, the operator should identify the leaking SG(s) and attempt to isolate that SG if plant conditions permit.

   d. The path is successful if all of the following criteria are met:

      (1) No steam plant radiation alarms,

      (2) No containment radiation alarms,

      (3) Containment pressure < [4] psig or, if the above three are not met, then

      (4) At least one containment isolation valve for each containment penetration not in use is closed.

   e. If the criteria are not met, then containment isolation is still in jeopardy. Continue attempting to satisfy containment isolation based on the following considerations:

      (1) The urgency of other safety functions in jeopardy.

      (2) The risk to plant personnel and the public of leaving certain penetrations unisolated.

      (3) The feasibility of isolating the penetration by alternate methods.

2. Containment Temperature and Pressure Control Using the Containment Fan Cooling System, CTPC-1

   a. [Verify automatic operation of the containment fan cooling system. If at least two containment fans are not running in slow they should be started manually.]

b. Ensure that cooling water is lined up to the containment fan cooling system.

c. Success is indicated if both of the following criteria are met:

(1) Containment pressure < [0.5] psig and constant or decreasing,

(2) Containment temperature < [215]°F and constant or decreasing

3. Containment Temperature and Pressure Control Using the Containment Spray System, CTPC-2

a. If containment pressure increases to [10 psig], verify initiation of or manually initiate containment spray.

b. If the CSAS has been actuated and containment pressure subsequently falls below [7 psig], containment spray may be terminated. Upon termination, it must be realigned for automatic actuation.

c. The path is successful if containment spray flow > [1500] gpm (per header) and containment temperature and pressure are constant or decreasing.

d. If containment temperature and pressure are not satisfied, the FRG instructs the operator to go on to other jeopardized safety functions and continue pursuing this function based on these considerations:

(1) Rate of change of containment temperature and pressure and potential for damage to the containment.

(2) The urgency of other jeopardized safety functions.

(3) The feasibility of restoring function to a success path by restoring vital auxiliaries necessary to operate components or systems in the success paths, manual operation of valves, and use of alternate components to implement a success path.

3.9.6.2 Staff Findings

Containment isolation and control of containment temperature and pressure are considered, and operator guidance for the performance of these functions is provided. Therefore, we find the containment guidance provided in the FRG to be acceptable for preparation and implementation of plant-specific technical guidelines. As discussed in Section 3.4.2, a significant extention of the coverage should be accomplished as a portion of the long range program for improvement of Emergency Procedure Guidelines and Emergency Operating Procedures.

3.9.7 Long-Term Actions

3.9.7.1 FRG Long Term Actions

The long-term action guideline provided in the EPG is:

"In this section the operator continues to periodically verify the adequate maintenance of safety functions, assesses the status of the plant and implements the optimal emergency procedure guidelines, if possible.

1. Using the Safety Function Status Check (Figure 10-3) for the success paths currently in use for each safety function, compare plant indications against the criteria. If any success paths do not meet the criteria, go to the appropriate plant resource assessment tree to fulfill the jeopardized safety functions.

2. Repeat step 1 continually anytime the Functional Recovery Guideline is in use.

3. The operator must establish what the present plant state is. This means identifying:

   a. Present RCS conditions (inventory, temperature, pressure, radioactivity levels, etc.)

   b. Modes (success paths) in use for fulfilling each safety function

   c. Adequacy of core cooling

   d. Plant area radiation levels

   e. Current rates of radioactivity release to the environment

4. If an event (e.g., LOCA, LOFC, LOF, etc.) or cause of the transient can be identified, useful guidance for further casualty management may be found in an optimal recovery EPG.

5. Do not remove a success path from use unless another equivalent path has been verified ready for use.

6. Decide if a cooldown to cold shutdown is necessary and if so, if it is feasible and/or urgent. Consider at least the following:

   a. Condensate inventory available; ability to replenish inventory

   b. Rates of release of radioactivity to environment

   c. Failed equipment or conditions which may prevent or inhibit a cool-down (e.g. loss of all pressurizer sprays, inability to dump steam, RCS voiding)

   d. Availability of electrical power to key equipment (e.g. diesel generators, offsite power, battery endurance)

   e. Other vital auxiliaries such as control air, cooling water, etc.

f. Availability and desirability (e.g. considering ability to depressurize RCS, RCS inventory adequate for LPSI pump suction, desirability of circulating highly radioactive coolant outside containment, etc) of shutdown cooling system

g. Personnel available including technical support center and offsite engineering."

3.9.7.2 Staff Findings

We find the long-term actions to be acceptable for development and implementation of plant-specific technical guidelines. However, significantly more guidance should be provided. The objective of the long-term actions should be that the plant be taken to a condition where other procedures apply, with a suitable interface with those other procedures; or that the plant be brought to a controlled, stable, cold shutdown condition; or that the plant be brought to a controlled, stable condition that is expected to last sufficiently long for support personnel to provide considered guidance for future actions. This additional guidance should be provided as part of the longer term guidelines improvement program. The stated condition for application of long term actions is for a stable plant to exist. This is not always provided by the EPGs. Either operator guidelines should be provided that result in a stable plant, or the long term actions should be consistent with the unstable but controlled conditions that may result from the prior guidance.

4 STAFF FINDINGS

The EPGs represent a significant improvement over the guidance provided in current emergency operating procedures. Implementation of the EPGs at operating reactors will provide a greater assurance of operational safety. Implementation should not stop the continuing efforts to improve the EPGs. Changes and supplements to the EPGs may be necessary as new information is gained from continuing industry and NRC programs and plant operations. The maintenance of "current" EPGs should be a continuing process.

4.1 Overview

The EPGs are an excellent step toward improved coverage of emergency conditions. The EPGs are acceptable as the basis for preparation of plant-specific guidelines and for implementation of EOPs. Updating the EPGs will be necessary as part of a longer term program which includes addition of those items not previously incorporated as well as a maintenance process.

The initial implementation will form the basis for improved operator instructions under emergency conditions. Amplifying information may still be provided by existing procedures. Updates will improve and extend coverage. The maintenance process will involve incorporation of new knowledge, correction, and general improvement.

Should events occur, and should the plant condition thereby warrant, either directly or due to additional failures, then the EPG approach provides an acceptable response to mitigate the event. The EPG approach is based on the present condition of the plant, and it is not necessary for the operator to know how the plant got to that state. The available equipment is used as necessary for the control of the NSSS, the containment, and associated equipment. If one or more pieces of equipment are not available, actions using alternate equipment are identified. For example, natural phenomena are implicitly covered since the effect upon the plant is adequately treated by the EPGs.

The approach of dividing the EPGs into a treatment of recognized "simple" conditions using Optimum Recovery Guidelines (ORGs) and coverage of everything else using Functional Recovery Guidelines (FRGs) meets the requirements for a symptom oriented emergency response. One key to this acceptance is the provision for continuous checking by the operator to assure that functions are being restored, and a transfer to a different guideline if the anticipated plant response is not obtained. Another key is a simple and straightforward diagnosis.

The approach minimizes transfer between EPG sections during event response. It also provides similar operator actions and tests for meeting safety needs throughout the EPG. This greatly simplifies dealing with emergency responses.

The safety functions used in the EPG are acceptable for identification and treatment of emergency conditions in CE plants.

The initial checking of safety functions against criteria defined in the EPG and the initial operator response to correct deficiencies are adequate. The guidance provides for a prompt response to emergency events and simultaneously provides the operator with information pertinent to plant conditions and event diagnosis. The diagnostic aides provided in the EPG are not intended to cover multiple failure events. This, as well as dealing with operator error, is accommodated by the safety function status check system. If plant response to operator actions is not acceptable, the use of that guidance is discontinued, and the operator transfers to different guidance.

4.2 Short Term Needs

As discussed in Section 3.1.2, additional instrumentation to track coolant inventory level is required for pressurized water reactors as specified in Item II.F.2 of NUREG-0737. This instrumentation, which is presently installed or soon to be installed for most plants, may not be turned on until operators can be trained in its use in accordance with approved EPGs. Therefore, the EPG should be revised to include use of inventory tracking (liquid level) instrumentation with interaction via the safety function status checks and actual inventory needs of the RCS.

4.3 Longer Term Needs

Other items where complete EPG coverage has not yet been obtained may be categorized in several areas.

The major areas which should be addressed further in a longer term EPG improvement program and the sections of the SER where additional information is located are as follows:

1. Multiple failures

   Comprehensive coverage of events with multiple failures should be extended. A typical example is a SGTR with complications, where the operator would be instructed to transfer to the FRG, but consideration of the specialized need for a SGTR condition is limited in the FRG. Further consideration of tube failures in both SGs is also needed. The extension of coverage should include guidance for alternate approaches to cooling the plant when conditions exist that could cause significant release of radioactive material outside of the containment boundary. Information should also be considered pertinent to timing of plant cooldown using the guidance provided for treatment of an SGTR condition. Such items as treatment of RCS voids and loss of the condenser should be included. Treatment of SLB should be expanded to include a condition where the SG(s) cannot be isolated and where both SGs are involved. Consideration should be provided to conditions which result in too much water in the SG secondary. Sections 3.4.2 (item 4), 3.5.2 (items 1, 2, 5, 8, 10), 3.6.2 (1, 2, 4), 3.8.2, 3.9.1.2(1), 3.9.2.2, and 3.9.5.2 apply.

2. Containment

   Guidelines and technical background for control of the containment environment should be included in the EPG. Such items as use of a hydrogen recombiner, operation of containment environment control equipment such as coolers, containment isolation operations, containment venting, and the criteria for control of all major parameters should be considered. Sections 3.4.2(3), 3.5.2(2, 12), 3.6.2(7), 3.7.2(5), 3.9.1.2(4), and 3.9.6.2 apply.

3. <u>Supporting technical analyses</u>

Further substantiation that the guidelines provide the expected plant control should be provided. This information should be provided with a close correspondence between the Guidelines and calculated parameters that the operator would observe. Examples include SGTR when operations follow the ORG and FRG, with coverage extending to cold shutdown; initiation of auxiliary spray in a loss of feed condition to extend the time to core uncovery; and timing of HPI operations with respect to plant response as a function of availability of HPI and, where applicable, the PORV. The organization and approach should provide an enhanced operator understanding of plant behavior under emergency conditions. Sections covering topics that should be considered in planning analyses are 3.4.2(4, 5), 3.5.2(1-8, 10, 11), 3.6.2(1, 2), 3.7.2(2-4), 3.9.1.2(1-3), 3.9.2.2, 3.9.3.2, 3.9.4.2(1), 3.9.5.2, and 3.9.7.2.

4. <u>Plant cooldown and interfacing with other plant procedures</u>

Guidance should be provided to bring the NSSS to one of the following conditions (in order of preference):

(1) a state in which non-emergency procedures apply,

(2) cold shutdown, or

(3) any controlled stable condition which minimizes release of radioactive material and which the operators can be anticipated to maintain for a sufficient time that support personnel can logically and carefully plan future operations.

If, in any of the above conditions, the three basic barriers are again jeopardized, then the EOPs should provide the operator with action steps to cope with the condition. Sufficient interfacing should exist between procedures that a logical transition is provided. The need to transfer back into the EOPS if the need arises should also be provided in interface guidance. Topics of interest to cooldown are discussed in Sections 3.1.2, 3.5.2(8), 3.6.2(6), 3.9.2.2, 3.9.4.2(1, 2), 3.9.5.2, and 3.9.7.2.

5. <u>Coverage of conditions which occur at other than power operation</u>

The EPG should be extended to cover conditions other than reactor trip and power operation. The EPG already contains material which is applicable to other conditions.* Coverage should be provided for any NSSS condition which jeopardizes, or potentially jeopardizes, an identified barrier to release of radioactive material. Sections 3.1.2 and 3.9.2.2 apply.

An acceptable alternate to incorporation of items in the EPG is to provide a definition of the appropriate coverage in plant procedures other than EOPs (abnormal operating procedures, for example), to provide interfacing information in the EPG, and to discuss the rationale for locating this material in these other procedures.

6. <u>Loss of power</u> (LOOP and loss of all AC)

   Errors in instrument displays, handling of unnecessary loads, conservation of inventory, actions to be taken upon power recovery, and plant cooldown-depressurization should be addressed. Sections 3.4.2(2) and 3.9.1.2(1) apply. Some aspects of this topic are the subject of the unresolved safety issue, A44 - Station Blackout. Full resolution of this issue may require additional EPG changes.

7. <u>ATWS</u>

   Section 3.9.2 describes the ATWS guidance for CE plants. As indicated, the areas addressed are acceptable; however, additional coverage and guidance for treatment of the expected phenomena should be provided.

8. <u>Post ICC with core damage</u>

   This long-term item should be provided consistent with the availability of knowledge regarding handling of plants with degraded or damaged cores. The work which can be accomplished now should include providing additional guidance to control the plant if the core has been damaged and an SGTR has occurred. Applicable topics are discussed in Sections 3.9.1.2(1) and 3.9.7.2.

9. <u>RCP operation</u>

   The EPG should provide instructions to use RCPs under conditions other than subcooled single phase fluid in the RCS to broaden the options available to the operator under emergency conditions. Further information is contained in Sections 3.4.2(1), 3.5.2(6, 9), and 3.6.2(3).

10. <u>SI</u>

   Use of the SIS should be more fully addressed, particularly with respect to providing an adequate inventory in the RCS. Additional emphasis on the charging system use with respect to RCS pressure should be provided. Consideration should also be given to searching for operating methods for enhancing SI flow by RCS depressurization, when needed, when the pressure is too high for the HPI pumps to deliver a significant flow rate into the

*Wording in the FRG indicates usage whenever the operator determines that a condition exists where guidance cannot be identified as part of abnormal or emergency procedures.

RCS. Interaction of guidance in each of the sections within the EPG with respect to SI should be assured as part of this additional effort. These topics are covered further in Sections 3.4.2(2), 3.5.2(3), 3.7.2(3), 3.8.2, 3.9.1.2(2), 3.9.3.2, and 3.9.5.2.

11. PORV and vent operation

    Additional guidance should be provided with respect to emergency cooling which does not rely on the SGs, particularly for those plants that do not have PORVs. Use of high point vents to assist in once through cooling and for pressure control are additional areas for consideration. See Sections 3.4.2(5), 3.5.2(11), 3.6.2(5), 3.7.2(1, 4), and 3.9.4.2(1, 2) for additional information.

12. Pressure-temperature limits

    Guidance should be provided for the case where pressure-temperature limits, typified by Figure 3.3-3, have been exceeded (applicable to all ORGs and the FRG).

Acceptable response to the above items, which also includes the details provided in Section 3 of this SER, should meet the need for Emergency Operating Procedures Guidelines as evaluated in this SER.

4.3 Human Factors Discussion

The staff has conducted a general human factors review of the Combustion Engineering guidelines to obtain assurance that:

(1) the guidelines can be translated into emergency operating procedures,

(2) the guidelines are sufficiently function-oriented to provide for accident mitigation without first having diagnosed the event, or with an incorrect diagnosis, and,

(3) procedures developed from the guidelines can be implemented in the control room environment.

At a meeting on October 30, 1979, representatives of Combustion Engineering (CE) and the CE Owners' Group (CEOG) met with the NRC to discuss their response to NUREG-0578, Item 2.1.9, Analysis of Design and Off-Normal Transients and Accidents. On October 31, 1979, the CEOG submitted the Inadequate Core Cooling Report, CEN-117, to the NRC for review.

At a follow-on meeting, on January 30, 1980, the CEOG met again with the NRC to discuss CE's proposed response to NUREG-0578, Item 2.1.9. On April 1, 1980, the CEOG submitted to the NRC supporting analyses and interim emergency procedure guidelines (EPGs) as CEN-128.

On July 17, 1980, the NRC forwarded comments on both CEN-117 and CEN-128 to the CEOG. The CEOG responded to NRC questions on the guidelines documents on December 10, 1980 and January 30, 1981. The CEOG also indicated that new guidelines were being developed from CEN-128 and that because of the significant revisions that were necessary to the CE program and the need to develop new guidelines, CE could not meet the schedule called for in the TMI Task Action Plan Item I.C.1. Furthermore, based on CEOG's proposed approach, there was some concern that the new guidelines would not be adequately comprehensive.

On June 1, 1981, the CEOG submitted the revised EPGs to the NRC as CEN-152 with a companion document, CEN-156, outlining the guidelines development process. A meeting was held with CE and the CEOG on July 24, 1981, to discuss the submittal. The staff identified deficiencies which required resolution before the guidelines would be acceptable. The concerns centered around continued emphasis on an event orientation of the guidelines and the lack of emphasis on a functional orientation. In addition, the guidelines did not provide adequate guidance for determining if adequate core cooling existed.

Based on the July 24, 1981 meeting, the staff forwarded to the CEOG on September 15, 1981, a letter identifying its remaining significant concerns. These concerns were to be addressed at working meetings between representatives of NRC and CE. The first such meeting took place on January 7, 1982.

At a January 7, 1982 meeting, CE presented an overview of their program which reflected an attempt to address NRC concerns. While significant and positive changes were made in the CEOG program, there still remained some key items that needed revision or clarification.

Another meeting was held March 31, 1982, in which CE again presented their revised program. Based on their presentation, additional staff concerns were identified. CEOG agreed that staff concerns would be addressed in revised guidelines (CEN-152/Rev 1).

Meetings were held on June 23, 24, and 29, 1982, to discuss preliminary comments on the draft guidelines and to develop a schedule for future submittals and reviews. At these meetings, the staff presented CE with preliminary questions on the revised guidelines (CEN-152/Rev 1). Many of these questions were resolved at the meeting and the programmatic aspects of the document were generally acceptable. However, there were still a number of technical issues that needed to be resolved.

Follow-on meetings with the CEOG were held on July 22 and August 20, 1982, to discuss the revised CE program, responses to earlier staff comments, and additional staff comments. The CEOG delivered a draft of newly revised guidelines which incorporated a large number of the latest PTRB and RSB concerns. This new document was reviewed by the staff and a meeting was held at CE in Windsor, Connecticut, on October 13 and 14, 1982. The purpose of this meeting was to discuss the preliminary staff comments on the revised guidelines and to exercise the guidelines on the CE simulator to evaluate both programmatic and technical aspects of the CE guidelines.

Based on this review, we find the CEOG guidelines (CEN-152) provide sufficient guidance such that they can be translated into acceptable emergency operating procedures using the process identified in NUREG-0899, "Guidelines for the Preparation of Emergency Operating Procedures."

5 REFERENCES

1. "Combustion Engineering, Emergency Procedure Guidelines," CEN-152, Revision 01, Combustion Engineering, Inc., November 1982.

2. "Clarification of TMI Action Plan Requirements," NUREG-0737, NRC, November 1980.

3. "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, August 1980 (Revised).

4. "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendation, NUREG-0578, July 1979.

5. R. W. Wells, "Transmittal of CEN-152 Revision 1, Combustion Engineering Emergency Procedure Guidelines," letter from CE Owners Group (Northeast Utilities), to Darrell G. Eisenhut, NRC, RWW-82-67, November 22, 1982.

6. "Resolution of TMI Action Item II.K.3.5, 'Automatic Trip of Reactor Coolant Pumps,' (Generic Letter No. 83-10e)," letter from Darrel G. Eisenhut, Director, Division of Licensing, NRC; to all applicants with Babcock & Wilcox (B&W) designed nuclear steam supply systems (NSSSs), February 8, 1983.

7. "Clarification of TMI Action Plan Requirements," NUREG-0737, Supplement No. 1, January 1983.

8. R. W. Wells, letter from CE Owners Group to Darrell G. Eisenhut, NRC, RWW-83-15, March 29, 1983.

9. "Guidelines for the Preparation of Emergency Operating Procedures," NUREG-0899, NRC, August 1982.

10. "Generic Implications of ATWS Events at the Salem Nuclear Power Plant," NUREG-1000, NRC, April 1983.