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SAFETY EVALUATION REPORT

Document Title: Oconee Nuclear Station Unit 3, Abnormal Transient Operating Guidelines (ATOG)

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Originating Organization: Babcock and Wilcox Nuclear Power Generating Division

CONTENTS

ACRONYMS

AC	Alternating current
ANO	Arkansas Nuclear One
ATOG	Abnormal transient operating guidelines, in this case for the Oconee plant
ATWS	Anticipated transient without scram
BWST	Borated water storage tank
B&W	Babcock and Wilcox
CFT	Core flood tank
CVC	Chemical volume control (system)
DHS	Decay heat system
ECC	Emergency core cooling
ECCS	Emergency core cooling system
EFW	Emergency feed water
EOP	Emergency Operating Procedures
ESFAS	Emergency safety features actuation system
FSAR	Final safety analysis report
FW	Feed water
HPI	High pressure injection
H_2	Hydrogen
ICC	Inadequate core cooling
LOCA	Loss of coolant accident
LOOP	Loss of offsite power
LPI	Low pressure injection
NC	Natural circulation
NDT	Nil ductility temperature
NRC	Nuclear Regulatory Commission
NSSS	Nuclear steam supply system
NUREG	Nuclear Regulatory Commission document designation
OL	Operating license
pH	Logarithm of the reciprocal of hydrogen ion concentration in gram atoms per liter
PORV	Power operated relief valve, pertains to the pressurizer as used here
P-T	Pressure-temperature
PTS	Pressurized thermal shock
RCP	Reactor coolant pump
RCS	Reactor coolant system
RT	Reactor trip
SAD	System auxiliary diagrams
SER	Safety evaluation report
SG	Steam generator
SGTR	Steam generator tube rupture
SI	Safety injection
SSD	Safety sequence diagram
TMI	Three Mile Island
T_{clad}	Temperature of the cladding on the fuel pellets

T_{cold}	Cold leg temperature of the RCS
T_{hot}	Usually the hot leg temperature of the RCS
T_{sat}	Saturation temperature
UH	Upper head (of the reactor vessel)
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 Babcock and Wilcox designed nuclear power reactors developed 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) should specify 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 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 (Refs. 2 and 5), NUREG-0660 (Ref. 3), and NUREG-0578 (Ref. 4). The Staff has evaluated the Oconee Unit 3 Guidelines using the criteria from these references. This Safety Evaluation Report (SER) documents the Staff's evaluation.

1.2 B&W Emergency Operating Procedures Guidelines, ATOG

The Abnormal Transient Operating Guidelines (ATOG) are being developed by the B&W Owners Group Operation Support Subcommittee in response to the need for improved emergency operator guidance and to TMI Action Plan (NUREG-0737) requirements. This SER documents the Staffs evaluation of the ATOG version applicable to the Oconee Unit 3 plant (Refs. 1 and 8).

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

(1) plant-specific technical guidelines, which B&W identifies as ATOG, and which contain the information necessary to mitigate the consequences of transients and accidents and to restore safety functions for a particular plant, and

(2) EOPs, which are the plant procedures that direct operator actions necesssary 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 which delineate the conditions which potentially jeopardize the successful confinement of radioactive material.

Unlike other vendor plants, there is no generic version of ATOG for B&W plants. The owners who are participating in the owners group program planned to provide sufficient documentation in the form of plant-specific ATOGs and Transient Information Documents (TIDs) so that the NRC can perform comparisons with the ATOG version evaluated in this SER. More recent information (Reference 9) indicates that a generic version of ATOG is being considered.

The ATOG approach is keyed to the behavior of four symptoms:

(1) Reactor power,
(2) Adequate primary inventory subcooling,
(3) Inadequate primary to secondary heat transfer,
(4) Excessive primary to secondary heat transfer.

If reactor power decreases as anticipated following reactor trip, <u>and</u> the Reactor Coolant System (RCS) inventory is adequately subcooled, <u>and</u> the RCS to steam generator secondary heat transfer is controlled, the assumptions are made that the core is not in an overheated condition, and decay heat is being adequately removed from the NSSS. If any of these symptoms do not respond as anticipated, guidance is provided to correct the symptom deficiency. If, in following the guidance, the desired symptom behavior is not obtained, alternate guidance paths are provided. The ATOG approach also contains guidance to meet the specialized requirements for steam generator tube rupture events, inadequate core cooling, and NSSS cooldown.

1.3 <u>Staff Evaluation</u>

ATOG is symptom oriented, considers multiple failures, is tolerant of operator error, addresses plant cooldown following an emergency, and addresses inadequate core cooling. We find the approach used in ATOG to be responsive to the criteria referenced in Section 1.1. Further, ATOG contains a significant quantity of valuable information for the guidance of operators under emergency conditions. However, ATOG is not fully developed and does not yet cover all of the events identified in NUREGs-0737 and -0660. The conclusion of our evaluation is as follows:

(1) We require an interim extension of ATOG to better cover ATWS and certain aspects of natural circulation. This is to be completed before ATOG is used in the implementation of procedures process.

(2) ATOG should be implemented in accordance with NUREG-0737, Supplement 1 (Ref. 5), and

(3) ATOG should be upgraded in a longer term program to provide more comprehensive coverage of emergency conditions.

Additional information regarding the coverage of emergency conditions and the ATOG evaluation is provided in Section 4 of this SER.

2 ORGANIZATION OF ATOG

2.1 Objective

The Abnormal Transient Operating Guidelines (ATOG) program was initiated by the B&W Owners Group in June 1979. The program objective was to develop a comprehensive set of emergency guidelines from which emergency operating procedures could be written. The procedures would be based on symptoms and would provide guidance to the operator for responding to any emergency event with no need for early event diagnosis. A secondary objective was to develop a background information package to support operator training.

An agreement was reached between the Owners Group and the Staff in August, 1981, in which the ATOG version for Oconee would be reviewed. In addition, the owners of B&W plants participating in the ATOG program would provide information which would allow NRC to identify differences between other versions of ATOG and the Oconee ATOG. No generic guideline would be prepared for B&W plants. See Reference 9 for more recent generic considerations. The staff started its review of the ATOG program early in 1981 by reviewing the ANO-1 ATOG that had been submitted in 1980. The Oconee ATOG was submitted April 3, 1981. At a meeting held in Bethesda on August 17, 1981, the staff and the B&W Owners agreed that the review of the ATOG program would be based on the Oconee ATOG, since it provided more extensive coverage than the existing ANO-1 ATOG. The staff reviewed the Oconee ATOG, and, based on this review, the Owners group transmitted the revised Oconee Unit 3 ATOG, dated March 23, 1982, to NRC, and submitted an additional revision on June 15, 1982 (Ref. 1). Additional information was sent on March 14, 1983 and May 21, 1983 (ATWS) (Ref. 10), which we have reviewed as part of ATOG (Ref. 8). The staff has evaluated the Oconee Unit 3 ATOG and the revisions. This SER documents the evaluation. A recent submittal from the Owners Group dated July 2, 1983 is under review by the NRC Staff and will be addressed in an SER Supplement.

2.2 ATOG

ATOG consists of two parts. Part I is procedural guidance which is to be developed into plant-specific procedures for use in the control room. Part II is a background and training aid which explains the design bases for, and the use of, Part I.

Table 1 outlines the organization of Part I. Immediate actions and vital system status verifications are common to every reactor trip and must be performed regardless of cause. If the plant responds as expected and comes to a steady post-trip condition for a normal trip, no further emergency procedures action is provided.*

If the plant responds in an abnormal or unexpected manner, the operator is directed to perform followup actions by using one or more of Sections IIIA through IIID. These actions are to bring the plant to a stable condition.

Once the plant has stabilized, cooldown is performed using one of the Cooldown Procedures CP-101 through CP-105.

Specific Rules are used during application of procedures to operate the High Pressure Injection (HPI) and Emergency Feedwater (EFW) systems, and to control Steam Generator (SG) level. System Auxiliary Diagrams (SADs) are used as troubleshooting aids when needed to restore a failed critical safety function. (SADs are not part of ATOG. Appropriate SADs are referenced in Part I.)

The last section of Part I, Inadequate Core Cooling (ICC), is entered if core exit thermocouple temperatures corresponding to superheated steam are detected. The ICC section assumes priority over other emergency procedures.

Table 2 outlines the organization of Part II which is to be used for background study. It is intended to give the operator a thorough understanding of Part I and to describe expected plant response under many conditions.

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*The reader is reminded that ATOG contains the major actions the operator will follow in the EOPs, but omits detail such as minor actions and some valve designations. Hence, reference to major actions the operator will take in the EOPs and reference to actions described in ATOG correspond. For simplicity, the remainder of this document is written as though the operator follows ATOG directly. The reader should remember that the operator will follow the EOPs, and that ATOG describes the actions, not necessarily the actual procedure in detail.

Table 1 Organization of ATOG Part I

Reactor Trip

- Section I, Immediate Actions
- Section II, Vital System Status Verification

Subcooling

- Section IIIA, Followup Actions for Treatment of Lack of Adequate Subcooling Margin

Lack of Heat Transfer

- Section IIIB, Followup Actions for Treatment of Lack of Primary to Secondary Heat Transfer in Either SG

Excessive Heat Transfer

- Section IIIC, Followup Actions for Treatment of Too Much Primary to Secondary Heat Transfer

SGTR

- Section IIID, Followup Actions for SG Tube Rupture

Cooldown Procedures

- CP-101, A Large LOCA has Occurred and the Core Flood Tank is Emptying
- CP-102, Normal Cooldown
- CP-103, Transient Termination Following an Occurrence that Leaves the RCS Saturated with SG(s) Removing Heat
- CP-104, Transient Termination Following an Occurrence that Leaves the RCS Being Cooled by HPI Cooling
- CP-105, Transient Termination Following an Occurrence that May Require Pressurizer Recovery or Solid Plant Cooldown with SGs Removing Heat

Specific Rules

Systems Auxiliary Diagrams (SAD)

- RCS Pressure and Inventory Control
- Secondary Heat Transfer Control
- Reactor Building Control

ICC

- Followup Actions for Inadequate Core Cooling

Table 2 Organization of ATOG Part II

VOLUME 1	FUNDAMENTALS OF REACTOR CONTROL FOR ABNORMAL TRANSIENTS	
	Introduction	
	Chapter A	- Basic Heat Transfer
	Addendum A	- Subcooled, Saturated, Superheated Water
	Addendum B	- Natural Circulation
	Chapter B	- Use of P-T Diagram
	Chapter C	- Abnormal Transient Diagnosis and Mitigation
	Chapter D	- Backup Cooling Methods
	Chapter E	- Best Methods for Equipment Operation
	Chapter F	- Post Transient Stability Determination
	Chapter G	- Fundamentals of Reactor Building Control
	Chapter H	- Use of the Guidelines
VOLUME 2	DISCUSSION OF SELECTED TRANSIENTS	
	Introduction	
	A.	Excessive Main Feedwater
	B.	Loss of Main Feedwater
	C.	Steam Generator Tube Rupture
	D.	Loss of Offsite Power
	E.	Small Steam Leak
	F.	Loss of Coolant Accident

3 ATOG PROGRAM REVIEW

3.1 Approach to Transient and Accident Control

3.1.1 Summary of ATOG

The ATOG approach to transient and accident control is symptom oriented. This approach differs from a traditional event oriented approach where procedures cover certain initiating events and where the operator has to correctly diagnose the event in order to execute the proper procedure.

In the ATOG symptom-oriented approach, the primary objective is to safeguard core integrity. To do this, the operator must ensure continuous removal of decay heat from the core to the ultimate heat sink. The two main steps to assure a heat removal path are heat transfer from the core to the RCS coolant and from the RCS coolant to the steam generator secondary side coolant.

Entry into ATOG is upon reactor trip or upon entering a condition that requires a forced shutdown. After any reactor trip, the operator starts with the same guidelines and the same immediate actions are taken. After these actions, the operator observes certain key symptoms in a prescribed order. Three symptoms are of primary interest in ATOG. First is reactor coolant subcooling because, with a loss of subcooling, the ability of the operator to control primary system inventory may be in jeopardy. Loss of subcooling also implies the existence of primary system voids. The second symptom is inadequate primary-to-secondary heat transfer, which may be indicated if reactor coolant temperature is increasing or cold leg temperature does not follow secondary side saturation temperature. The third symptom is excessive primary-to-secondary heat transfer, which may be indicated if primary coolant temperature is decreasing rapidly below the normal post-trip value. This generally indicates a secondary side malfunction.

The information used in ATOG to identify and track the symptoms consists of core exit temperatures, reactor coolant system (RCS) hot and cold leg temperatures, RCS pressure, steam generator pressures, and steam tables. Much of this information is presented to the operator in a consolidated manner via display on a P-T diagram presented as shown in Figure 1. P-T diagrams are displayed on CRT monitors in the control room. The RCS operating point can be drawn as a path on the screen and thus progression of an event can be continuously displayed. Steam generator state points are shown by moving horizontal and vertical lines. Both primary coolant loops are monitored separately via separate CRTs. If CRTs are not available, the operator maintains a P-T diagram manually during the event.

Symptoms are treated using the guidelines in Sections IIIA, IIIB, or IIIC. If a loss of subcooling occurs in coincidence with other symptoms, Section IIIA is used first and Section IIIB or IIIC immediately thereafter. The goal is to stabilize the plant. The stable condition may differ from the normal hot-standby condition. Accordingly, various cooldown procedures are provided for operator guidance during long-term recovery.

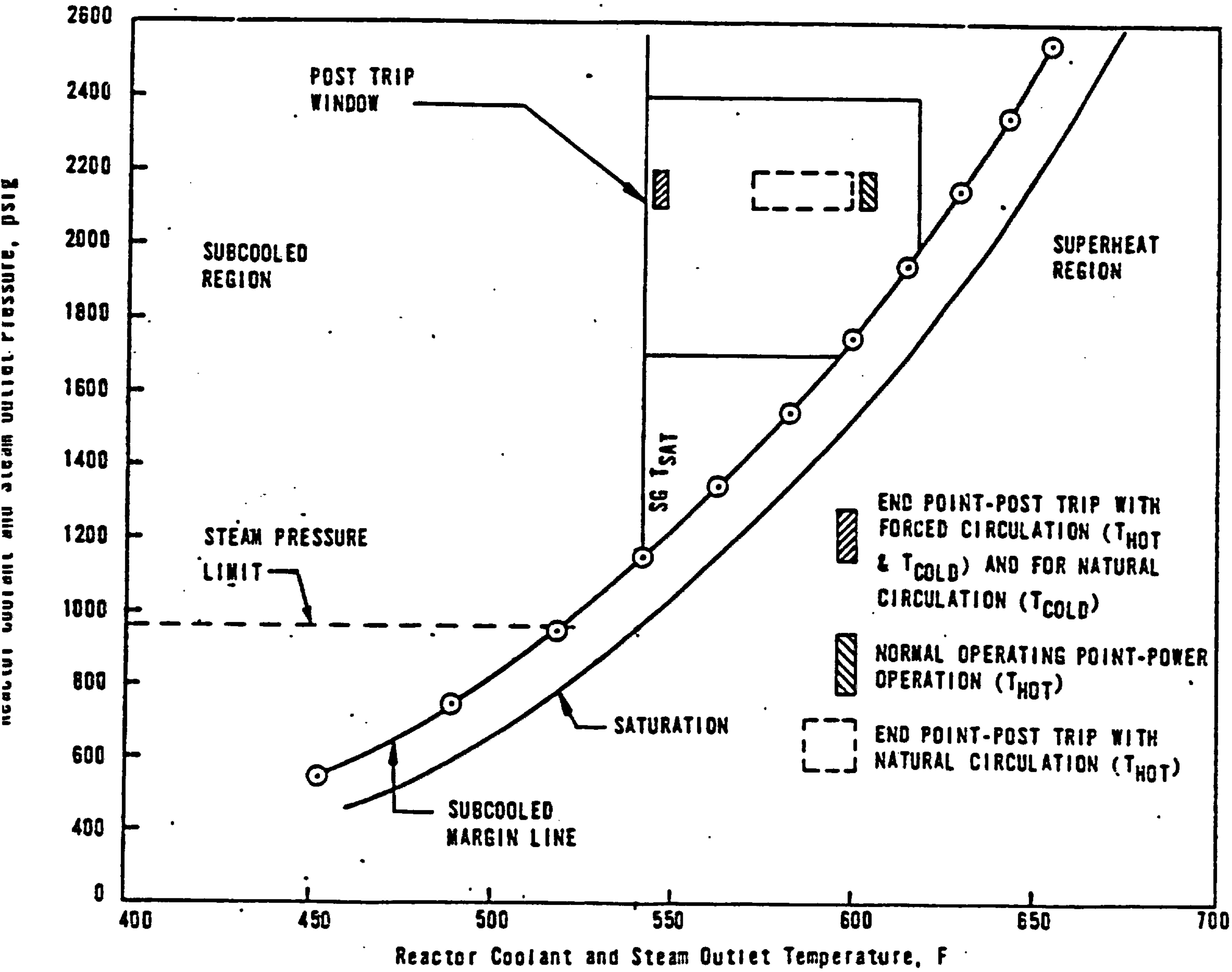

Figure 1 Typical P-T diagram

An initiating event not treated on a purely symptom oriented basis is the steam generator tube rupture event. A special guideline, Section IIID, covers this event. The tube rupture guideline is entered, after treating other symptoms, if radiation alarms have been received from the main steam lines or condenser air ejectors.

The overall philosophy and approach used in ATOG is explained in Part II, Volume 1, Chapter H which is part of the operator training material.

3.1.2 Staff Findings

Focusing attention first on subcooling is important because loss of subcooling may cause steam collection in the inverted U-bend of the hot leg and thus interrupt natural circulation. Fast response may also be necessary to prevent steam line flooding during overfeed transients and to minimize adverse consequences of a steam generator tube rupture. A further advantage of the symptom oriented approach is that it implicitly covers various multiple failure events without the need to specify all failure combinations. A drawback is that recovery may be delayed and unnecessary operator actions may be taken. However, since a balancing of ATOG against alternative approaches shows the selection to have a sound basis, the overall ATOG approach is acceptable for B&W plants.

3.2 ATOG Entry

3.2.1 Summary of ATOG

Entry into ATOG is upon reactor trip or forced shutdown. However, for the latter, the only time one remains in ATOG is for a steam generator tube rupture.

3.2.2 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.

There is no mention of inventory or vessel level instrumentation. 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 ATOGs. This should be accomplished as part of the longer term development program.

3.3 Initial Actions

3.3.1 Summary of ATOG

The initial actions are covered in guideline Sections I and II. In Section I, operator action is determined by whether there has been a reactor trip or a forced shutdown. If a steam generator tube rupture (SGTR) has occurred, requiring a forced shutdown, a transfer is made directly to Section IIID of ATOG for treatment. If the forced shutdown is for some other reason, then shutdown is accomplished by following non-emergency operating procedures. If a reactor trip (RT) has occurred, then the operator routinely pushes the reactor trip and turbine trip buttons and continues to Section II. In Section II, the operator verifies vital systems status and takes remedial actions if systems are not responding as expected.

The first priority is to verify reactor shutdown and decreasing power on intermediate range instrumentation. Remedial actions include starting emergency boration with HPI from the BWST or with normal boration systems. Another prompt verification relates to closure of all main turbine stop valves. If valves have failed to close, a turbine trip is actuated locally.

One abnormal transient, excessive main feedwater, is stated to require fast recognition and response by the operator to prevent possible adverse consequences due to steam generator overfill and water spillover into the steam lines. Therefore, once the reactor and turbine trip have been verified, the operator focuses on the main feedwater system and trips the running FW pumps if necessary to terminate overfeed. If all FW pumps are tripped, the operator must verify start of the EFW system. The adequacy of operator capability to respond to this particular event should be explicitly observed during the verification and validation program by each utility.

Other verifications are not considered to be as urgent in ATOG as the three cited above, and they can be performed in any sequence. The verifications and remedial actions are:

- Letdown flow is through the block orifice only. If not, the block orifice bypass valve is closed.

- Power is supplied to control and instrument systems. If not, specific procedures for this malfunction are used.

- Station auxiliaries are powered from the startup transformer. If not, proper start and loading of emergency hydro-turbine-generators is verified (Oconee has hydro-turbines instead of diesels), steam generator levels are raised to 50% of the operating range to promote natural circulation, a makeup pump is started, and RCP seal injection is verified or established.

- If any of the ESFAS actuation setpoints are reached, proper start of the respective safety systems is verified and possible malfunctions are corrected with the help of the applicable Systems Auxiliary Diagram. Further, the letdown storage tank outlet valve and PORV block valve are closed, and should there be a loss of subcooling margin (which may indicate a LOCA), the operator trips all RCPs and raises all steam generator levels to 90-95% of the operating range.

Following verifications, the operator monitors plant parameters for abnormal symptoms. If no abnormal symptom occurs, and the plant comes to a steady post-trip condition, ATOG guidance is that operation can be continued with normal procedures. In case of an abnormality, the operator is instructed to use the appropriate ATOG section.

3.3.2 Staff Findings

Sections I and II contain the most important verifications which have to be performed when abnormal conditions occur. We find the initial verifications to be sufficient for initial implementation.

The acceptability of the RCP trip 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 in the coming year to determine compliance with the guidance in the referenced letter. At that time, specific procedures for RCP trip will be examined as a part of the inspection.

Our review has identified additional items where more information or work should be accomplished to enhance operator initiated actions. These include:

(1) Loss of off-site power (LOOP). A LOOP condition causes or potentially causes a number of plant perturbations which require operator attention and/or may mislead the operator. These may include instrumentation failures which may not be obvious, loss of control air with the requirement that the operator manually start the backup air supply or load the normal air supply onto the hydro bus, and manual start of the makeup pumps. Failure to perform the operations may result in loss of key systems such as the turbine bypass systems.

(2) Loss of All AC power (Station Blackout). This scenario has not been addressed. The following potential items associated with station blackout should be included: 1) elimination of unnecessary loads, 2) action to control RCS inventory, 3) and perturbations and actions to be performed when power is restored should be addressed. Correction of the LOOP condition may induce problems which should be considered, such as restart of RCPs with most of the RCS cool, a high temperature void in the upper head, and attendant void collapse and transient pressure vessel upper head stress due to the sudden temperature change.

(3) Containment. Radiation levels and associated isolation actions should be considered.

(4) ATWS. Reference 7 contains the following: "...resolution of this generic issue is beyond the scope of the ATOG program....In the interim, ATOG addresses ATWS to this extent for the present plant configurations: the operator is instructed to manually trip the reactor and verify that control rods are on the bottom and that neutron counts are decreasing; if not, he is instructed to initiate emergency boration." Additional instructions, such as to drive rods into the core, to control RCS temperature, and to control RCS pressure, should be provided for operator guidance contained in the initial implementation. In addition, ATOG should be reviewed and modified where necessary to assure that the information provided to the operator in the initial implementation is compatible with ATWS conditions. We require the above items be incorporated into ATOG prior to implementation and that implementation of procedures based upon ATOG, as described in Reference 5, incorporate these items by the agreed date for implementation. Addressing other ATWS concerns where significant evaluation and study is required should be a topic of the longer term program for updating and improvement of ATOG. Additional considerations will be identified by the pending Commission rulemaking on ATWS, or by generic requirements resulting from the NRC review of the Salem event.

3.4 Treatment of Loss of Subcooling Margin

3.4.1 Summary of ATOG

Whenever the indicated subcooling margin is less than 20°F, the assumption is that the RCS is saturated. The RCS can become saturated as a result of three basic causes:

(1) loss of coolant inventory (LOCA)

(2) prolonged loss of heat transfer that allows the RCS to overheat

(3) overcooling that results in sufficient coolant contraction to drain the pressurizer and surge line

The operator will treat loss of subcooling margin with ATOG Section IIIA. Immediate actions are independent of the cause of RCS saturation. First, the RCPs are tripped if not already tripped in Section II. This is to minimize inventory loss for a certain range of small break sizes and locations.

The second action is to start raising SG levels to 90-95% of the normal operating range. In the event of a small-break LOCA, this should promote condensation of steam in the RCS side of the tubes, thus promoting natural circulation. If the transient was caused by total loss of secondary heat sink, the operator may not be able to restore SG level at this point, and will go to the next step in ATOG.

The third action is to initiate HPI if not already in operation and to verify that the system supplies the required flow. If one HPI pump fails to start, a makeup pump is lined up and started to perform the safety injection function. If the HPI system is not operating properly, troubleshooting and corrective actions are attempted using the System Auxiliary Diagram. Operation with full HPI capacity is specified whenever the subcooling margin is lost.

The fourth and last mitigating action of Section IIIA is an attempt to isolate potential Reactor Coolant System leaks. The operator routinely closes the letdown isolation valve, RCP seal return valve, and the following pressurizer valves: PORV block valves, spray block valve, vent valve, and sample valves.

The operator is then instructed to observe plant response and to continue in the applicable ATOG section.

If some or all of the mitigating actions cannot be accomplished, an ICC condition can occur, and temperature measurements at the core exit may eventually indicate superheated conditions. If superheat is indicated, the operator is instructed to go to the ICC Section.

If the plant stabilizes with the RCS saturated and with primary to secondary heat transfer in both SGs, long-term recovery is initiated using cooldown procedure CP-103 for a saturated RCS. If RCS pressure decreases continuously and the Core Flood Tanks start emptying, ATOG states a major LOCA is indicated. In that case, Cooldown Procedure CP-101 is used. If continued saturated conditions are encountered and the pressure stays above the CFT set pressure, the operator goes to Section IIIB, Lack of Heat Transfer. If actions in

Section IIIA have been successful and subcooling margin has been reestablished, the operator is instructed to reduce HPI flow, as needed, to protect the reactor pressure vessel against pressurized thermal shock (PTS) and to maintain pressurizer level within appropriate operating limits. Once an acceptable pressurizer level and subcooling margin have been established, HPI may be terminated and normal makeup control resumed.

After HPI has been stopped or controlled, one RCP per loop is restarted, if possible. The pressurizer spray block valve is reopened and the condition of the spray system is checked by monitoring RCS pressure.

If no abnormal symptoms (excessive or inadequate primary-to-secondary heat transfer) are observed after reestablishment of subcooling, long-term recovery is performed with Cooldown Procedure CP-105. Abnormal symptoms would require an entry to the applicable followup section.

3.4.2 Staff Findings

Section IIIA is acceptable as the basis for development and implementation of emergency operating procedures.

Section IIIA contains actions necessary for treatment of loss of subcooling margin. If the RCS stays saturated, ATOG directs the operator to an applicable ATOG section for subsequent actions. The instructions to be used after successful reestablishment of subcooling are acceptable subject to the following comments:

(1) PTS. The pressure-temperature region where the RCS is to be maintained by HPI flow control is defined by Oconee with consideration of PTS concerns. This guideline is acceptable for interim use; however, operator guidance should be provided for situations where RCS conditions are outside the desired region (see Fig. 3, p. 3-18). Since the pressurized thermal shock issue is still under generic NRC review as part of USI A-49, revisions may be necessary as a result of the generic study.

(2) RCS Voids. At the time of RCP restart, steam may be trapped in the reactor vessel upper head. Mixing with subcooled water will condense the steam, and the RCS pressure will rapidly decrease. If the pressurizer does not contain a sufficient amount of saturated water to compensate for upper head void collapse, the reactor coolant system may return to saturated conditions after RCP restart. To avoid undesirable pressure transients during recovery, the RCP restart conditions should be specified. B&W has proposed to follow up on this issue after a study on RCS voids and their implications on plant operations has been completed. This is an acceptable approach. Topics such as thermal/hydraulic fluid behavior and transient induced head stresses due to pump restart with the upper head voided and the remainder of the RCS subcooled, should be subjected to analyses, where appropriate, to assure that the guidance is correct and does not result in unacceptable consequences. Closely related to the pump restart issue with the presence of voids in the upper head is the broader issue of upper head void treatment. This should be addressed in ATOG in the longer term. The study should also cover upper head voiding which can occur while the remainder of the RCS never loses subcooling margin, and appropriate operator instructions should be provided.

(3) Cooldown. See Section 3.9 of this SER.

3.5 Treatment of Lack of Heat Transfer

3.5.1 Summary of ATOG

There are three potential causes for lack of primary-to-secondary heat transfer:

(1) not enough secondary coolant for heat removal,

(2) void in the RCS hot legs sufficient to interrupt natural circulation,

(3) secondary pressure not below primary pressure.

Lack of heat transfer is treated using ATOG Section IIIB. The subcooling margin is checked first and, if not sufficient, RCP trip and full HPI flow are checked. The operator is also reminded to go immediately to the Inadequate Core Cooling Section if superheated conditions are indicated by core exit temperature measurements.

The second task is to determine availability of the secondary heat sink. The operator tries to establish and maintain appropriate SG levels by using emergency or main feedwater. If neither is available, the instructions are to attempt to feed one SG from any available source (e.g., emergency feedwater cross connected from a neighboring unit, or service water). At the same time, troubleshooting is performed on the EFW system, using the System Auxiliary Diagram. If all attempts to feed either SG fail, HPI cooling is started by initiating HPI (if not already on) and by opening the pressurizer PORV. Long-term recovery is then performed using Cooldown Procedure CP-104.

Void formation in the RCS hot leg inverted U-bend may be indicated if steam generator water levels can be established and maintained but there is no primary-to-secondary heat transfer. The operator tries to remove the void and induce heat transfer by lowering secondary pressure and by bumping RCPs. If the RCPs cannot be bumped, HPI cooling is established and further recovery is performed using Cooldown Procedure CP-104.

With the RCPs operable, each of the pumps is bumped once. (An RCP "bump" means to start an RCP and run it for 10 seconds.) Between two consecutive bumps, the operator is instructed to wait 15 minutes to see if natural circulation is established. If this action does not remove voids, the SG pressures are lowered until secondary T_{sat} is about 100°F lower than the RCS saturation temperature.

When one hour has passed since reactor trip, one RCP is started and run continuously, provided conditions exist to preclude undue risk of RCP damage. (The only time significant risk of RCP damage is allowed is under severe ICC conditions.) The delay of one hour is to avoid having a pump restart cause unacceptable coolant loss from certain ranges of RCS breaks (restart might cause the leak to turn from vapor to two-phase fluid). Long-term recovery is accomplished by using Cooldown Procedure CP-103 (saturated RCS) or CP-105 (subcooled RCS).

3.5.2 Staff Findings

The instructions given in Section IIIB are acceptable for development and implementation of emergency operating procedures on the basis of current understanding of B&W plant behavior.

Information should be provided with respect to restrictions for initiation of HPI, and for any differences in operator guidance with respect to availability of HPI (two, one, or no HPI trains, for example). Analyses have been conducted that indicate some of the operations are critical with respect to when HPI cooling is initiated and, if taken too late, may not be effective. The background for these areas is needed and, where operating restrictions are critical, the operator should be informed. Availability of the PORV and the use of high point vents should be addressed with respect to HPI cooling, as well as elimination of steam from the RCS prior to extreme ICC conditions being reached. The usefulness of bumping the RCP should be demonstrated to us by tests or by acceptable calculations. Items pertinent to RCP operation (Section 3.2.2), voiding (Section 3.4.2), and cooldown (Section 3.9.6) also apply here.

3.6 <u>Treatment of Excessive Heat Transfer</u>

3.6.1 Summary of ATOG

Excessive heat transfer is stated in ATOG to always be an indication of a secondary side malfunction. The malfunction may be one (or more) of the following:

(1) excessive steam flow caused by a steam line break or failed open valve,

(2) excessive main feedwater flow which increases the steam generator level above the normal setpoint, or

(3) excessive auxiliary feedwater flow which condenses the steam and increases the steam generator water level.

Excessive heat transfer is treated using ATOG Section IIIC. If the steam generator causing overcooling can be identified, corrective actions are taken only on that steam generator; otherwise, both steam generators are initially treated in the same way. Before any actions are taken on the secondary side, the HPI system is started (or automatic start verified) if necessary to prevent the pressurizer from draining.

The first action taken on the secondary side is to isolate the overcooling SG (or both SGs). If the isolation attempt fails, the leaking SG is allowed to boil dry while feedwater is restored to the intact SG. Long-term recovery is performed using Cooldown Procedure CP-102 if no further abnormal symptoms occur.

If SG isolation terminated the transient, the failure was either overfeeding or a steam leak downstream of the isolation valves. Either main or auxiliary feedwater (whichever is operating properly) is reestablished to the isolated SG(s) and steam is released from both SGs using an available system (turbine bypass or atmospheric relief). Further actions depend upon an evaluation of the transient.

3.6.2 Staff Findings

The actions to terminate the overcooling transient are acceptable for development and implementation of emergency operating procedures.

Items pertinent to RCP operation (Section 3.3.2), voiding (Section 3.4.2), and cooldown (Section 3.9.6) should also be considered here. Overfill of an SG which results in water in the steam lines should be addressed. This is discussed further as part of the SGTR evaluation. ATOG Part I does not address blowdown of both SGs, although information pertinent to this situation is contained in Part II. This guidance should be provided in Part I. Further, ATOG should be reviewed to assure that operator instructions are consistent with an inactive SG and the increased likelihood of RCS voiding in that SG during natural convection cooling.

3.7 Treatment of Steam Generator Tube Rupture

3.7.1 Summary of ATOG

Steam generator tube rupture is treated using an event-specific guideline.

ATOG Section IIID provides various recovery paths depending on tube rupture size, RCP availability, and possible simultaneous steam leaks. Section IIID is also unique since it can be entered before reactor trip.

During power operation, if the operator sees indications of an SGTR (radiation alarms from the secondary side, steam/FW flow mismatch, increased charging flow, decreasing pressurizer level and pressure), the operator is instructed to perform a rapid power reduction. The purpose of this action is to place the reactor in a low power condition so that the atmospheric relief valve does not open when the reactor and turbine are finally tripped. It is also easier to identify the ruptured SG during power operation than after trip. The recommended power level for manual reactor trip is less than 20%. During power reduction, the HPI system is started manually if needed to maintain pressurizer level and to prevent automatic reactor trip.

After reactor trip, the operator follows ATOG Sections I and II, and then returns to IIID, unless higher priority symptoms require treatment. For example, a steam line break in addition to an SGTR would be treated first using Section IIIC.

The ATOG guidance and unique features of the B&W steam generator design result in a condition where the tube leak cannot be terminated before the plant has been brought to cold shutdown. (The pressure differential between the RCS and steam generator secondary cannot be eliminated when the RCS is maintained in a subcooled state.) Thus, cooldown must be expedited if the leak rate is large. The leak is considered large when normal makeup is inadequate to replace lost coolant. Expedited cooldown is also required if the RCPs or condenser are not available.

ATOG requires the following preparations before starting cooldown:

(1) If subcooling margin is lost, RCP trip and HPI start are verified.

(2) If subcooling margin exists or is regained, HPI flow is controlled to maintain appropriate pressurizer level.

(3) Makeup to the borated water storage tank is initiated.

(4) Letdown is isolated and the pressurizer heaters are turned off.

(5) If one SG has blown down and was isolated using Section IIIC, it is supplied with a small continuous feedwater flow to provide shell cooling.

(6) The SG levels are controlled to appropriate values.

If sufficient subcooling margin has been reestablished before cooldown, one RCP will be restarted per loop to facilitate cooldown.

The first goal during cooldown is to decrease RCS temperature to 500°F. At this temperature, RCS pressure can be reduced to close to the ruptured SG pressure. The cooldown rate is limited to 240°F/hr, or, in less severe events, to 100°F/hr (small leak; RCPs, and condenser in service). Cooldown is initially performed with both SGs. When the hot leg temperatures are below 540°F, the ruptured SG is isolated as soon as it has been identified. The hot leg temperature of 540°F is low enough that there will be no heat transfer to the ruptured SG at steam pressures near the atmospheric relief valve set pressure, and thus the risk of direct atmospheric relief of radioactive steam is reduced. However, even after isolation, it may be necessary to steam the ruptured SG (preferably to the condenser) to maintain its pressure below atmospheric relief valve set pressure and to maintain SG level on scale (leakage of primary coolant continues to the secondary side). If the RCPs are not in operation, the operator is instructed to steam the ruptured SG to prevent void formation in the RCS.

The RCS is depressurized during cooldown while maintaining a subcooling margin of 20-50°F. While the smaller margin is preferable because it will minimize the leak, if pressurizer spray is not available and the depressurization has to be conducted with the PORV (which causes a very rapid pressure drop), the operator must have the larger margin before a PORV opening cycle.

Since the primary and secondary side temperatures will be roughly the same with good heat transfer in the steam generators, and since the secondary side is saturated and the primary is kept subcooled, the primary pressure will remain higher than the secondary pressure. Thus, the leak will continue throughout the cooldown period.

Below 500°F, the RCS cooldown rate is reduced to 100°F/hr. Even that rate cannot be maintained for an extended period because only the intact SG removes heat (under conditions of natural circulation, some heat load must be taken also by the ruptured SG), and its capacity becomes a limiting factor at lower temperatures.

If an unisolable steam line break has also occurred, cooldown to the decay heat removal system alignment conditions must be performed using the SG which is capable of retaining pressure (which may also be the SG with the tube rupture).

After the decay heat removal system is started, the main part of the RCS can be cooled without the SGs. However, it is necessary to also cool down the higher portions of the loops before the RCS can be completely depressurized. Thus, the operator is instructed to run or occasionally bump an RCP until the hot legs are below 212°F, or to continue steaming the SGs to cool down the loops. These actions cause the leak to continue during decay heat removal system operation.

The leak can be terminated at cold shutdown conditions either by draining the RCS to the level of the SG secondary side, or by adding nitrogen to the isolated SG secondary side to provide a slight backpressure.

3.7.2 Staff Findings

The ATOG treatment of steam generator tube rupture is acceptable for development and implementation of emergency operating procedures.

Further analysis and guidelines improvement is needed in the following areas and should be accomplished in the guideline maintenance program.

(1) The possibility of terminating the RCS to SG secondary side leak prior to reaching cold shutdown conditions should be studied further and improvements incorporated into ATOG.

(2) Alternate guidelines to steaming the faulted SG should be provided and analyzed for purposes of heat removal as well as for SG level control.

(3) ATOG should be extended to cover multiple tube ruptures in one SG.

(4) ATOG should be extended to cover single and multiple tube rupture in both SGs.

(5) Alternates for control of RCS pressure should be analyzed. Coverage should be provided for loss of use of the PORV and pressurizer spray.

(6) Guidance should be provided and analyses conducted which evaluate plant response to and the consequences of inadvertent or accidental overfill of the SG and introduction of water into the steam lines.

(7) Items pertinent to RCP operation (Section 3.3.2), voiding (Section 3.4.2), and cooldown (Section 3.9.6) should also be considered in the treatment of SGTR.

3.8 Treatment of Inadequate Core Cooling

3.8.1 Summary of ATOG

ATOG Section ICC (Inadequate Core Cooling) is entered whenever superheated conditions are indicated by core exit temperature measurements. Superheated conditions at the core exit can occur only if the core is at least partially uncovered. The operator actions to treat ICC depend on the amount of core exit superheating, as shown in Figure 2.

The ATOG ICC Section is normally entered when the RCS is in Region 2 of Figure 2. The maximum available safety injection flow from HPI, LPI, and Core Flood Tanks is verified. On the secondary side, SG levels are increased to close to the operating range maximum and the SGs are depressurized at a controlled rate to enhance RCS cooling. If these initial actions return the RCS to a subcooled condition (Region 1 in Figure 2), long-term recovery is performed using Cooldown Procedure CP-103.

If the RCS continues to superheat and proceeds into Region 3 of Figure 2, then the operator is to take further actions. If there are no interlocks preventing RCP start, one pump per loop is started in an attempt to drive the available water inventory into the core. The operator also depressurizes the SG as rapidly as possible to 400 psig, or further, if necessary, to achieve a 100°F decrease in secondary side saturation temperature. To achieve additional RCS depressurization with a minimum associated inventory loss, all high point vent valves are opened. These actions are accomplished in an attempt to bring the RCS to a pressure where the Core Flood Tank can empty. If primary-to-secondary heat transfer is established and the core is flooded, the PORV is cycled to attempt to control RCS pressure slightly above secondary pressure.

If the secondary side depressurization does not reduce primary pressure, the operator is instructed to open the PORV. If this step helps to depressurize the RCS and to flood the core, further recovery is performed using Cooldown Procedure CP-104. If not, the RCS will heat up further and enter Region 4 of Figure 2.

In the extreme region of superheating, all RCPs are started by defeating the starting interlocks. However, the pumps are not run beyond the overload protection limit or for more than 30 minutes without motor cooling. The SGs are depressurized as quickly and to as low a pressure as possible. The only limit for depressurization is the minimum pressure required to operate the steam-driven auxiliary FW pump unless another steam source or the motor-driven auxiliary FW pumps are available. Independent of the efficiency of primary to secondary heat transfer, the PORV is opened and left open. These actions are taken to reduce RCS pressure to the LPI system operating range and finally to return the RCS to a saturated state. After that, LPI cooling is continued and long-term actions (control of coolant chemistry, containment, etc.) are taken using Cooldown Procedure CP-101. Special attention is paid to limiting radioactive contamination because fuel is damaged.

3.8.2 Staff Findings

The ICC guidance is acceptable for development and implementation of emergency operating procedures, because it prescribes reasonable steps to accomplish the necessary functions to mitigate an ICC condition.

Areas in the ICC guidance which need improvement include:

(1) Changes to the ICC Section should provide guidance on the use of reactor vessel level/inventory measurement systems becoming operational in B&W plants.

(2) Additional analytical investigations are needed, as discussed in Section 3.13.

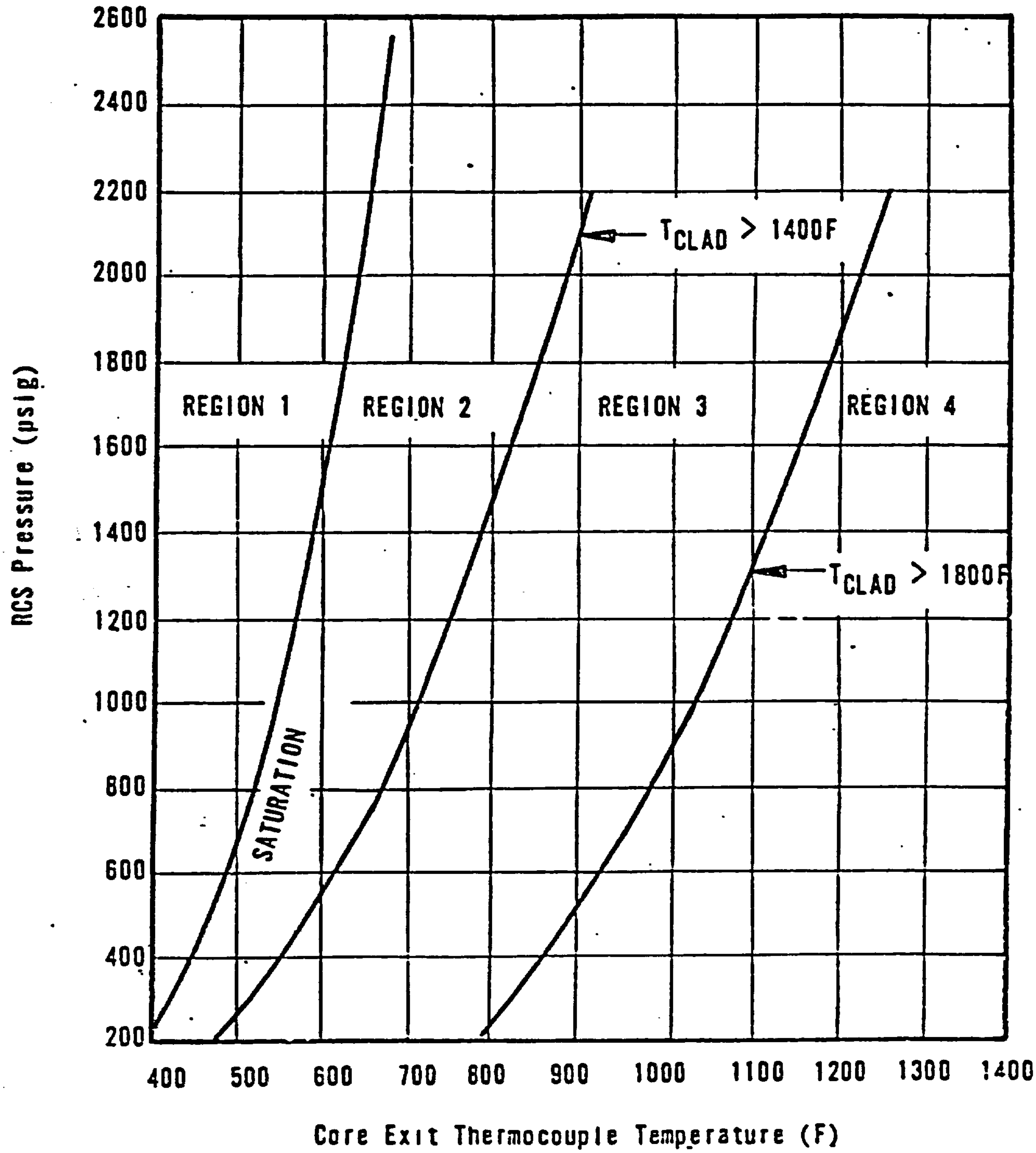

Figure 2 Operator actions regions for ICC

(3) The Guidelines should provide operator guidance following potential core damage, such as clad degradation, with particular attention given to minimization of releases for such conditions as a SGTR and the use of steam release as a method for control of plant parameters.

(4) Additional comments regarding RCP operation (Section 3.2.2), voiding (Section 3.4.2), and cooldown (Section 3.9.6) should be considered in providing ICC guidance.

3.9 Plant Cooldown

The initial objective stated in ATOG is to terminate the transient and stabilize the plant with controlled decay heat removal. Once stable conditions have been achieved, further plant cooldown is largely based on normal operating procedures. However, end conditions at stabilization will not necessarily coincide with entry conditions for normal cooldown procedures. Therefore, additional cooldown procedures are provided in ATOG to accomplish the transition from ATOG to normal plant procedures. Five cooldown procedures are provided to cover the five possible end conditions. Each is evaluated separately.

3.9.1 CP-101, A Large LOCA Has Occurred and the Core Flood Tank is Emptying

3.9.1.1 Summary of ATOG

The first steps to recover the plant from post large break LOCA conditions are related to alignment of ECC systems. If possible, the Core Flood Tanks are isolated upon reaching the Lo-Lo level before they start injecting nitrogen to the RCS. HPI and LPI system suctions are aligned to the containment sumps before the borated water storage tank is depleted. HPI system operation is terminated after the LPI system has been verified to provide sufficient cooldown flow. The possibility of a break location close to the LPI injection point is checked by observing CFT and LPI behavior as a function of RCS pressure, and if one of the LPI trains is found to be discharging directly to the containment, the line is isolated.

After ECC systems alignment, proper containment isolation is verified valve by valve. If long-term core cooling is being maintained by ECC systems, steam and feed lines are isolated. Reactor containment conditions are observed, and containment coolers, containment spray, and hydrogen purge systems are operated in accordance with specified criteria. Reactor coolant chemistry is controlled to assure adequate boron concentration and RCS pH. Applicable steps of the normal shutdown procedure are performed while maintaining LPI cooling in the recirculation mode.

3.9.1.2 Staff Findings

The approach for post-LOCA cooldown in the guidelines is acceptable because it prescribes reasonable steps to accomplish the necessary functions to mitigate a large break LOCA; however, additional followup is needed for the evaluation of treatment of containment, discussed in Section 3.10 of this SER. Other longer term needs are also identified in Section 3.9.6 of this SER.

3.9.2 CP-102, Normal Cooldown

3.9.2.1 Summary of ATOG

A direct transition to normal cooldown is possible if the leaks have been isolated, decay heat is being transferred to at least one SG, and normal pressurizer controls are in service. The preferred technique is with one RCP running in each loop. Therefore, if possible and before initiating cooldown, one RCP in each loop is started if the pumps were tripped during the transient.

The possibility of a small-break LOCA, compensated by HPI or makeup flow, is checked. If uncontrolled loss of coolant is observed, further recovery is performed using Cooldown Procedure CP-103. If one SG is dry, its tube-to-shell temperature difference is verified frequently and cooldown rate is limited to maintain the temperature difference within design limits. If RCPs are not available, the PORV is used to depressurize the RCS. Otherwise, the cooldown is performed using normal operating procedures.

3.9.2.2 Staff Findings

The approach used in CP-102 is acceptable for normal cooldown from emergency conditions, because it prescribes reasonable steps to accomplish the necessary functions for this situation.

3.9.3 CP-103, Transient Termination Following an Occurrence that Leaves the RCS Saturated with SG(s) Removing Heat

3.9.3.1 Summary of ATOG

This cooldown procedure involves a cooldown of the RCS by increasing SG steaming with maintenance of maximum safety injection flow and with the SG level close to the maximum allowable value. If the borated water storage tank level decreases to a low limit during cooldown, the ECCS are aligned to the recirculation mode.

During cooldown, the operator observes the RCS status and transfers to other procedures if necessary. If the core flood tanks start to empty before cooldown is started, further actions are taken with Cooldown Procedure CP-101. If natural circulation is lost and cannot be restored by RCP bump, the operator transfers to Cooldown Procedure CP-104. If superheated conditions are indicated, the operator enters the ICC section. If the RCS becomes subcooled, one RCP is restarted whenever possible. Pump restart may cause a temporary loss of subcooling due to void collapse, but after subcooling has been reestablished and is maintained, operations are continued with Guideline CP-105.

If the RCS remains saturated and heat is continuously transferred to the secondary side, cooldown and depressurization are continued until LPI cooling can be established and maintained. When the borated water storage tank level drops to a minimum level, the ECC systems are aligned to the recirculation mode. Recirculation through the containment sumps is continued as long as the RCS is saturated. If adequate subcooling margin is attained and both LPI trains are operable, one of the trains is aligned to the normal decay heat removal mode in preparation for removing all heat via the DHS.

During long-term cooling, reactor coolant chemistry and containment conditions are controlled as in CP-101. Other actions related to plant shutdown are taken using normal operating procedures.

3.9.3.2 Staff Findings

The CP-103 approach is acceptable because it prescribes reasonable steps to accomplish the necessary functions for cooldown with the RCS saturated.

3.9.4 CP-104, Transient Termination Following an Occurrence that Leaves the RCS Being Cooled by HPI Cooling

3.9.4.1 Summary of ATOG

This cooldown procedure is used if decay heat cannot be removed by the steam generators and/or via a break (other than the PORV and RCS safety valves).

As long as the RCS is saturated, the cooldown is performed with maximum HPI flow and venting through the safety valves and PORV. If subcooling margin is reestablished, HPI flow is throttled to maintain the RCS in a P-T region considered safe against pressurized thermal shock, as outlined in Figure 3. The RCS is calculated to cool down and depressurize gradually when core decay heat decreases. The core flood tanks are isolated before they start injecting and long-term cooling (first in ECC recirculation and then in the decay heat removal mode) is established using the last part of Cooldown Procedure CP-103.

If the prerequisites for primary-to-secondary heat removal become available during HPI cooling, the operator attempts to restore the normal heat transfer mode. The SG levels are raised to close to the maximum of the operating range and indications of natural circulation are checked. If natural circulation is established, Cooldown Procedure CP-103 (saturated RCS) or Cooldown Procedure CP-105 (subcooled RCS) is continued. If natural circulation is not established, the operator tries to induce it by bumping the RCPs (one each 15 minutes) or, after one hour has elapsed, by restarting and continuously running one RCP. If subcooled circulation is established with the help of the RCPs, the operator goes to CP-105; otherwise, HPI cooling is continued.

3.9.4.2 Staff Findings

The CP-104 approach is acceptable as a contingency guideline for development and implementation of emergency operating procedures because it prescribes reasonable steps to address transient termination following an occurrence that leaves the RCS being cooled by HPI cooling.

There are several areas that should be addressed in the longer term guideline maintenance program:

(1) HPI cooling through the safety valves and PORV with the SG secondary side empty may pose a problem to SG tube integrity. Further investigation of SG temperature distribution, RCS temperature distribution and flow effects (including direction of flow), and resultant tube stress should be performed.

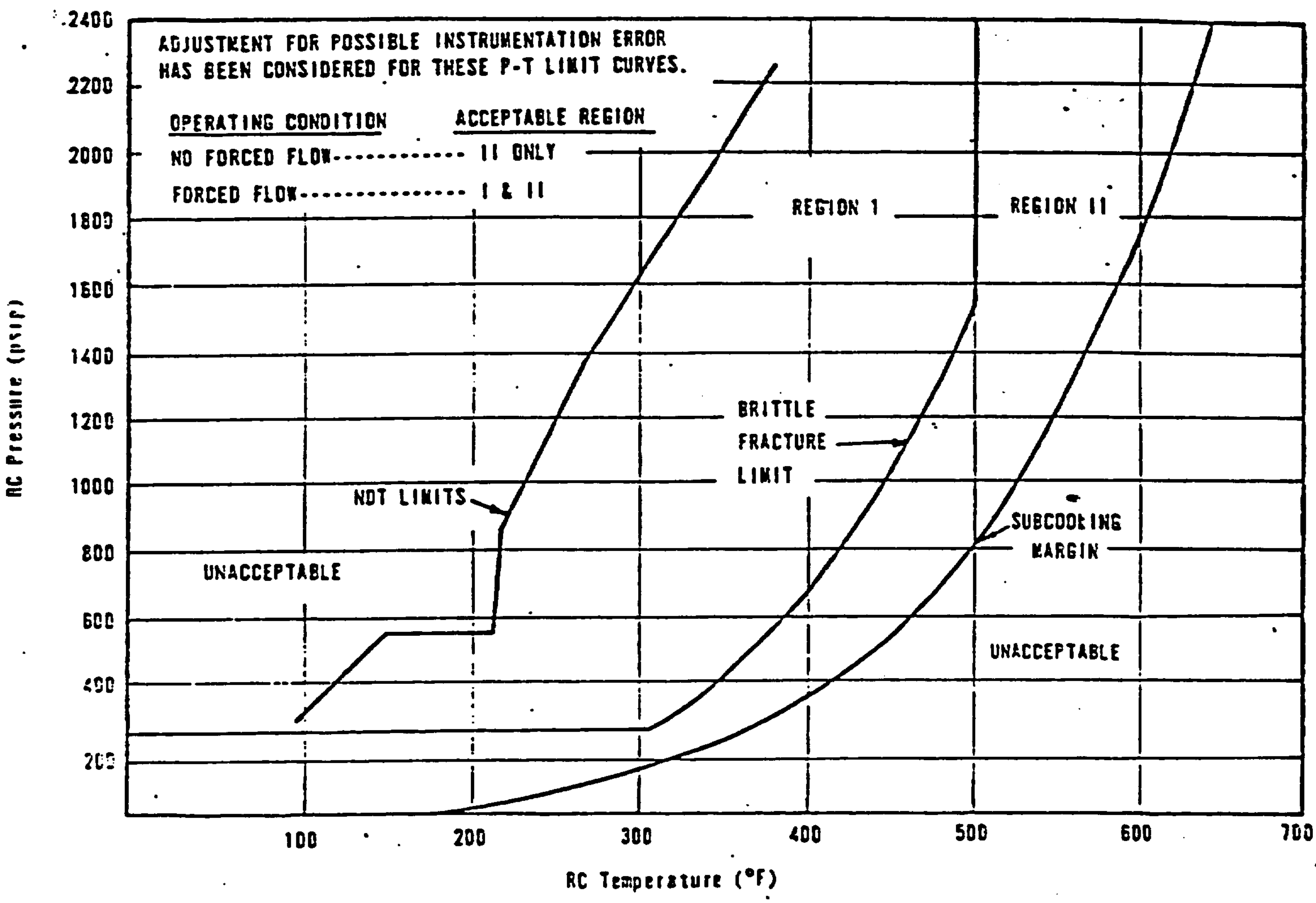

Figure 3 P-T limit curves

(2) As stated in Section 3.4.2, the findings of the PTS review may require changes, particularly with respect to pressure/temperature control while in HPI cooling mode.

(3) The question of whether there are critical restrictions associated with when manual initiation of HPI cooling occurs should be addressed, particularly if degraded HPI conditions or an inoperative PORV exist. Justification should be provided to determine if there are conditions under which HPI cooling is ineffective. The system investigation is necessary to provide RCS flow information pertinent to item (1), above. Additional objectives are to determine expected behavior and determine if different operator guidance is needed with availability of two, one, or no HPI pumps.

(4) The instructions relative to operation of the decay heat removal system should be clarified regarding operation with the RCS saturated. If saturated RCS operation is intended, voiding due to inadequate head for the pump suction should be addressed. If such operation is not intended, the wording should be clarified.

3.9.5 CP-105, Transient Termination Following an Occurrence That May Require Pressurizer Recovery or Solid Plant Cooldown With SGs Removing Heat

3.9.5.1 Summary

This cooldown procedure is used if the plant will stabilize in subcooled conditions but normal pressurizer controls are not in operation. The plant will either be cooled down without pressurizer controls or pressurizer controls will be established and normal cooldown performed.

Before the cooldown method is selected, the pressurizer PORV and high point vent valves are closed or verified closed. Letdown flow is established and the RCS is maintained as close as practical to the adequate subcooling margin by adjusting HPI and letdown flows.

If a decision has been made to try to establish pressurizer control, the heaters are turned on. When the pressurizer has reached saturation temperature and a bubble starts to form, level is decreased to the normal operating value. Cooldown is then started with Cooldown Procedure CP-102.

If the plant will be cooled down without pressurizer controls, the letdown line is closed. Then secondary side steaming is increased slowly to attain a steady cooldown rate. The RCS pressure is controlled to establish an approximately 50°F subcooling margin by adjusting HPI flow. One RCP per loop is started after the recommended subcooling margin has been reached. Other actions needed for plant shutdown are taken using normal operating procedures.

3.9.5.2 Staff Findings

Cooldown Procedure CP-105 is acceptable and provides sufficient instructions for development and implementation of emergency operating procedures because it prescribes reasonable steps to accomplish the necessary functions for transient termination following an occurrence that may require pressurizer recovery or solid plant cooldown with SGs removing heat.

However, additional validation should be performed to ensure the technique for controlling pressure is feasible and does not result in prohibitively large pressure swings.

3.9.6 Additional Staff Findings Concerning Cooldown Procedures

Certain phenomena with respect to RCS voiding which leads to interruption of natural circulation during small break LOCA must be covered in ATOG prior to implementation. This includes description of the phenomena, the potential conditions under which interruption of natural circulation and/or heat transfer may occur, indications the operator can expect if this should happen, likelihood of occurrence, and guidance for handling the NSSS.

The following items should be addressed in a longer term program:

(1) Cooldown Procedures should be reviewed in detail and supplemented as necessary with respect to proper application. There are a large number of ways in which they can be entered, and a number of cross transfers are possible within different procedures. For example, CP-105 is referenced under conditions when the RCS may not be solid; and during a LOCA, one can get into a closed loop involving CP-102, CP-103, and CP-105 in which cooldown is not permitted.

(2) Degraded core should be adequately covered.

(3) Other prior items pertinent to RCP operation (Section 3.2.2), natural circulation in the RCS (Section 3.9.6), and RCS voiding (Section 3.4.2) should also be considered in treatment of this topic.

3.10 Containment Control

3.10.1 Summary of ATOG

Some containment control instructions are given in Section II and in Cooldown Procedure CP-101.

In Section II, Vital System Status Verification, the operator verifies after each reactor trip that containment isolation, containment cooling, and containment spray have actuated as required. If any of the systems is not responding properly, troubleshooting is performed using the related System Auxiliary Diagram.

Containment control steps of Cooldown Procedure CP-101 are performed after any event which has caused an unisolated reactor coolant leak to the containment (either from a break or the PORV). The steps include:

(1) starting the containment coolers at high containment pressure, temperature, radiation, or high hydrogen concentration.

(2) controlling the pH of the coolant recirculated through the containment sumps,

(3) terminating containment spray when no longer needed, and

(4) operating the hydrogen purge system as needed.

In addition to the steps in ATOG Part I, ATOG Part II includes an extensive discussion of containment control. It provides useful guidance for long-term accident mitigation. The summary tables of Part II give, in a compact form, the rules for:

(1) containment isolation at high pressure, high radiation, and low RCS pressure,

(2) control of cooling and spray systems at various containment pressure and temperature conditions,

(3) control of cooling, spray, and hydrogen purge systems at various containment radiation and hydrogen concentration conditions,

(4) control of pH, boron concentration, and level in the containment sumps, and

(5) control of containment penetration room ventilation system.

Most of the containment control actions, as instructed in ATOG, are apparent and directly related to system design conditions. An exception is control of coincident high radiation and high hydrogen concentration which requires a trade-off decision between large releases and increased risk of hydrogen combustion. ATOG contains a recommendation to stop hydrogen purge if radiation increases above a certain limit. The limit is not yet specified. To suppress hydrogen ignition, the containment spray is started at a hydrogen concentration of 4%. Continuous spray operation is assumed to prevent ignition.

3.10.2 Staff Findings

The guidance given in ATOG PART I should be expanded to include the type of information given in ATOG PART II. The areas that should be addressed are:

(1) 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.

(2) Guidelines for reactivation of the containment spray system should be addressed with respect to its influence on hydrogen flammability and flame propagation. Guidance should be provided for an envelope of containment conditions (H_2, steam, air concentrations) for which combustion would not jeopardize containment integrity as well as for restoration of operation

to within an acceptable envelope from regimes not within an acceptable envelope. (See also item 1, above.)

(3) Selection of H 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.

(4) Instructions for operation of hydrogen recombiners should be included or referenced.

(5) Guidelines for operator action to manually initiate containment isolation during an accident, and in particular, to isolate lines which provide direct communication between the containment atmosphere and the environment, should be considered.

(6) 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 action.

3.11 Staff Evaluation of Guideline Coverage for Initiating Events

The TMI Action Plan, Item I.C.1, requires that initiating events considered during emergency procedure guideline development include the events presented in the FSAR, loss of instrumentation buses, and natural phenomena such as earthquakes, floods, and tornadoes.

Regardless of the initiating event, the operator starts using ATOG after a reactor trip by entering Section I. The operator may enter Section IIID if a steam generator tube rupture is diagnosed before reactor trip. Once ATOG has been entered, the operator treats symptoms in a preferred order independent of the initiating event. For example, if one or more line breaks were caused by an earthquake, ATOG provides valid instructions for accident mitigation using available equipment, even though the initiating event is not explicitly addressed.

No explicit guidance is given in ATOG for natural phenomena. We understand some precautionary guides are provided in plant-specific procedures for action to be taken before an automatic reactor trip. The contents of these procedures depend on site-related conditions. We consider initiating events, such as natural phenomena, to be adequately treated. The approach of treating symptoms is such that a response to difficulties is provided without the need to identify the cause. In this sense, an initiating event caused by natural phenomena is no different from an event initiated by another cause.

ATOG should be extended to cover conditions other than reactor trip and power operation. The ATOG 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.

An acceptable alternate to incorporation of items in ATOG 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 ATOG, and to discuss the rationale for locating this material in these other procedures.

3.12 Staff Evaluation of Guideline Coverage for Multiple Failures

The TMI Action Plan, item I.C.1 (Ref. 2), provides examples of multiple failures. Our evaluation of these examples is as follows:

(1) Multiple tube ruptures. Multiple SG tube ruptures should be considered in ATOG. See Section 3.7.2.

(2) Feedwater failure. Failure of main and auxiliary feedwater is discussed in Sections 3.5 and 3.9. Secondary inventory control relies on availability of the feedwater or emergency feedwater systems. As alternate water sources, emergency feedwater from another unit and service water are mentioned. Further instructions on their use should be provided in the Oconee ATOG.

(3) Makeup system failure. Guidance for failure of the high-pressure reactor coolant makeup system should be included as part of the efforts discussed in Sections 3.8 and 3.13.

(4) ATWS events. Some guidance for protecting the plant against ATWS events is given in ATOG Section II. Discussion of the phenomena and operator response related to ATWS should be added to ATOG Part II and additional guidance developed for Part I.

To achieve core subcriticality, ATOG contains instructions for the operator to trip the reactor and then start HPI from the borated water storage tank or start emergency boration. For HPI failures or for chemical addition system failures, the operator may consult the related System Auxiliary Diagram. Guidance to achieving core subcriticality and listing all means to insert control rods or increase RCS boron concentration should be provided. Some ATOG updating is required immediately, as discussed in Section 3.3.2.

(5) Operator errors. Operator errors are not addressed explicitly in ATOG. However, since each error of importance will manifest itself as an abnormal system or plant response and will be treated accordingly, operator error is adequately covered.

NUREG-0737 did not provide a complete list of multiple failures, only examples. Additional areas which should be covered in the longer term are:

(6) Loss of AC Power (Station Blackout). ATOG should provide instructions for total loss of ac power. Plant-specific procedures relative to station blackout assume that the plant can be kept in a stable hot shutdown condition by operating the turbine-driven auxiliary feedwater pumps and by dumping steam to the atmosphere or to the condenser (the Oconee condenser can be cooled by gravity-driven water flow). This assumption is valid only as long as the RCS remains intact with sufficient inventory. RCP seal integrity at high pressure without cooling is questionable in the

long term. Thus, subsequent operator guidance to cool down and depressurize the plant without AC power should be studied as required by resolution of Unresolved Safety Issue A-44. Battery and inventory conservation measures should be provided to maximize the time available for ac power restoration. Additional ATOG changes may be needed following generic resolution of USI A-44.

(7) Loss of RCS pressure control. For reducing primary pressure, ATOG instructs the operator to use pressurizer spray or the PORV. Alternative instructions for depressurization should be provided. This is particularly important after a steam generator tube rupture (see Section 3.7.2) or during HPI cooling, where a depressurization without delay is necessary.

(8) Loss of RCS inventory control. For primary system inventory control, ATOG covers the available makeup means. The last resort is the LPI system which has to be available to maintain inventory. ATOG Part II also discusses the actions to be taken if sump recirculation flow is blocked and cannot replace lost coolant. The mitigating actions would be successful only if the primary system has no significant leaks below the DHR system suction. The ATOG Part II discussion should be written in guidelines format and added to Part I.

(9) SG pressure control. Secondary pressure control is based on turbine bypass and atmospheric dump valve operation. Backup means to dump steam should be listed and instructions on their use provided in the Oconee ATOG.

(10) Containment control. Multiple failures in the containment control systems can be addressed using the related System Auxiliary Diagrams. ATOG Part II provides a discussion on how the various systems can be used as backups for each other. The information in ATOG Part II should be expanded as outlined in Section 3.10.2, written in guideline format, and added to Part I to cover containment control failures.

3.13 Staff Evaluation of Calculations Supporting the Guidelines

Much of ATOG can be written without the support of detailed analyses. However, suitable analyses (for the scenarios discussed in the remainder of this section) are needed to:

(1) indicate which system parameters can be used to guide operator actions,

(2) demonstrate the feasibility of a recovery technique for some well defined accidents,

(3) Optimize steps which have potentially adverse side effects (e.g., increased loads on equipment, increased releases), and

(4) select the best recovery path.

Computer simulations have been made for the main success paths and for certain single failure paths of the following events:

(1) loss of main feedwater,
(2) loss of offsite power,
(3) excessive main feedwater,
(4) small steam line break, and
(5) steam generator tube rupture.

In addition to the calculations performed in the context of the ATOG program, the results of a separate B&W small-break analysis program have been used.

The calculations performed in support of the ATOG program have demonstrated the general applicability of the ATOG approach and have significantly enhanced the understanding of various events. The following work should be conducted in the longer term to provide adequate information for understanding transients, for operator training, and for development of guidelines:

(1) All calculations should be reevaluated and justified to assure that they have been extended in time sufficiently so that all significant portions of transients are covered. For example, calculations in ATOG Part II for small break LOCAs should indicate cyclic repressurization of the RCS when it may occur. Calculations for SGTRs should extend far enough into the transient to establish the time to cooldown and to show that operator actions are effective in establishing cooldown in a reasonable time with reasonable release of radioactive material to the environment.

(2) The codes used to calculate NSSS behavior should be verified by comparison to experimental systems data. Therefore, effort should continue to provide adequate quantitative data applicable to the B&W system thermal-hydraulic behavior. This is particularly important for several aspects of the B&W NSSS, such as the unique B&W hot leg and SG configurations.

(3) Transients where known or suspected unusual behavior are of concern should be covered. This includes consideration of upper head voiding, other RCS voiding, oscillatory flow behavior in the RCS, oscillatory pressure behavior, and long term cooldown (as identified in part in item (1), above). All calculated behavior should be examined for reasonableness and suitable information provided in ATOG Part II so that the operator obtains a good understanding of NSSS conditions. The assumptions used for calculations should be critically examined to assure they are consistent with the objective of illustrating ATOG application to events, particularly with respect to operator actions. Key assumptions should be stated.

Treatment of multiple failures should be expanded throughout ATOG and supported by calculations. Examples where further calculations are needed include:

(1) The applicability of SG tube rupture recovery techniques for ruptures larger than a single double-ended tube rupture should be demonstrated.

(2) The NSSS response to RCP restart in a partly steam-filled system should be investigated, particularly with respect to system pressure, void distribution, thermal stress, and CFT behavior, when the guidelines are followed. Effectiveness under ICC conditions should be investigated.

(3) Recovery from total loss of feedwater should be studied with respect to ATOG. In particular, restrictions for establishment of HPI cooling relative to SG secondary side emptying, pressure control of the secondary side (blowdown or attempt to maintain high pressure as long as possible), HPI capability, and availability of electrical power should be addressed. The SG tube stresses caused by differential thermal expansion resulting from HPI cooling should be studied. Emphasis should be on NSSS response when the guidelines are being applied, with evaluation of guidance effectiveness when confronted with various equipment failures and the influence of operator error.

(4) Possible recovery methods from a small-break LOCA with total loss of HPI should be studied.

(5) Means to reestablish primary-to-secondary heat transfer after hot leg voiding should be analyzed, including the use of RCPs as proposed in ATOG if this has not been covered in item (1), above.

(6) NSSS behavior after a total loss of AC power and evaluation of the NSSS response to operator actions should be analyzed, and guidance for the operator should be provided.

(7) Long-term recovery from small-break LOCAs, including potential pressure and temperature oscillations and their treatment as instructed in ATOG, should be analyzed.

3.14 Additional Staff Comments Regarding Part II.

Results from the analyses discussed in Section 3.13., as well as from previous analyses, should be incorporated into ATOG Part II, as appropriate, to provide the operator with an enhanced understanding of NSSS response under various conditions. Particular attention should be paid to coverage of RCS voiding and natural convection behavior. We require that the coverage of voiding and natural circulation be extended, with particular attention given to conditions and phenomena leading to and resulting from loss of natural circulation. We further require, at a minimum, that an interim extension in response to this requirement be provided prior to implementation, and the implementation of procedures based upon ATOG, as described in Reference 5, incorporate these items by the agreed date for implementation. More extensive coverage should be part of the longer term ATOG improvement program.

4 STAFF FINDINGS

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

4.1 Overview

ATOG will be acceptable as the basis for development and implementation of plant emergency procedures when extended to provide additional ATWS and natural circulation guidance. We require this ATOG extension be provided prior to implementation. Additional information on this requirement is provided in Sections 3.3.2, 3.9.6, and 3.14.

The approach to implementation of Procedures consists of two broad steps:

1. An initial implementation based on presently available Emergency Procedures Guidelines as modified in accord with the prior paragraph.

2. Updating as part of a longer term program which includes addition of the open items identified in the SER as well as a maintenance process.

The initial implementation will form the basis for "upgraded" operator instructions under emergency conditions. Initially, modified emergency procedures will be applied to provide more complete coverage. Updates will improve and extend coverage, as well as provide for the maintenance process, which will involve incorporation of new knowledge, correction, and general improvement.

Should an accident occur, and should the plant condition thereby warrant, either directly or due to additional failures, then the ATOG approach can provide a response to mitigate the event. The ATOG approach is based on the present condition of the plant, and it is not necessary for the operator to know how the plant arrived at 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 ATOG.

4.2 Longer Term Requirements

Items where ATOG coverage has not yet been obtained may be categorized in several areas. The major areas which should be addressed further in a longer term ATOG improvement program are as follows:

1. Multiple failures, particularly with respect to SGTR. (See SER sections 3.6.2, 3.7.2, 3.12, 3.13.)

Correction of an overfilled SG condition that results in water in the steam lines needs treatment. Alternate RCS depressurization guidance is needed, particularly to cover PORV and spray failures. ATOG coverage of multiple tube ruptures, in one SG and in both SGs, should be greatly expanded. A more comprehensive treatment is needed to better control RCS-SG secondary fluid transfer, provide improved long-term depressurization, and provide better control of environmental releases. Alternate control schemes for SG level are also needed.

2. Containment. (3.3.2, 3.10.2, 3.12)

The technical background for containment actions in Part II should be strengthened and the information should be provided as guidelines in Part I.

3. Technical thermal-hydraulic background, particularly for consideration of RCS voids and extension sufficiently far into the accident to cover all of the phenomena which impact or potentially impact operation. (3.4.2, 3.7.2, 3.9.4.2, 3.9.5.2, 3.12, 3.13)

A credible quantitative basis is needed to insure that ATOG guidance will result in operator actions which ameliorate the accident/transient.

RCS voids, including the upper head, should be adequately treated in ATOG. Plant response to depressurization via the PORV needs to be covered. Loss of NC followed by RCS repressurization and associated behavior should be extended beyond the work required for initial implementation (see first paragraph of Section 4.1). Plant behavior during various aspects of SGTR and illustration of response to the provided operator actions should be shown. Long-term plant response should be shown with particular attention to phenomena of interest expected beyond the time range provided by the present analyses. Timing of HPI, particularly if delayed and/or degraded, needs quantification. In some cases, suitable integral system data need to be provided to confirm calculated results. See also items 1, 4, 5, 6, 7, 8, 9, 10, and 11 where pertinent investigations may be needed.

4. Plant cooldown and interfacing with other (non-emergency) procedures. (3.2.2, 3.9.4.2, 3.9.6, 3.13)

The plant cooldown guidelines contain a large number of transfers between various instruction paths. These should be carefully reviewed to assure that internal loops without exits, and transfers into inappropriate or incorrect paths, do not occur. Interfacing to non-emergency procedures should be broadened and the means of transferring from those procedures to and from ATOG appropriately defined. Operator error in procedure selection and in transferring should be addressed.

HPI cooling effects on SG tube integrity should be evaluated.

Operation of the decay heat removal system with the RCS saturated should be evaluated.

5. Coverage of conditions which occur at other than power operation. (3.2.2, 3.11)

   ATOG should be extended to cover conditions other than reactor trip and power operation. ATOG 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.

   An acceptable alternate to incorporation of items in ATOG is to provide a definition of the appropriate coverage in other plant procedures, interfacing information in the ATOG, and discussion of the rationale for locating this material in other procedures, rather than ATOG.

6. Loss of AC power. (3.3.2, 3.12, 3.13)

   Perturbation of instrument displays, handling of unnecessary loads, conservation of inventory, actions to be taken upon power recovery, and plant cooldown-depressurization should be addressed.

   Note some aspects of this topic are the subject of the unresolved safety issue, A-44 - Station Blackout. Full resolution of this issue may require further ATOG changes.**

7. ATWS. (3.3.2, 3.12)

   Further actions to control ATWS which utilize existing plant equipment should be considered, and additional coverage and guidance for treatment of the expected phenomena should be provided.

8. PTS. (3.4.2, 3.9.4.2)

   Guidance should be provided for the case where pressure-temperature limits, typified by Figure 3, have been exceeded.

9. Post-ICC with core damage. (3.7.2, 3.8.2)

   This long-term item should be provided consistent with knowledge regarding handling of plants with degraded cores. Some work can be accomplished now, such as some aspects to control the plant with SGTR conditions (3.7.2, 3.8.2).

**Recognized weaknesses are expected to be addressed in a timely manner. We will not accept waiting for a complete resolution of an unresolved safety issue as a reason for not correcting weaknesses.

10. <u>RCP operation</u>. (3.3.2, 3.5.2, 3.6.2, 3.7.2, 3.8.2, 3.9.6, 3.13)

    Review of RCP operation with respect to trip, restart, and operation has not been completed due to the publication of Reference 6. There is a need for information regarding operation when the RCS is not in a subcooled condition.

11. <u>Instrumentation</u>.

    Guidelines which utilize the RCS inventory instrumentation should be provided to coincide with those instruments becoming operational (3.8.2).

12. ATOG, Part I, Section II, Step 8.0 instructs the verification of "No ES Alarms" when executing "Vital System Status Verification" after a reactor trip. This statement should be clarified to read "No ES Alarms or Conditions That Require an ES Alarm."

13. ATOG, Part I, Section IIIB, Step 6.1 instructs that, for a "Lack of Heat Transfer" with "lack of feed water either subcooled or saturated," EFW to both SGs should be initiated, but does not recognize that one SG may have been previously isolated. ATOG should address this condition and amend the guideline if needed.

14. ATOG, Part I, Section IIID, Steps 11.5, 11.8, and 17.1 instruct the use of TBVs for various operations. ATOG should provide additional guidance for determining the availability of the TBVs and alternate instructions for cases when TBVs are not available.

15. ATOG, Part I, Section IIID, Step 10 uses the word "when" in its instruction. ATOG must clarify if, by this instruction, it is intended to wait until the condition is achieved or if execution of subsequent steps is to be continued.

16. ATOG should justify the use of PORV operation in Part I, Section CP 102, Step 4.3 for depressurization in preference to use of an auxiliary pressurizer spray (for plants equipped with high pressure auxiliary spray).

17. With regard to the guideline tests to be used by the operator to verify natural circulation and heat transfer, ATOG should address apparent inconsistencies (e.g., Part I, Section CP-103, Step 4.2 versus Section CP-104, Step 10.1).

18. ATOG should resolve the inconsistency between Part I and Part II, Table 3 in selection of parameters to govern S.G. inventory control decisions.

19. ATOG, Part II, Table 46 has omitted all containment parameters except pressure as key indicators. ATOG should provide additional guidance to reflect the other parameters.

20. Analyses should be provided or referenced to support HPI performance discussions in ATOG, Part II, Chapter D (page 99).

21. ATOG, Part II, ICC discussion (P116) states that "special cooldown precautions need to be followed to contain...contaminants." The need for these special precautions should also be identified in the applicable locations in ATOG, Part I as requiring plant-specific evaluation and additions.

22. The method for reactor building temperature monitoring identified in ATOG, Part II, Section 3.5 (p. 220), should be justified as representative and its use explained.

23. The ATOG, Part II (p. 267) discussion of Loss of "Offsite Power/RC Pumps Not Running" should provide additional guidance on the capability and operation of the condenser.

24. ATOG, Part II, Appendix E (P. E-9) instructs that seal injection or CCW must be restored to RCPs within 60 seconds or the RCPs must be tripped. This requirement should be justified with regard to its adequacy for the hardware involved and the capability of the operator to execute the required actions.

25. ATOG, Part II, Appendix F introduces the term "boiling pot mode," which should be clarified to be consistent with the remainder of ATOG.

26. ATOG, Part II, Appendix F uses terms "very rapidly," and "slow." These terms do not reflect a mutually consistent time frame in this discussion and should be quantified for clarity.

27. ATOG, Part II, Table F-3 indicates that superheated conditions can be expected for up to 10 minutes after a large break LOCA, and that ICC need not be entered. Justification for the 10 minutes should be provided and further discussion should be submitted to address why this instruction will not lead to procedures calling for either a premature or late entry into ICC.

28. ATOG, Part I, Section III A, step 6.0 has been revised to instruct the operator to enter the Inadequate Core Cooling section if superheat is indicated by incore thermocouples (replacing coincidence indication by the incore thermocouples and hot leg RTDs). Clarification, revision and/or justification should be provided for other ATOG sections (including III, items 4.1 and 4.2, CP-103, item 8.0, and Figure III A) in which indications utilized for inadequate core cooling are not consistent with revised Part I, Section III A step 6.0.

29. Figures A-7, C-3, D-9, and E-4, revised per the discussion in March 14, 1983 letter, Attachment A, should be provided to confirm resolution of associated clarification/consistency items.

A positive response to the above twenty-nine items, which also includes attention to the detail provided in Section 3 of this SER, should complete coverage of all of the items necessary to meet the need for Emergency Procedures Guidelines as evaluated in this SER. With regard to future Owners Group responses to these concerns, we emphasize that the examples cited in most cases are intended only to clarify the concern, and are not intended to identify all instances where the concern occurs in ATOG. As part of the resolution of these items, the B&W Owners Group should assure that all instances have been addressed.

4.3 Human Factors Discussion

The staff has conducted a general human factors review of the Oconee 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 with the B&W Owners on August 14, 1981, in Bethesda, MD, the staff expressed concern about Abnormal Transient Operating Guidelines (ATOG) being sufficiently function oriented to ensure mitigative corrective action without diagnosis of the initiating event. The staff also expressed a concern regarding consistent application of ATOG at all B&W facilities, since plant specific rather than generic guidelines were being developed by B&W for the Owners.

The NRC staff visited the B&W training facility in Lynchburg, Virginia, on September 4, 1981, to observe use of the ATOG on the B&W simulator. The purpose of the observation was to determine if the ATOG were sufficiently function oriented, and to have further discussions with the B&W staff regarding the ATOG program. The discussions and observations revealed that the ATOG approach is symptom oriented rather than strictly function oriented (i.e., rather than have procedures address a number of discrete functions), B&W combined various functions into symptom categories. On the basis of the observations and discussions with B&W, we have concluded that these guidelines provide an adequate mitigative strategy that is independent of early event diagnosis.

At the request of the NRC staff, B&W added a section to ATOG that discusses use of ATOG. This provides information to operators for use in training and to plant staff for writing emergency operating procedures from the ATOG. Based on this information and our discussions with the B&W Owners Group Operations Support Subcommittee at meetings held September 4, 1981, November 5, 1981, and March 4, 1982, we find that the ATOG provides 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. "Oconee Nuclear Station, Unit 3, Abnormal Transient Operating Guidelines (ATOG)," 74-1123297-00, Babcock & Wilcox, Nuclear Power Generation Division, March 23, 1982; with revisions transmitted to Darrell G. Eisenhut, Director, Division of Licensing, NRC, via letter from Daniel D. Whitney, Chairman, Operator Support Subcommittee, Babcock & Wilcox Owners Group, June 15, 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 Recommendations, NUREG-0578, July 1979.

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

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

7. "Abnormal Transient Operating Guidelines (ATOG) Program Description, prepared for B&W Owners Group, Operator Support Committee," Document I.D. 47-1132940-00, Babcock & Wilcox (no date).

8. Napior, D. A., "Resolution of NRC Comments on Oconee ATOG," letter from B&W to B&W Owners Group, Operator Support Committee, March 14, 1983.

9. Whitney, D. D., "B&W Owners Group Emergency Procedures Guidelines (ATOG)," letter from B&W Owners Group, Operator Support Committee to D.G. Eisenhut (NRC), May 4, 1983.

10. Whitney, D. D., "B&W Owners Group Emergency Procedures Guidelines (ATOG)," letter from B&W Owners Group, Operator Support Committee to D. G. Eisenhut (NRC), May 21, 1983.