CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

EMERGENCY OPERATING PROCEDURES
GENERATION PACKAGE

REVISION 1

ABSTRACT

The purpose of this document is to identify the elements used by Carolina Power & Light Company's Brunswick Steam Electric Plant to prepare and implement improved symptom oriented emergency operating procedures (EOPs) for use by Control Room personnel to assist in mitigating the consequences of a broad range of accidents and multiple equipment failures. This document applies only to the EOPs so designated; it does not address emergency preparedness or emergency planning.

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A. INTRODUCTION

1. Purpose and Scope

This document identifies the elements used by Carolina Power & Light Company's Brunswick Steam Electric Plant to revise its emergency operating procedures. The Brunswick EOPs have been restructured and reformatted to a symptom basis; i.e., converted to a function oriented procedure as opposed to the event oriented procedure. The revised EOP will provide the operator with improved directions to mitigate the consequences of a broad range of accidents and multiple equipment failures. The guidance provided in this document applies only to Brunswick's EOPs and not to other procedures; e.g., plant emergency procedures (PEPs).

This document is based upon the NRC Guideline for Preparation of Emergency Operating Procedures; i.e., NUREG-0899, August 1982.

2. Background

Shortly after the accident at TMI, the NRC formed the Bulletins & Orders Task Force (B&OTF) within the Office of Nuclear Reactor Regulation. The task force was responsible for reviewing and directing the NRC activities associated with the Three Mile Island type accident for all operating plants to assure their continued safe operation.

On the basis of NRC's review, it was concluded that the General Electric designed boiling water reactor plants were quite capable of coping with small break LOCAs and with feedwater transients with or without stuck open relief valves.

The NRC did, however, identify improvements in the systems, procedures, and analysis, which will make the GE designed BWRs less susceptible to core damage during accidents and transients, coupled with system failures or operator errors. One of the recommendations from the B&OTF was to restructure and reformat the current EOPs from an event basis to a symptom basis. The symptom based emergency operating procedures would be categorized according to general plant symptoms, such as loss of coolant inventory, as opposed to several separate existing associated procedures; i.e., LOCA inside containment, LOCA outside containment, and loss of normal feedwater.

The Loss of Coolant Inventory procedure would include the essential features of those existing procedures associated with LOCA inside containment, LOCA outside containment, and loss of normal feedwater, but would make use of the fact that the initial operator response for the latter procedures are similar.

Shortly after the TMI accident, the Owners Groups were formed to study and resolve problems associated with the operation of their plants. The GE Owners Group concurred with the NRC and recommended that the emergency operating procedures for nuclear plants be restructured and reformatted to a symptom basis, as opposed to the more event specific basis.

The Owners Group developed a generic guideline to be used by the utilities to produce symptom based or function oriented emergency operating procedures. This guideline; i.e., Emergency Procedure Guidelines, Revision 2, NEDO-24934, June 1982, was reviewed and approved by the Office of Nuclear Reactor Regulation and issued to all licensees on February 8, 1983 (Generic Letter 83-05).

B. BRUNSWICK STEAM ELECTRIC PLANT EMERGENCY OPERATING PROCEDURE UPGRADE PROGRAM

The Brunswick emergency instructions (EIs) were found to have several deficiencies. One of these deficiencies was that there were too many EIs. No clear guidance was provided to help the operator determine which EI to use during multiple failures.

Event based procedures are inadequate because they place a greater burden upon the Reactor Operator in that each event must be classified prior to being able to pick up the right procedure. The operator must then remember the immediate action to be performed. If more than one procedure is required concurrently, which is usually the case, the operator must establish the priority of actions.

This type of emergency operating procedure results in no systematic and consistent method established for handling emergency conditions.

The Brunswick EOP Upgrade Program consisted of the following general outline (see Figure 1):

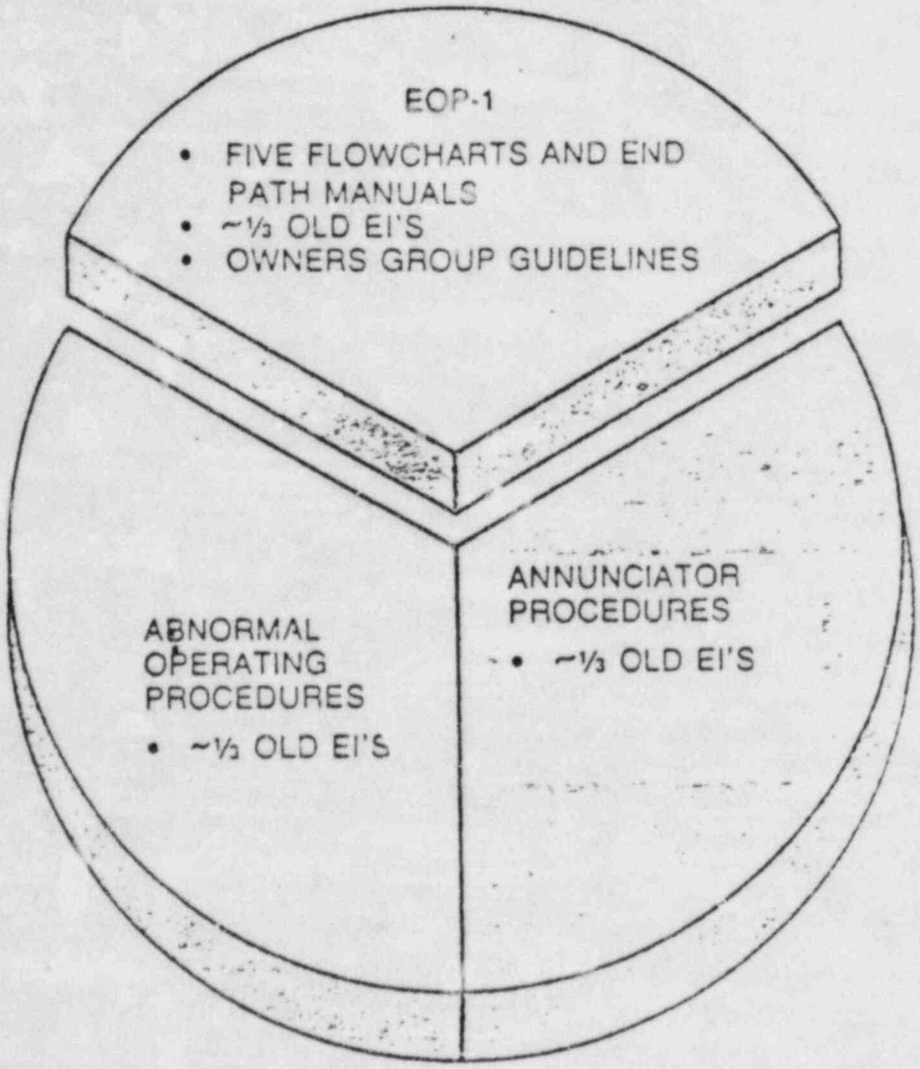
1. Converted some existing emergency instructions into annunciator procedures.

2. Converted some existing emergency instructions into abnormal operating procedures (AOPs).

3. Reworked remaining emergency instructions and the generic guidelines into function oriented immediate action flowcharts and subsequent action End Path Manual procedures.

The Brunswick emergency instructions were reviewed to determine their applicability to the EOP. The general guide used was to place actions required prior to a reactor scram into an AOP or annunciator procedure. The actions required subsequent to a scram were written into the appropriate sections of the EOP. The disposition of all emergency instructions was documented to ensure all necessary procedural guidance was retained.

FIGURE 1



EMERGENCY OPERATING PROCEDURES
RESTRUCTURE

The generic guideline and the Brunswick PSTG were developed as guidelines from which a plant-specific EOP should be developed. These guidelines lack the detail necessary to be an effective procedure. If the Brunswick PSTG (or the generic guideline) was used as a procedure, it would be possible for the operator to be in as many as eight procedures concurrently. In order to make the procedure usable for operators, the initial actions upon entering the EOP have been prioritized.

The entry condition to the Brunswick EOP was defined as any reactor scram signal, manual or automatic. In order to prioritize the initial operator actions, a list of key parameters was developed. The key parameters diagnose the plant conditions and quickly places the operator in the appropriate procedure. These key parameters are at the top of each flowchart. Using this method, the operator need only remember to pick up any of the five flowcharts following a scram. The key parameters on each flowchart will then direct the operator to the appropriate procedure.

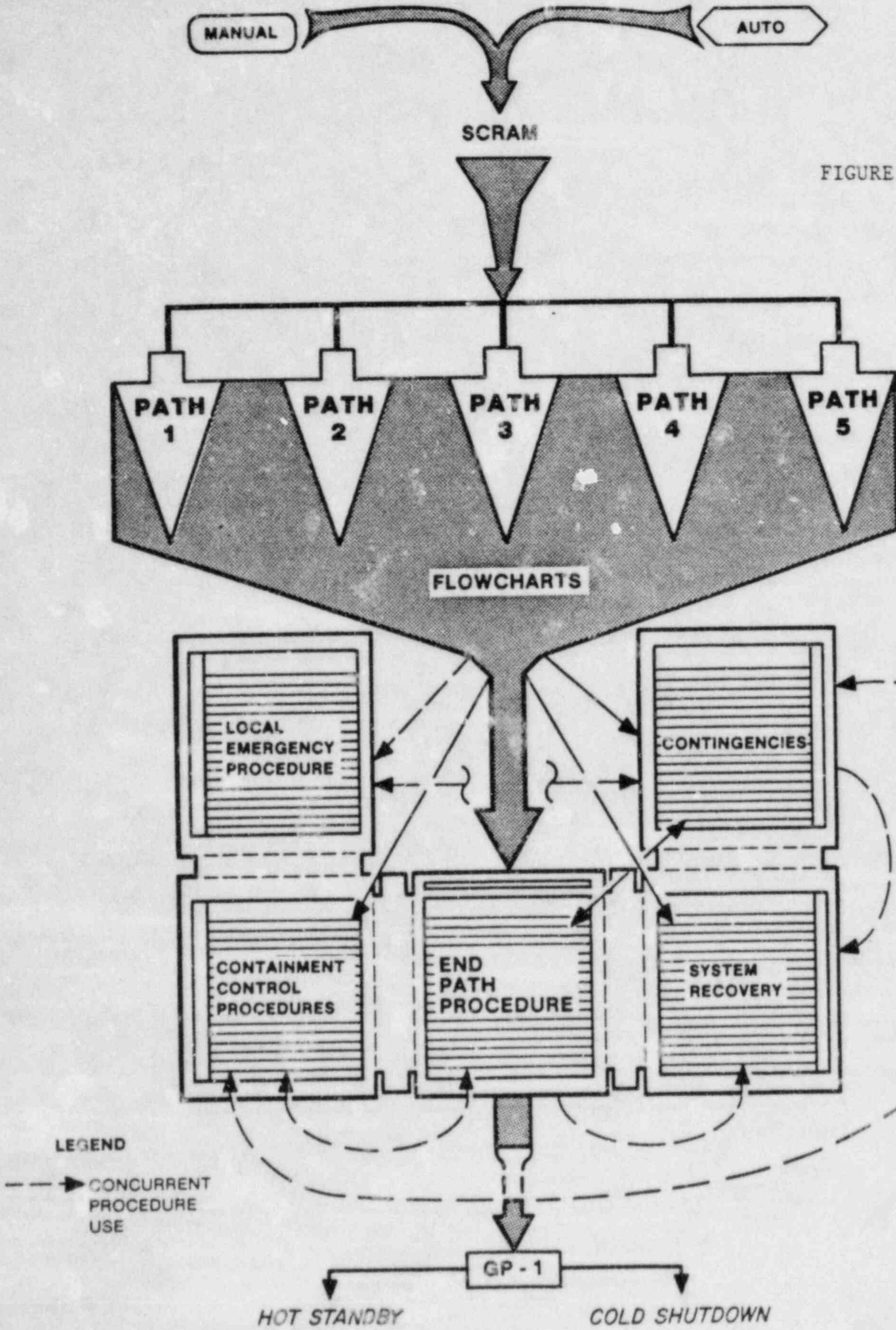
As an example, if a scram occurs the operator will pick up any one of the five flowcharts and insert a manual scram. The next block on all flowcharts is the first key parameter; a decision block that asks if reactor power is less than 3%. If reactor power is not less than 3%, the operator will be directed to enter path 1 which contains reactivity control steps early in the procedure. If reactor power is less than 3%, reactivity control is a lower priority and the operator will continue to the next key parameter (see Figure 1).

Each flowchart contains the guidance necessary to control reactor vessel level, pressure, and power. The RPV control guideline in the PSTG simply requires that upon entry to the guideline, RC/L (reactor water level control), RC/P (reactor pressure control), and RC/Q (reactor power control) be executed concurrently. Using the key parameters relieves the operator of the burden of executing three procedures concurrently. It should be noted that this method does not skip or delete steps contained in the PSTG, it simply diagnoses the plant conditions and prioritizes initial operator actions.

The containment control guideline and the contingency procedures were not prioritized. The necessary plant-specific details--numerical limits, graphs, etc., were added. These procedures are in the End Path Manual.

Once the flowchart steps are completed, the operator will be directed from the flowchart to one of the sections of the End Path Manual. The End Path Manual is a specially designed binder that holds five sections. The manual folds out in a manner that allows concurrent use of all five sections of the manual without interference (see Figure 2). Under

FIGURE 2



BRUNSWICK EOP NETWORK

normal conditions, the operator will enter the end path procedure from the flowchart. The end path procedure will then direct the operator to other sections of the End Path Manual as required. It is possible, under degraded conditions, to enter a contingency procedure directly from the flowchart. The flowchart will establish that the entry conditions to the contingency procedure have been met and direct the operator to the appropriate procedure from the flowchart.

In order to ensure that all the steps from the PSTG are reflected in the EOP, Appendix III, Attachment B was developed. This attachment outlines where and how the steps of the PSTG were used in the EOP.

The following list of Brunswick EOP improvements was accomplished as a result of the upgrade program:

1. Made immediate operator actions visible.

2. Reduced reliance on operator memory.

3. Guided operator to appropriate procedure.

4. Removed confusion as to which procedure applied.

5. Improved operator awareness of total plant conditions.

6. Improved operator decision-making process.

7. Improved operator training for emergency conditions.

8. Provided operator job performance improvement.

C. BRUNSWICK STEAM ELECTRIC PLANT PLANT-SPECIFIC TECHNICAL GUIDELINE

The generic guideline was used as a basis for the Brunswick Plant-Specific Technical Guideline. The format and arrangement of the Brunswick guideline closely parallels the generic guideline.

Since the Brunswick technical guideline is based upon the generic guideline, which has been validated by the Owners Group and approved by the NRC, there is no requirement to validate the Brunswick Plant-Specific Technical Guideline.

The brackets in the generic guideline enclose plant unique setpoints, design limits, pump shutoff pressures, etc., and parentheses within brackets indicate the source for the bracketed variable. The generic guidelines are generic to GE-BWR-1 through six designs in that they address all major systems which may be used to respond to an emergency. Because no specific plant includes all of the systems in these guidelines, the guidelines are applied to individual plants by deleting statements which are not applicable or by substituting equivalent systems where appropriate.

In converting the generic guideline into the Brunswick PSTG, the processes listed above were used. Where brackets were used, plant unique information was inserted. In order to ensure the accuracy of this information, the source of each parameter used in the PSTG has been listed in Appendix III, Attachment A. In addition, as part of a general validation/verification process, and independent review and verification was performed of all numerical limits and graphs contained in the Brunswick PSTG and EOPs. This included both calculated limits and graphs and limits determined directly from plant data.

Where the generic guideline contains systems that Brunswick does not have, the systems are deleted or equivalent systems inserted. This is not considered a deviation from the generic guideline since the intent of the guideline is met; i.e., using whatever systems are available at Brunswick to accomplish the required action.

All deviations from the generic guideline are documented in Appendix III, Attachment C. Deviations include using numerical limits other than those specified, deleting or altering steps that apply to Brunswick, or changing any step in the generic guideline that would change the intent of the guideline. All deviations require justification which are included in Appendix III, Attachment C.

D. BRUNSWICK STEAM ELECTRIC PLANT WRITERS' GUIDE FOR EMERGENCY OPERATING PROCEDURES

The Brunswick EOP Writers' Guide is based upon the requirements of Guidelines for the Preparation of Emergency Operating Procedures, NUREG-0899, August 1982, Section 5.0, Plant-Specific Writers' Guide, and the industry's Emergency Procedures Writing Guideline, INPO-82-017, July 1982.

The Brunswick EOP Writers' Guide contains all the necessary information and guidance for translating the technical information into Brunswick's EOPs (see Appendix II).

E. BRUNSWICK STEAM ELECTRIC PLANT VALIDATION/VERIFICATION PROGRAM FOR EMERGENCY OPERATING PROCEDURES

The Brunswick EOPs have undergone an extensive process of validation/verification to establish the accuracy of information provided and to determine that these procedures can be accurately and efficiently carried out.

The validation/verification process has addressed both technical and human engineering adequacy of the Brunswick EOPs.

All Brunswick licensed personnel, consisting of operators and engineers, have participated in extensive classroom (desk top reviews) and simulator exercises, using the upgraded EOPs during special courses and annual requalification training. Simulator exercises have been conducted at three simulators; i.e., Browns Ferry, Limerick, and Hatch.

A preimplementation training session for all licensed personnel was completed in late 1983. The training was conducted on the Brunswick simulator.

The EOPs were revised many times during the EOP development phases as a result of licensed personnel comments and recommendations. This experience indicates, with a large degree of confidence, that the upgraded Brunswick EOPs are adequate to mitigate transients and accidents.

1. Objectives of the Brunswick Validation/Verification Process

Objective 1: The Brunswick EOPs are technically correct; i.e., they accurately reflect the technical guidelines.

Discussion: The GE Owners Group has validated and the NRC has approved the Generic Emergency Operating Procedure Guidelines (Revision 2). The generic guideline was used to develop the BSEP Plant-Specific Technical Guideline and the Brunswick EOPs.

Objective 2: The Brunswick EOPs are written correctly; i.e., they accurately reflect the writers' guide.

Discussion: The Brunswick EOP Writers' Guide was used in the preparation of the EOPs (see Appendix II). The purpose of the writers' guide is to provide administrative and technical guidance on the preparation of EOPs to ensure they are complete, accurate, convenient, readable, and acceptable to the BSEP Control Room personnel.

Objective 3: The Brunswick EOPs are usable; i.e., they can be understood and followed without confusion, delay, or errors.

Discussion: Brunswick's licensed personnel experience in the use of the new EOPs during classroom and simulator exercises has demonstrated that the procedures can be accurately and efficiently carried out and that the EOPs are adequate to mitigate transients and accidents.

The General Physics Corporation conducted a Human Factors Review of the Brunswick flowcharts.

Comments and recommendations from the licensed personnel at Brunswick and General Physics Corporation (Human Factors Review) were used to revise; i.e., improve the EOPs.

Objective 4: There is a correspondence between the EOPs and the Brunswick Control Room/plant hardware; i.e., control/equipment indications that are referenced are available (inside and outside the Control Room), use the same designation, use the same units of measurement and operate as specified in the procedures.

Objective 5: The language and level of information presentation in the Brunswick EOPs is compatible with the minimum number, qualifications, training, and experience of the plant operating staff.

Objective 6: There is a high level of assurance that the Brunswick EOPs work; i.e., the procedures guide the operator in the mitigation of transients and accidents.

Discussion: The licensed operator training sessions, Brunswick Control Room walk-throughs, preimplementation reviews by ONS, QA, Operations, and Engineering, and an independent Human Factors Review adequately substantiates that Objectives 4, 5, and 6 have been met.

2. Methods of Brunswick EOP Validation/Verification

The methods of Brunswick EOP validation/verification are listed as follows (see Appendix III):

a. Desk top reviews

b. Simulator exercises

c. Control Room walk-throughs

   (1) Phase I (operational scenarios)

   (2) Phase II (check of each step of EOP)

   (3) Back panel walk-through

   (4) Outside Control Room walk-through

d. Preimplementation review of Brunswick EOPs

e. Documentation of technical guidelines (see Appendix III, Attachments A, B, and C)

f. Independent Human Factors Review (summary)

F. BRUNSWICK STEAM ELECTRIC PLANT SYMPTOMATIC EMERGENCY OPERATING PROCEDURES TRAINING

All Brunswick licensed personnel; i.e., operators and engineers, have had extensive training in the use of the new EOPs (see Figure 3 and Appendix IV). During the training sessions, comments and recommendations from the trainees were recorded. A response to each comment was made by the EOP development group and was sent to the Shift Operating Supervisor for each group of operators. This method of feedback encouraged operator input to the new EOP development process. The EOPs were greatly improved by this valuable input.

A daily quiz was given to each trainee during this training. The trainees participation and quiz grade were documented (see Figure 4). The trainees were also evaluated during the simulator training (see Figure 5).

Simulator exercises were selected to meet the following objectives:

1. Control manipulations required by the Harold Denton letter, dated March 28, 1980, Enclosure 4.

2. Exercise all portions of the flowcharts.

3. Exercise all procedures in the End Path Manual that the simulator is capable of simulating.

4. Exercise flowchart branching; i.e., path-to-path arrow changes, key parameter changes, path-specific parameter changes.

The simulator exercises used for validation and verification were also used for training. Examples of these exercises are included in Appendix III.

The licensed personnel at Brunswick received the following EOP training:

1. Initial Classroom Training

   a. Location: Plant Training facility

   b. Subjects:

      (1) Course Description

      (2) Background

      (3) Existing BSEP Procedures

      (4) BSEP's Approach to Owners Group Guidelines (EPGs)

      (5) Use of Brunswick's New EOPs

c. Duration of training per group: Four days

d. Number of groups: Five

e. Schedule: Beginning February 3, 1982 (three days each week), ending March 5, 1982

The objective of initial operator training was to licensed personnel to the concepts of symptom-based procedures. The initial draft of the flowcharts were used during this training to introduce licensed personnel to techniques of flowchart use and get their response to using flowcharts for operator actions. The response to flowchart use was very favorable.

2. Initial Simulator Training

a. Location: Limerick simulator

b. Subject: Simulator Training Using New Symptomatic Emergency Procedures

c. Duration of training per group: Four days

d. Number of groups: Twelve

e. Schedule: Beginning March 13, 1982, ending May 18, 1982

This training involved actually using the flowcharts on the Limerick simulator. The flowcharts used were the initial draft. The End Path Manual procedures were not developed for this training.

3. Emergency Procedure Guideline Training

a. Location: Plant Training facility

b. Subject: GE Owners Group Guideline (EPGs)

c. Duration of training per group: Four days

d. Number of groups: Eight

e. Schedule: Beginning December 1982, ending May 1983

This training session introduced licensed personnel to the concepts of the generic guideline and how they were used in the Brunswick EOP. During this training, the containment control and contingency procedures were reviewed.

4. Simulator Training

   a. Location: Hatch simulator

   b. Subject: Simulator Training Using New Symptomatic Emergency Procedures

   c. Duration of training per group: Four days

   d. Number of groups: Fourteen

   e. Schedule: Beginning January 31, 1983, ending May 29, 1983

   This training involved using flowcharts, end path procedures, and containment control and contingency procedures. The remainder of the procedures in the End Path Manual were not developed.

5. EOP Preimplementation Training

   a. Location: Brunswick simulator/classroom

   b. Subjects:

      (1) Flowcharts

      (2) End Path Manuals

      (3) EOP Network

      (4) BSEP EOP Limits

      (5) EOP Exercises

      (6) Operation Outside License Conditions or Technical Specifications

      (7) EOP Administrative Controls

   c. Duration of training per group: Four days

   d. Schedule: Beginning November 7, 1983, ending December 30, 1983

   This training involved using flowcharts and all End Path Manual procedures in the classroom and on the simulator. While not all procedures could be exercised on the simulator, each procedure in the End Path Manual was reviewed in the class to ensure all personnel were adequately trained on all aspects of the EOP.

6. EOP Training for Auxiliary Operators

The Brunswick Auxiliary Operators received the following EOP training:

a. Location: Plant Training facility

b. Subject: EOP Training for Auxiliary Operators

c. Duration of training: Sixteen hours

d. Schedule: Beginning November 7, 1983, ending December 30, 1983

This training ensured that Auxiliary Operators were adequately trained in the portions of the EOP they would be expected to perform; i.e., steps that are performed outside the Control Room.

G. EMERGENCY OPERATING PROCEDURE ADMINISTRATIVE CONTROL

The Brunswick Administrative Procedures Manual, Volume I, Section 5.5.2, generally outlines how the EOPs are to be maintained.

When changes occur in the plant design, technical specifications, technical guidelines, writers' guide, other plant procedures, or Control Room that will affect the EOPs, they shall be revised on a timely basis to reflect these changes. In addition, when operating and training experience, simulator exercises, Control Room walk-throughs, or other information indicate that incorrect or incomplete information exists in the EOPs, they shall be revised on a timely basis.

Any revision to the EOP must be consistent with the following documents:

1. Brunswick EOP Writers' Guide

2. Brunswick EOP Technical Guideline

3. Brunswick EOP Calculation Procedures

4. General Electric Topical Report, NEDO-24934, Emergency Procedure Guidelines' latest revision

The EOP Committee (see Section D of Appendix III) will be an ongoing EOP review committee at Brunswick. Changes to the EOP will be approved by the EOP Committee as well as the normal administrative procedure for document control. The EOP Committee will determine if the change requires validation and verification and what type of validation and verification is required. A permanent procedure will be developed which will described the requirements and the process for the continuing validation and verification of the EOP.

FIGURE 3

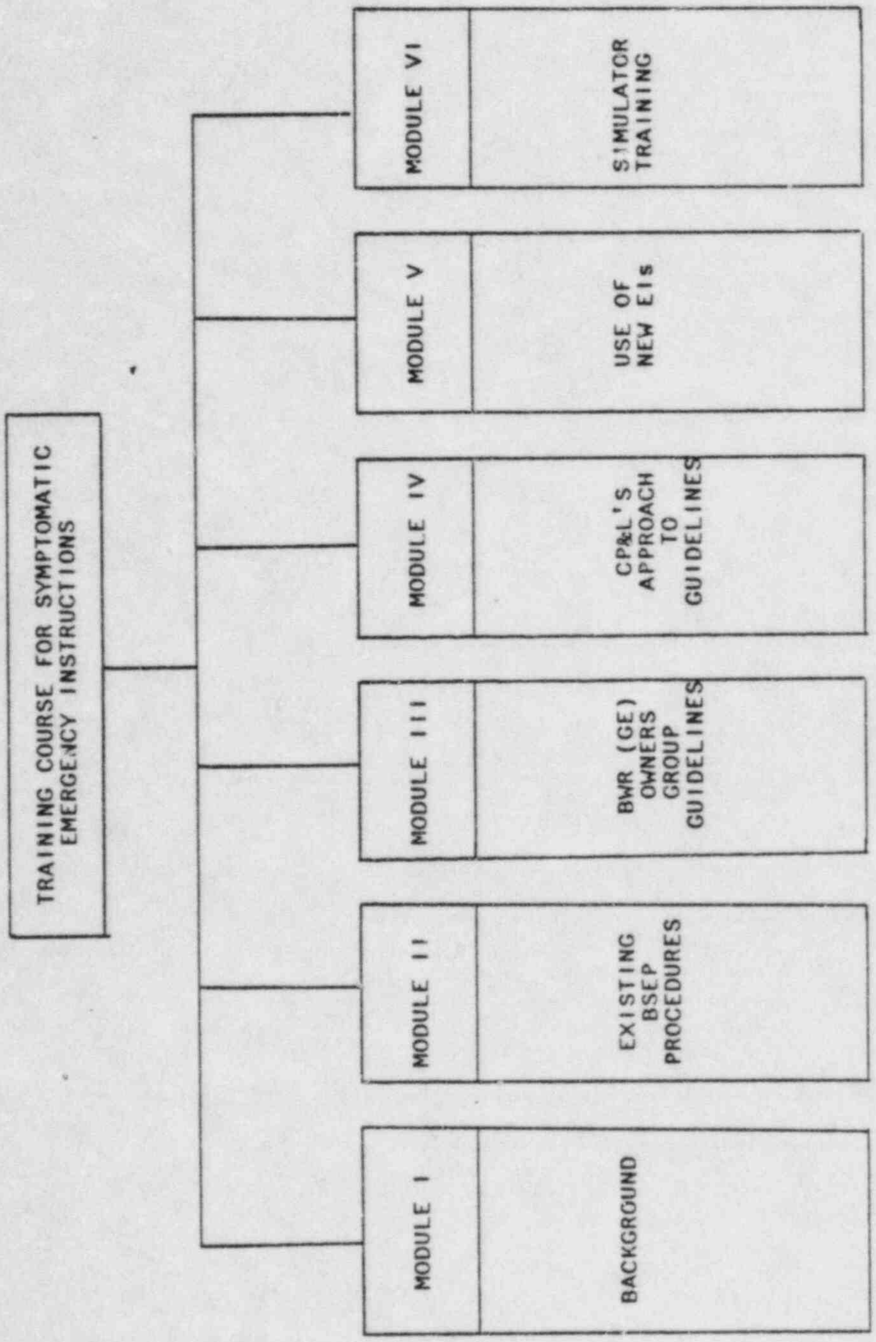

TRAINING COURSE FOR SYMPTOMATIC EMERGENCY INSTRUCTIONS
MODULE I
BACKGROUND
MODULE II
EXISTING BSEP PROCEDURES
MODULE III
BWR (GE) OWNERS GROUP GUIDELINES
MODULE IV
CP&L'S APPROACH TO GUIDELINES
MODULE V
USE OF NEW EIs
MODULE VI
SIMULATOR TRAINING

FIGURE 4

CLASSROOM TRAINING

SYMPTOMATIC EMERGENCY OPERATING INSTRUCTIONS

TRAINEE'S NAME ______________________________

INSTRUCTOR'S NAME ______________________________

DATES OF TRAINING ______________________________

DATE	COURSE OR SUBJECT	QUIZ	CLASS PARTICIPATION		
			S	NI	U

S = SATISFACTORY

NI = NEEDS IMPROVEMENT

U = UNSATISFACTORY

NOTE: If NI or U evaluation is made, the instructor must explain in Remarks section.

REMARKS

FIGURE 5

SIMULATOR TRAINING

SYMPTOMATIC EMERGENCY OPERATING INSTRUCTIONS

NAME ______________________________ LICENSE ______________

DATE	POSITION	DESCRIPTION OF EXERCISE	A	B	C	D	E	F	G	H

*
A = USED PROPER PROCEDURE
B = USED PROCEDURE CORRECTLY
C = EXECUTED PATH CHANGES CORRECTLY
D = ENTRY TO AND USE OF END PATH PROCEDURE MANUALS
E = COMMUNICATION
F = ACTION TAKEN WHEN KEY PARAMETERS CHANGE
G = ACTION TAKEN WHEN PATH-SPECIFIC PARAMETERS CHANGE
H = SYSTEM MANIPULATION AND VERIFICATION

REMARKS (MANDATORY IF ANYTHING OTHER THAN SATISFACTORY)

SAT = S NEEDS IMPROVEMENT = N
*OPERATOR ACTION TAKEN

INSTRUCTOR ______________________________

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

APPENDIX I

PLANT-SPECIFIC TECHNICAL GUIDELINE FOR EMERGENCY OPERATING PROCEDURES

INTRODUCTION

Based on the BWR system design, the following Symptomatic Emergency Procedure Guidelines have been developed:

- RPV Control Guideline
- Containment Control Guideline

The RPV Control Guideline restores and maintains RPV water level within a satisfactory range, shuts down the reactor, controls RPV pressure, and cools down the RPV to cold shutdown conditions. This guideline is entered after low RPV water level, high drywell pressure, or an isolation has occurred or when a condition which requires reactor scram exists and reactor power is above 3% or cannot be determined.

The Containment Control Guideline controls primary containment temperatures, pressure, and level whenever suppression pool temperature, drywell temperature, drywell pressure, or suppression pool water level is above its normal operating limit or suppression pool water level is below its normal operating limit.

At various points throughout these guidelines, precautions are noted by the symbol /_#_/. The number within the box refers to a numbered "Caution" contained in the Operator Precautions section. These "Cautions" are brief and concise red flags for the operator.

At various points within these guidelines, limits are specified beyond which certain actions are required. While conservative, these limits are derived from engineering analyses utilizing best-estimate (as opposed to licensing) models. Consequently, these limits are not as conservative as the limits specified in a plant's Technical Specifications. This is not to imply that operation beyond the Technical Specifications is recommended in an emergency. Rather, such operation may be required under certain degraded conditions in order to safely mitigate the consequences of those degraded conditions. The limits specified in the guidelines establish the boundaries within which continued safe operation of the plant can be assured. Therefore, conformance with the guidelines does not ensure strict conformance with a plant's Technical Specifications or other licensing bases.

The entry conditions for these Emergency Procedure Guidelines are symptomatic of both emergencies and events which may degrade into emergencies. The guidelines specify actions appropriate for both. Therefore, entry into procedures developed from these guidelines is not conclusive that an emergency has occurred.

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OPERATOR PRECAUTIONS

****

CAUTION #1

Monitor the general state of the plant. If an entry condition for either the RPV Control Guideline or the Containment Control Guideline occurs, enter that procedure. When it is determined that an emergency no longer exists, enter the normal Operating Procedure.

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CAUTION #2

Monitor RPV water level and pressure and primary containment temperatures and pressure from multiple indications.

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CAUTION #3

If a safety function initiates automatically, assume a true initiating event has occurred unless otherwise confirmed by at least two independent indications.

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CAUTION #4

Whenever RHR is in the LPCI mode, inject through the heat exchangers as soon as possible.

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CAUTION #5

Suppression pool ⌐perature is determined by:

Unit 1 Only:

The average of Computer Points W108 and W117
OR
The average of Points 14 and 21 on CAC-TR-1258.

Unit 2 Only:

Point 1 on CAC-TR-4426 OR
Point 1 on CAC-TR-4426 OR
Computer Point G050 OR
Computer Point G051.

Drywell average temperature is determined by Computer Point C074 on PT-16.2.

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CAUTION #6

Whenever temperature near the instrument reference leg vertical runs exceeds the temperature in the table and the instrument reads below the indicated level in the table, the actual RPV water level may be anywhere below the elevation of the lower instrument tap (see page 6).

Temperature	Indicated Level	Instrument	
Any	255 in	Shutdown Range Level	150 to 550 in
Any	54 in	Wide Range Level	0 to 210 in
304°F	170 in	Narrow Range Level	150 to 210 in

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CAUTION #7

Heated reference leg instrument B21-N026A and B indicated levels are not reliable during rapid RPV depressurization below 500 psig. For these conditions, utilize cold reference leg instruments to monitor RPV water level.

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NOTE

DRYWELL TEMPERATURE NEAR THE LEVEL INSTRUMENT REFERENCE LEGS IS DETERMINED BY:

UNIT ONE ONLY

A THE AVERAGE OF POINTS 1,2, 3 AND 4 ON CAC-TR-1258

OR

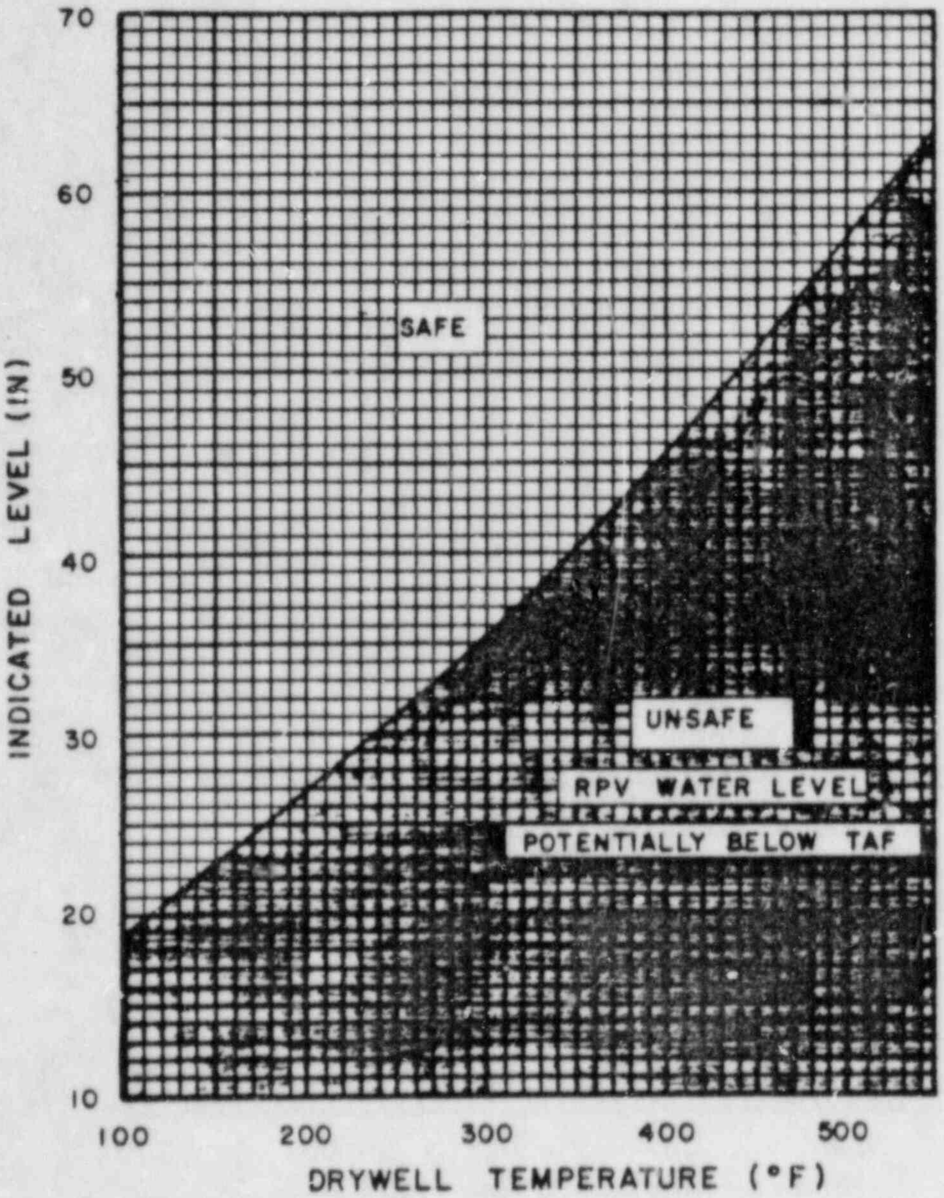
THE AVERAGE OF COMPUTER POINTS W109, W110, F147 AND F148.

UNIT TWO ONLY

A. THE AVERAGE OF POINTS 9 AND 10 ON CAC-TR-4426-1 AND POINTS 8 AND 9 ON CAC-TR-4426-2

OR

THE AVERAGE OF COMPUTER POINTS W109, W110, F147 AND F148.



CAUTION 6
ALL HEATED REFERENCE LEG INSTRUMENTS

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CAUTION #8

Observe net positive suction head (NPSH) requirements for pumps taking suction from the suppression pool (see page 8).

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CAUTION #9

If signals of high suppression pool water level -24 inches (high level suction interlock) or low condensate storage tank water level 3.0 feet (low level suction interlock) occur, confirm automatic transfer of or manually transfer HPCI and RCIC suction from the condensate storage tank to the suppression pool.

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CAUTION #10

Do not secure or place an ECCS in MANUAL mode unless, by at least two independent indications, (1) misoperation in AUTOMATIC mode is confirmed or (2) adequate core cooling is assured. If an ECCS is placed in MANUAL mode, it will not initiate automatically. Make frequent checks of the initiating or controlling parameter. When manual operation is no longer required, restore the system to AUTOMATIC/STANDBY mode if possible.

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CAUTION #11

If a high drywell pressure ECCS initiation signal 2.0 psig (drywell pressure which initiates ECCS) occurs or exists while depressurizing, prevent injection from those core spray and RHR pumps not required to assure adequate core cooling prior to reaching their maximum injection pressures. When the high drywell pressure ECCS initiation signal clears, restore core spray and RHR to AUTOMATIC/STANDBY mode.

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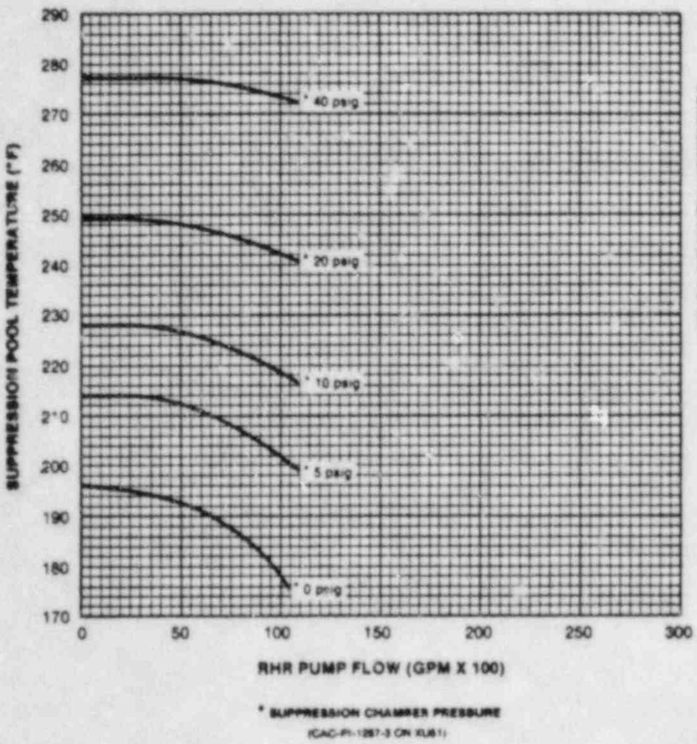
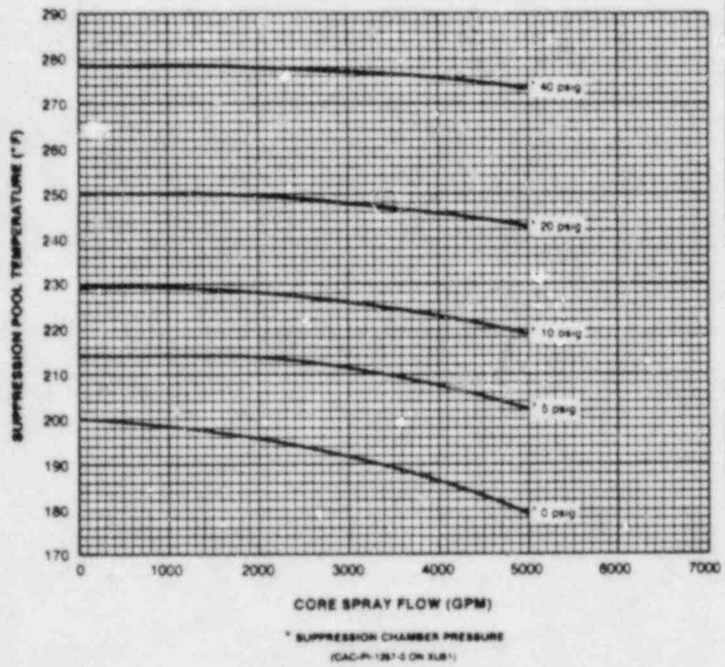
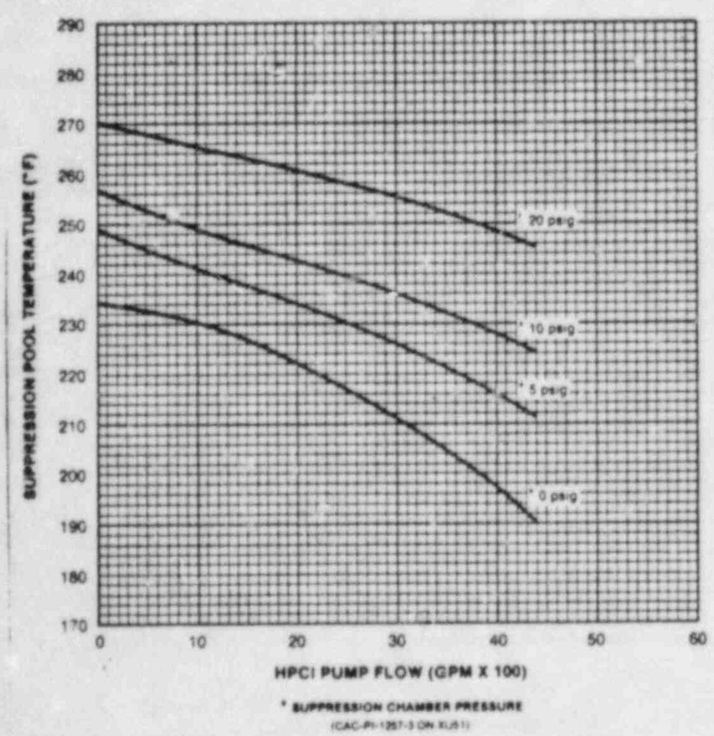
RHR NPSH LIMIT



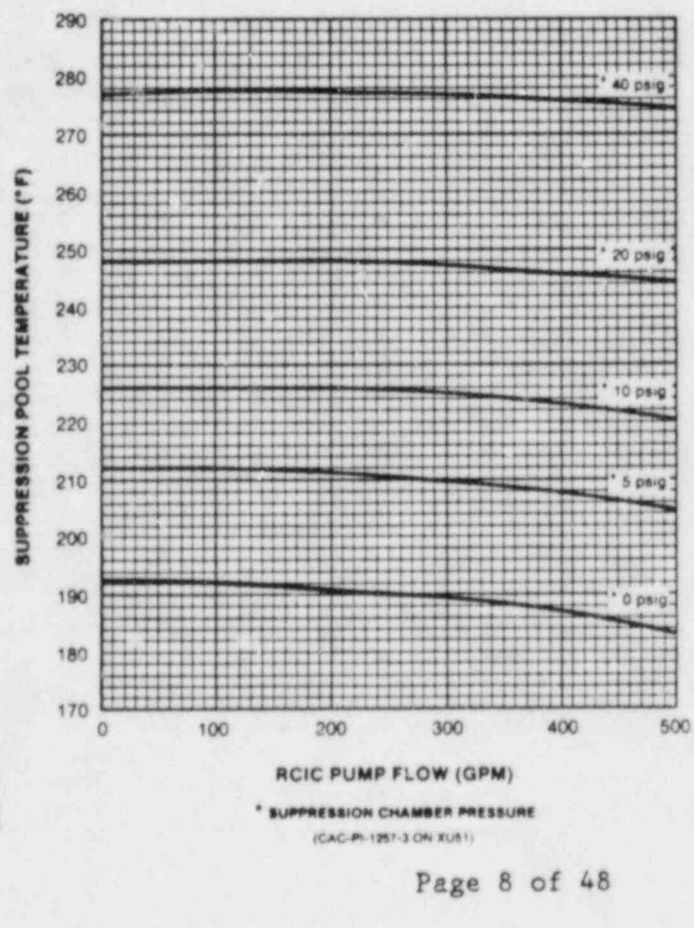
CORE SPRAY NPSH LIMIT



HPCI NPSH LIMIT



RCIC NPSH LIMIT



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CAUTION #12

Do not throttle HPCI speed below 3000 rpm or RCIC speed below 2000 rpm (minimum turbine speed limit per turbine vendor manual).

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CAUTION #13

Cooldown rates above 100°F/hr (RPV cooldown rate LCO) may be required during periods of rapid RPV depressurization.

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****

CAUTION #14

Do not depressurize the RPV below 120 psig (HPCI low pressure isolation setpoint) unless motor driven pumps sufficient to maintain RPV water level are running and available for injection.

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CAUTION #15

Open SRVs in the following sequence if possible: A, E, J, B, F, D, G, C, H

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CAUTION #16

Bypassing RPV low water level ventilation system and MSIV isolation interlocks may be required to accomplish this step.

****

****

CAUTION #17

Cooldown rates above 100°F/hr (RPV cooldown rate LCO) may be required to conserve RPV water inventory, protect primary containment integrity, or limit radioactive release to the environment.

****

****

CAUTION #18

If continuous LPCI operation is required to assure adequate core cooling, do not divert all RHR pumps from LPCI mode.

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****

CAUTION #19

Manually trip SLC pumps at 0% level in the SLC tank.

****

****

CAUTION #20

Defeating RSCS interlocks may be required to accomplish this step.

****

****

CAUTION #21

Elevated suppression chamber pressure may trip the RCIC turbine on high exhaust pressure.

****

****

CAUTION #22

Defeating isolation interlocks may be required to accomplish this step.

****

****

CAUTION #23

Do not initiate drywell sprays unless suppression pool water level is below -1 inch (elevation of bottom of Reactor Building to suppression chamber breakers).

****

****

CAUTION #24

A rapid increase in injection into the RPV may induce a large power excursion and result in substantial core damage.

****

****

CAUTION #25

Large reactor power oscillations may be observed while executing this step.

****

RPV CONTROL GUIDELINE

Purpose

The purpose of this guideline is to:

- Restore and maintain RPV water level within a satisfactory range,
- Shut down the reactor, and
- Control RPV pressure and cool down the RPV to cold shutdown conditions (RPV water temperature below 212°F).

Entry Condition

A condition which requires or has initiated a reactor scram.

Operator Actions

RC-1 If reactor scram has not been initiated, initiate reactor scram.

> Irrespective of the entry condition, execute Steps RC/L, RC/P and RC/Q concurrently.

RC/L Monitor and control RPV water level.

RC/L-1 Confirm initiation of any of the following:

- Isolation
- ECCS
- Emergency diesel generator

Initiate any of these which should have initiated but did not.

> If while executing the following step:
>
> - Boron Injection is required, enter CONTINGENCY #7.
> - RPV water level cannot be determined, RPV FLOODING IS REQUIRED; enter CONTINGENCY #6.
> - RPV Flooding is required, enter CONTINGENCY #6.

RC/L-2 Restore and maintain RPV water level between +162.5 inches (low level scram setpoint) and +208 inches (high level trip setpoint) with one or more of the following systems: #9 #10 #11

System	RPV Pressure Range for System Operation
Condensate	200-0 psig
Condensate/Booster	350-0 psig
Feed Pumps	1250-0 psig
CRD	1490-0 psig
RCIC	1190-62 psig
HPCI	1280-120 psig
RHR	200-0 psig
Core Spray	300-0 psig

#12

If RPV water level cannot be restored and maintained above +162.5 inches (low level scram setpoint), maintain RPV water level above 0 inches (top of active fuel).

If RPV water level can be maintained above 0 inches (top of active fuel) and the ADS timer has initiated, prevent automatic RPV depressurization by resetting the ADS timer.

If RPV water level cannot be maintained above 0 inches (top of active fuel), enter CONTINGENCY #1.

If Alternate Shutdown Cooling is required, enter CONTINGENCY #5.

RC/L-3 Proceed to cold shutdown in accordance with GP-05.

RC/P Monitor and control RPV pressure.

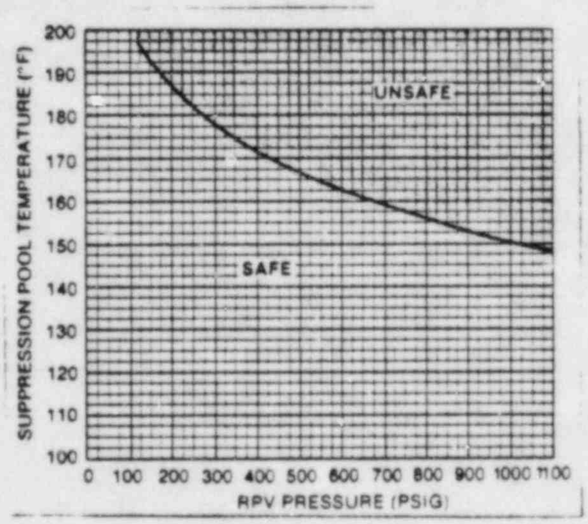
If while executing the following steps:

- Emergency RPV Depressurization is anticipated, rapidly depressurize the RPV with the main turbine bypass valves. #13
- Emergency RPV Depressurization or RPV Flooding is required and less than seven (number of SRVs dedicated to ADS) SRVs are open, enter CONTINGENCY #2.
- RPV Flooding is required and at least seven (number of SRVs dedicated to ADS) SRVs are open, enter CONTINGENCY #6.

RC/P-1 If any SRV is cycling, manually open SRVs until RPV pressure drops to 950 psig (RPV pressure at which all turbine bypass valves are fully open).

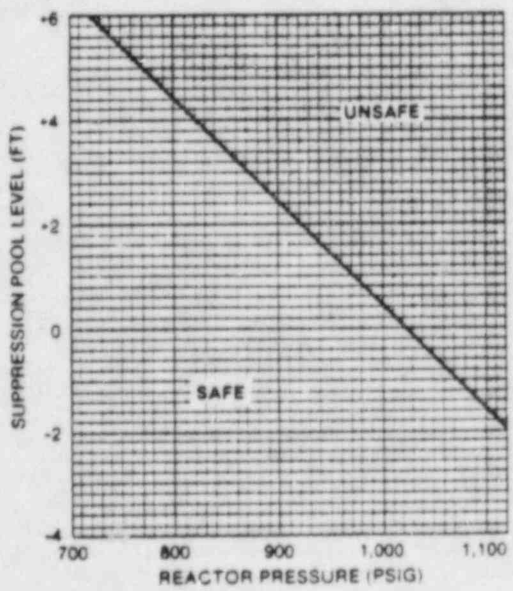
If while executing the following steps:

- Suppression pool temperature cannot be maintained below the Heat Capacity Temperature Limit, maintain RPV pressure below the Limit. #8 #13 #14



Heat Capacity Temperature Limit

- Suppression pool water level cannot be maintained below the Suppression Pool Load Limit, maintain RPV pressure below the Limit. #13 #14



Suppression Pool Load Limit

- Steam Cooling is required, enter procedure developed from Contingency #3.

If while executing the following steps:

- Boron Injection is required, and
- The main condenser is available, and
- There has been no indication of gross fuel failure or steam line break,

open MSIVs to reestablish the main condenser as a heat sink. #16

RC/P-2 Control RPV pressure below 1105 psig (lowest SRV lifting pressure) with the main turbine bypass valves. #14

RPV pressure control may be augmented by one or more of the following systems:

- SRVs. If the continuous SRV pneumatic supply is or becomes unavailable, depressurize with sustained SRV opening. #15
- HPCI #12
- RCIC
- RWCU (recirculation mode) if no boron has been injected into the RPV.
- Main steam line drains
- RWCU (blowdown mode) if no boron has been injected into the RPV. Refer to sampling procedures prior to initiating blowdown.

If while executing the following steps the reactor is not shut down, return to Step RC/P2.

RC/P-3 When RPV water level is stabilized and either:

- All control rods are inserted to position 00 (maximum subcritical banked withdrawal position), or
  - 570 pounds (Cold Shutdown Boron Weight) of boron have been injected into the RPV, or
  - The reactor is shut down and no boron has been injected into the RPV,

Depressurize the RPV and maintain cooldown rate below 100°F/hr (RPV cooldown rate LCO). #14, #17

RC/P-4 When the RHR shutdown cooling interlocks clear, initiate the shutdown cooling mode or RHR. #18

If the RHR shutdown cooling mode cannot be established and further cooldown is required, continue to cool down using one or more of the systems used for depressurization.

If RPV cooldown is required but cannot be accomplished and all control rods are inserted to position 00 (maximum subcritical banked withdrawal position), ALTERNATE SHUTDOWN COOLING IS REQUIRED; enter CONTINGENCY #5.

RC/P-5 Proceed to cold shutdown in accordance with GP-05.

RC/Q Monitor and control reactor power.

> If while executing the following steps:
>
> - All control rods are inserted to position 00 (maximum subcritical banked withdrawal position), terminate boron injection.
> - The reactor is shut down and no boron has been injected into the RPV, enter GP-05.

RC/Q-1 Confirm or place the reactor mode switch in SHUTDOWN.

RC/Q-2 If the main turbine-generator is on line and the MSIVs are open, confirm or initiate recirculation flow runback to minimum.

RC/Q-3 If reactor power is above 3% (APRM downscale trip) or cannot be determined, trip the recirculation pumps.

> Execute Steps RC/Q-4 and RC/Q-5 concurrently.

RC/Q-4 If the reactor cannot be shut down before suppression pool temperature reaches 110°F (Boron Injection Initiation Temperature), BORON INJECTION IS REQUIRED; inject boron into the RPV with SLC and prevent automatic initiation of ADS. #19

RC/Q-4.1 If boron cannot be injected with SLC, inject boron into the RPV by one or more of the following methods:

- CRD
- RWCU
- Feedwater
- HPCI
- RCIC

RC/Q-4.2 If boron is not being injected into the RPV by RWCU, confirm automatic isolation of or manually isolate RWCU.

RC/Q-4.3 Continue to inject boron until 570 pounds (Cold Shutdown Boron Weight) of boron have been injected into the RPV.

RC/Q-4.4 Enter End Path Procedure for cooldown following boron injection.

RC/Q-5 Insert control rods as follows:

RC/Q-5.1 If any scram valve is not open:

- Remove:

  H12-P609 C71-F14A,C and F15A and F16A
  H12-P611 C71-F14B,D and F15B and F16B

  (fuses which deenergize RPS scram solenoids).

- Close F095 (scram air header supply valve) and open drain valves for C12-PSL-3363 and -3364.

When control rods are not moving inward:

- Replace:

  H12-P609 C71-F14A,C and F15A and F16A
  H12-P611 C71-F14B,D and F15B and F16B

  (fuses which deenergize RPS scram solenoids).

- Close drain valves for C12-PSL-3363 and -3364 (scram air header vent valves) and open F095 (scram air header supply valve).

RC/Q-5.2 Reset the reactor scram.

If the reactor scram cannot be reset:

1. Start both CRD pumps.

   If no CRD pump can be started, continue in this procedure at Step RC/Q-5.6.1.

2. Close F034 (HCU accumulator charging water header valve).

3. Rapidly insert control rods manually until the reactor scram can be reset. #20

4. Reset the reactor scram.

5. Open F034 (HCU accumulator charging water header valve).

RC/Q-5.3 If the scram discharge volume vent and drain valves are open, initiate a manual reactor scram.

1. If control rods moved inward, return to Step RC/Q-5.2.

2. Reset the reactor scram.

   If the reactor scram cannot be reset, continue in this procedure at Step RC/Q-5.5.1.

3. Open the scram discharge volume vent and drain valves.

RC/Q-5.4 Individually open the scram test switches for control rods not inserted to position 00 (maximum subcritical banked withdrawal position).

When a control rod is not moving inward, close its scram test switch.

RC/Q-5.5 Reset the reactor scram.

If the reactor scram cannot be reset:

1. Start both CRD pumps.

   If no CRD pump can be started, continue in this procedure at Step RC/Q-5.6.1.

2. Close F034 (HCU accumulator charging water header valve).

RC/Q-5.6 Rapidly insert control rods manually until all control rods are inserted to position 00 (maximum subcritical banked withdrawal position). #20

If any control rod cannot be inserted to position 00 (maximum subcritical banked withdrawal position):

1. Individually direct the effluent from F102 (CRD withdraw line vent valve) to a contained radwaste drain and open F102 (CRD withdraw line vent valve) for each control rod not inserted to position 00 (maximum subcritical banked withdrawal position).

2. When a control rod is not moving inward, close its F102 (CRD withdraw line vent valve).

CONTAINMENT CONTROL GUIDELINE

Purpose

The purpose of this guideline is to control primary containment temperatures, pressure and level.

Entry Conditions

The entry conditions for this guideline are any of the following:

- Suppression pool temperature above 95°F (most limiting suppression pool temperature LCO)
- Drywell temperature above 135°F (drywell temperature LCO or maximum normal operating temperature, whichever is higher)
- Drywell pressure above 2.0 psig (high drywell pressure scram setpoint)
- Suppression pool water level above -27 inches (maximum suppression pool water level LCO)
- Suppression pool water level below -31 inches (minimum suppression pool water level LCO).

Operator Actions

Irrespective of the entry condition, execute Steps SP/T, DW/T, PC/P and SP/L concurrently.

SP/T Monitor and control suppression pool temperature.

SP/T-1 Close all SORVs.

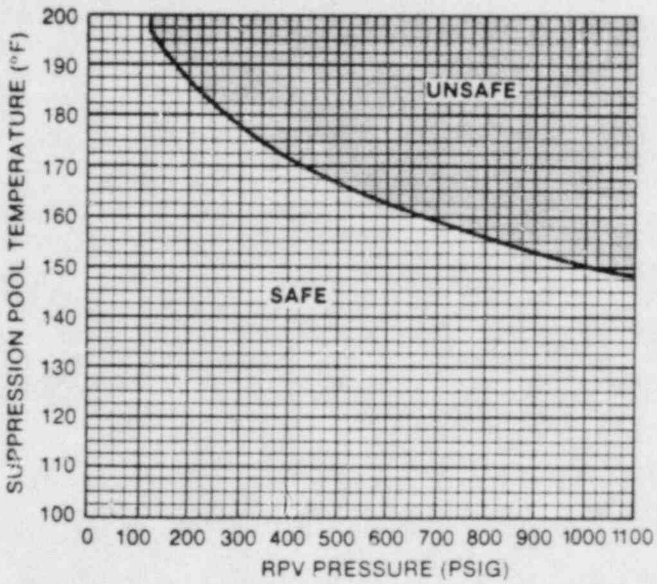
As soon as it is recognized that the valve will not close, scram the reactor.

SP/T-2 When pool temperature exceeds 95°F (most limiting suppression pool temperature LCO), operate available suppression pool cooling. #18

SP/T-3 Before suppression pool temperature reaches 110°F (Boron Injection Initiation Temperature), scram the reactor.

SP/T-4 If suppression pool temperature cannot be maintained below the Heat Capacity Temperature Limit, maintain RPV pressure below the Limit. #8 #13 #14

If suppression pool temperature and RPV pressure cannot be restored and maintained below the Heat Capacity Temperature Limit, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED; enter the RPV Control Guideline at Step RC-1 and execute it concurrently with this procedure.

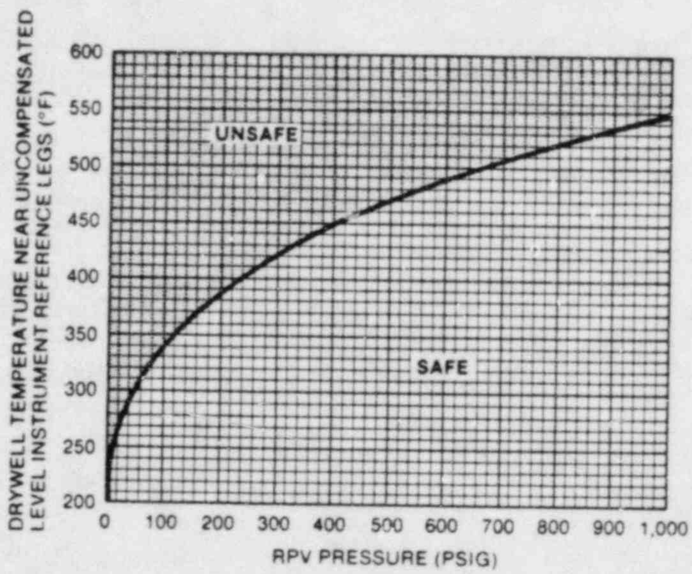


Heat Capacity Temperature Limit

DW/T Monitor and control drywell temperature.

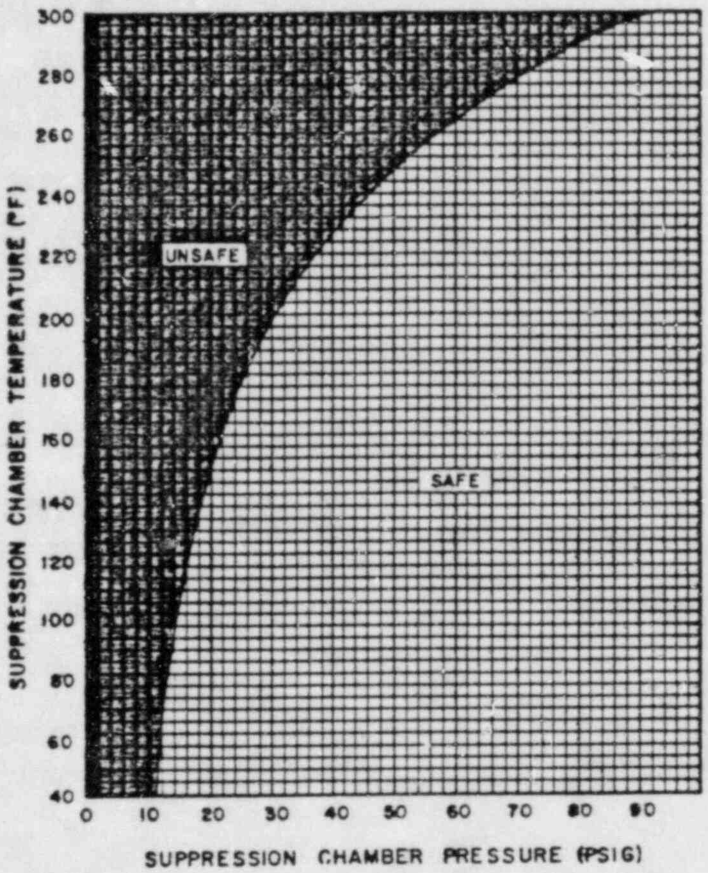
DW/T-1 When drywell temperature exceeds 135°F (drywell temperature LCO or maximum normal operating temperature, whichever is higher), operate available drywell cooling. #6

DW/T-2 If drywell temperature near the cold reference leg instrument vertical runs reaches the RPV Saturation Temperature, RPV FLOODING IS REQUIRED; enter the RPV Control Guideline at Step RC-1 and execute it concurrently with this procedure.



RPV Saturation Temperature

DW/T-3 Before drywell temperature reaches 300°F (maximum drywell design temperature) but only if suppression chamber temperature and pressure are below the Drywell Spray Initiation Pressure Limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays. #18



DRYWELL SPRAY
INITIATION PRESSURE LIMIT

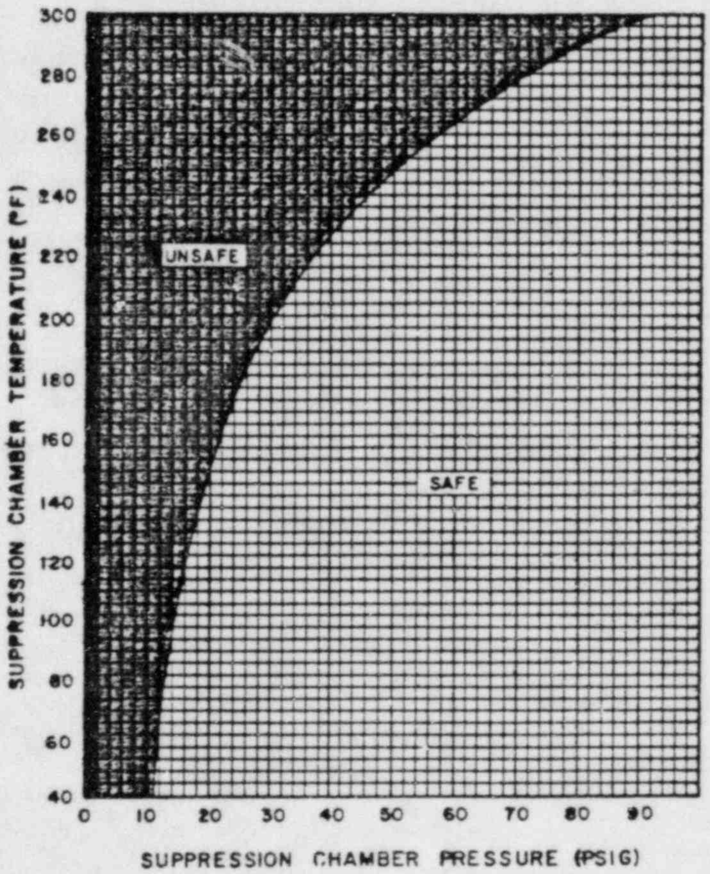
DW/T-4 If drywell temperature cannot be maintained below 300°F EMERGENCY RPV DEPRESSURIZATION IS REQUIRED; enter the RPV Control Guideline at Step RC-1 and execute it concurrently with this procedure.

PC/P Monitor and control primary containment pressure.

PC/P-1 Operate the SBGT and drywell purge as required, only when the temperature in the space being evacuated is below 212°F (Maximum Noncondensable Evacuation Temperature). Use SBGT and drywell purge operating procedures. #21

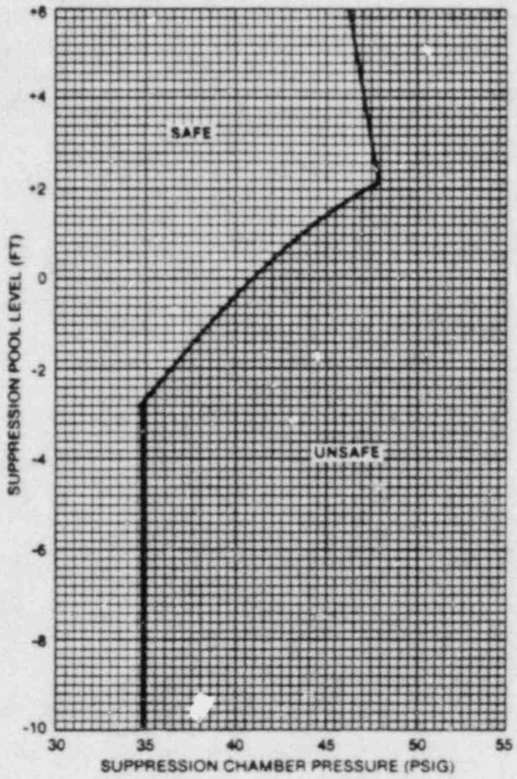
PC/P-2 Before suppression chamber pressure reaches 16.5 psig (Suppression Chamber Spray Initiation Pressure) initiate suppression pool sprays. #8, #18

PC/P-3 If suppression chamber pressure exceeds 16.5 psig (Suppression Chamber Spray Initiation Pressure) but only if suppression chamber temperature and pressure are below the Drywell Spray Initiation Pressure Limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays. #18



DRYWELL SPRAY
INITIATION PRESSURE LIMIT

PC/P-4 If suppression chamber pressure cannot be maintained below the Pressure Suppression Pressure, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED.

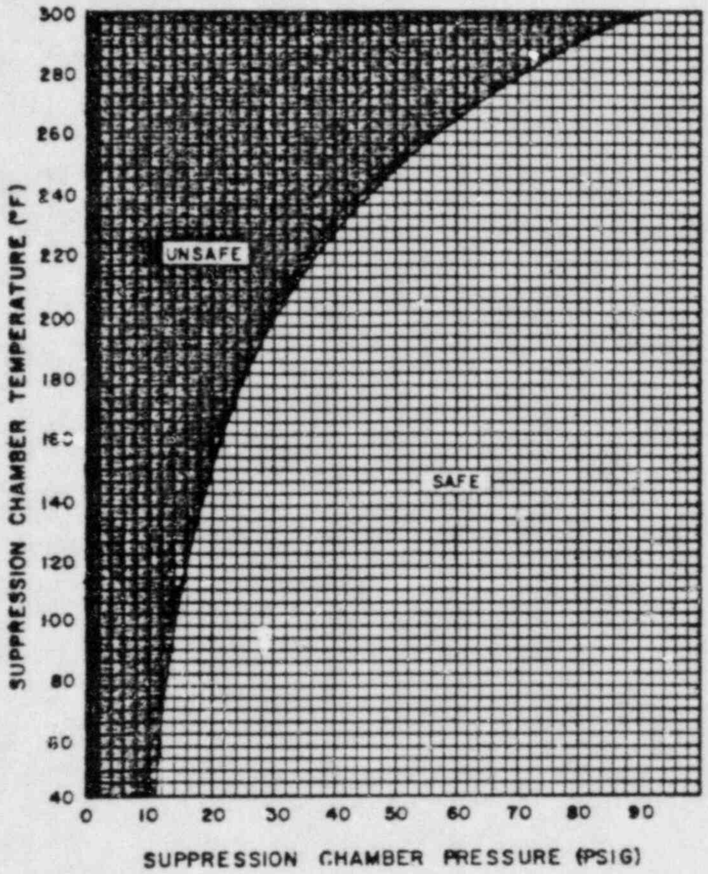


Pressure Suppression Pressure

PC/P-5 If suppression chamber pressure cannot be maintained below 58 psig (the Primary Containment Design Pressure), RPV FLOODING IS REQUIRED.

PC/P-6 If suppression chamber pressure cannot be maintained below 58 psig (the Primary Containment Pressure Limit), then irrespective of whether adequate core cooling is assured:

- Initiate suppression pool sprays.
- If suppression chamber temperature and pressure are below the Drywell Spray Initiation Pressure Limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays.



DRYWELL SPRAY INITIATION PRESSURE LIMIT

PC/P-7 If suppression chamber pressure exceeds 58 psig (the Primary Containment Pressure Limit), vent the primary containment in accordance with the procedure containment venting to reduce and maintain pressure below the Primary Containment Pressure Limit.

#22

SP/L Monitor and control suppression pool water level.

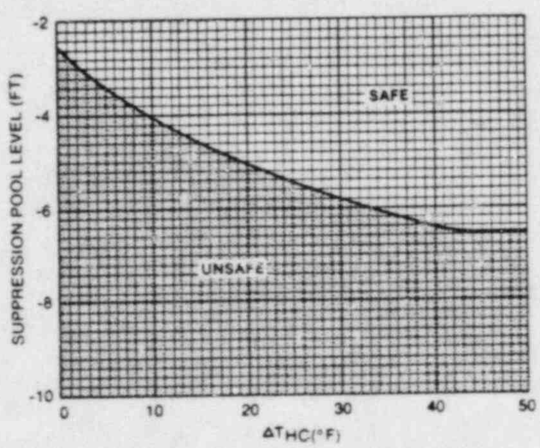
SP/L-1 Maintain suppression pool water level between 27 inches (maximum suppression pool water level LCO) and 31 inches (minimum suppression pool water level LCO). Refer to the sampling procedure prior to discharging water.

#8, #9

SP/L-2 If suppression pool water level cannot be maintained above the Heat Capacity Level Limit, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED; enter the RPV Control Guideline at Step RC-1 and execute it concurrently with this procedure.

TABLE 1. (SP/L) HEAT CAPACITY LEVEL LIMIT

REACTOR PRESSURE	SUPPRESSION POOL TEMPERATURE LIMIT	MINUS	ACTUAL SUPPRESSION POOL TEMPERATURE	EQUALS	ΔT_{HC} (°F)
1000 TO 1100 psig	148°F	–		=	
900 TO 1000 psig	150°F	–		=	
800 TO 900 psig	152°F	–		=	
700 TO 800 psig	155°F	–		=	
600 TO 700 psig	158°F	–		=	
500 TO 600 psig	162°F	–		=	
400 TO 500 psig	166°F	–		=	
300 TO 400 psig	171°F	–		=	
200 TO 300 psig	177°F	–		=	
150 TO 200 psig	186°F	–		=	
LESS THAN 150psig	(°F) ΔT_{HC}: 50°F				50°F

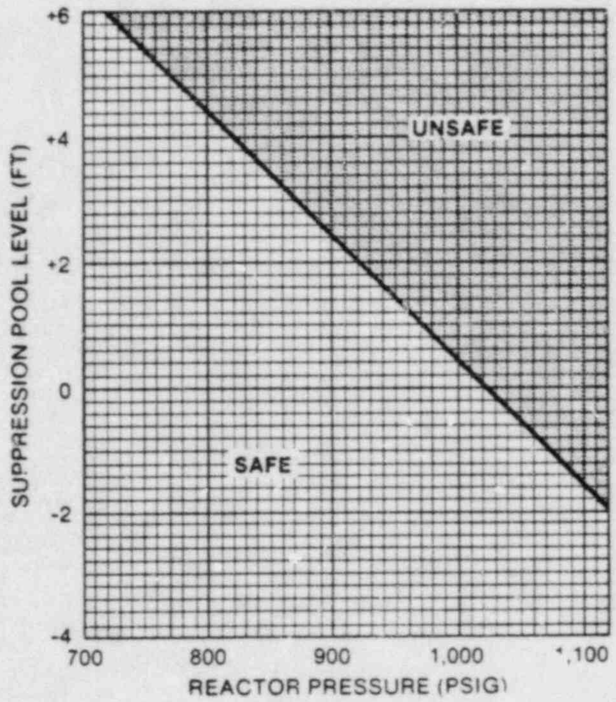


Heat Capacity Level Limit

SP/L-3 If suppression pool water level cannot be maintained below 27 inches (maximum suppression pool water level LCO):

SP/L-3.1 If adequate core cooling is assured, terminate injection into the RPV from sources external to the primary containment.

SP/L-3.2 If suppression pool water level cannot be maintained below the Suppression Pool Load Limit, maintain RPV pressure below the Limit. #13 #14

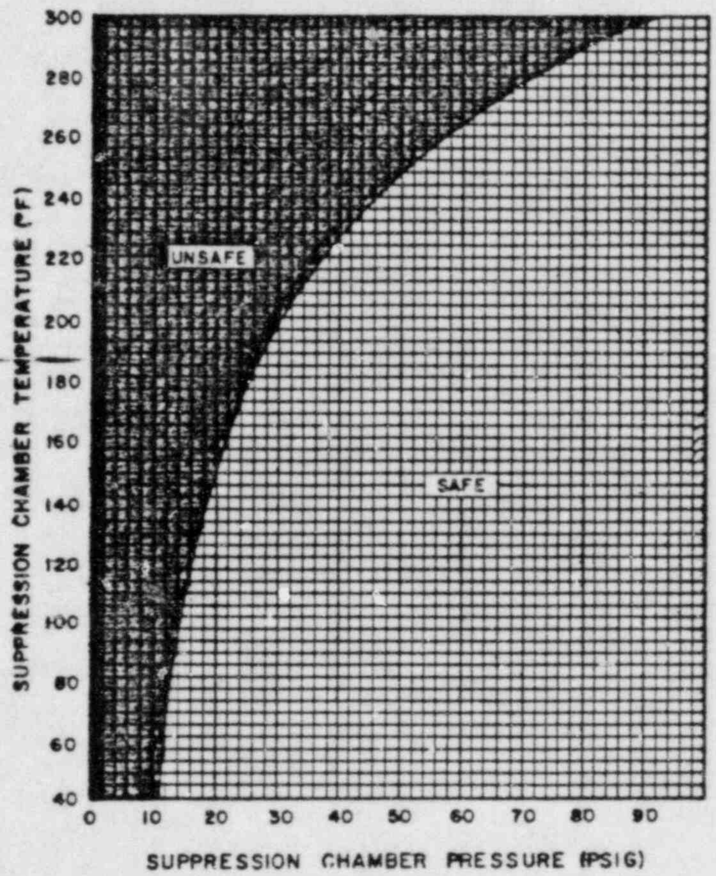


Suppression Pool Load Limit

If suppression pool water level and RPV pressure cannot be restored and maintained below the Suppression Pool Load Limit, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED; enter the RPV Control Guideline at Step RC-1 and execute it concurrently with this procedure.

SP/L-3.3 Before suppression pool water level reaches -1 inch (elevation of bottom of Mark I Reactor Building to suppression chamber vacuum breakers) but only if suppression chamber temperature and pressure are below the Drywell Spray Initiation Pressure Limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays.

#18



DRYWELL SPRAY
INITIATION PRESSURE LIMIT

SP/L-3.4 If suppression pool water level exceeds -1 inch (elevation of bottom of Mark I Reactor Building to suppression chamber vacuum breakers), continue to operate drywell sprays. #23

CONTINGENCY #1

LEVEL RESTORATION

> If while executing the following steps:
>
> - Boron Injection is required, enter CONTINGENCY #7.
> - RPV water level cannot be determined, RPV FLOODING IS REQUIRED; enter CONTINGENCY #6.
> - RPV Flooding is required, enter CONTINGENCY #6.

C1-1 Line up for injection and start pumps in two or more of the following injection subsystems:

- Condensate
- RHR A
- RHR B
- RHR C
- RHR D
- Core Spray A
- Core Spray B

If less than two of the injection subsystems can be lined up, commence lining up as many of the following alternate injection subsystems as possible:

- Fire System
- ECCS Keepfill Systems
- Condensate Transfer System
- SLC (test tank)
- SLC (boron tank)
- RHR Service Water Cross-tie

C1-2 Monitor RPV pressure and water level. Continue in this procedure at the step indicated in the following table.

RPV PRESSURE REGION

(350 psig)[1] (120 psig)[2]

		HIGH	INTERMEDIATE	LOW
RPV LEVEL	INCREASING	C1-3	C1-4	C1-5
	DECREASING	C1-6		C1-7

[1] (RPV pressure at which core spray shutoff head is reached)
[2] (HPCI low pressure isolation setpoint)

If while executing the following steps:

- The RPV water level trend reverses or RPV pressure changes region, return to Step C1-2.
- RPV water level drops below +45 inches (ADS initiation setpoint), prevent automatic initiation of ADS.

C1-3 RPV WATER LEVEL INCREASING, RPV PRESSURE HIGH

Enter the RPV Control Guideline at Step RC/L.

C1-4 RPV WATER LEVEL INCREASING, RPV PRESSURE INTERMEDIATE

IF HPCI and RCIC are not available and RPV pressure is increasing, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV pressure is decreasing, enter the RPV Control Guideline at Step RC/L.

If HPCI and RCIC are not available and RPV pressure is not increasing, enter the RPV Control Guideline at Step RC/L.

If HPCI or RCIC is available, when RPV water level reaches +162.5 inches (low level scram setpoint), enter the RPV Control Guideline at Step RC/L.

C1-5 RPV WATER LEVEL INCREASING, RPV PRESSURE LOW

If RPV pressure is increasing, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV pressure is decreasing, enter the RPV Control Guideline at Step RC/L.

Otherwise, enter the RPV Control Guideline at Step RC/L.

C1-6 RPV WATER LEVEL DECREASING, RPV PRESSURE HIGH OR INTERMEDIATE

If HPCI or RCIC is not operating, restart whichever is not operating.

If no CRD pump is operating and no injection subsystem is lined up for injection with at least one pump running, start pumps in alternate injection subsystems which are lined up for injection.

When RPV water level drops to 0 inches (top of active fuel):

- If no system, injection subsystem or alternate injection subsystem is lined up with at least one pump running, STEAM COOLING IS REQUIRED. When any system, injection subsystem or alternate injection subsystem is lined up with at least one pump running, return to Step C1-3.

- If any RPV injection exists, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV water level is increasing or RPV pressure drops below 120 psig (HPCI low pressure isolation setpoint) return to Step C1-3.

C1-7 RPV WATER LEVEL DECREASING, RPV PRESSURE LOW

If no core spray subsystem is operating, start pumps in alternate injection subsystems which are lined up for injection.

If RPV pressure is increasing, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED.

When RPV water level drops to 0 inches (top of active fuel), enter CONTINGENCY #4.

CONTINGENCY #2
EMERGENCY RPV DEPRESSURIZATION

#13, #14

C2-1 When either:

- Boron Injection is required and all injection into the RPV except from boron injection systems and CRD has been terminated and prevented, or

- Boron Injection is not required,

C2-1.1 Open all ADS valves.

If any ADS valve cannot be opened, open other SRVs until seven (number of SRVs dedicated in ADS) valves are open.

C2-1.2 If less than three (Minimum Number of SRVs Required for Emergency Depressurization) SRVs are open and RPV pressure is at least 50 psig (Minimum SRV Reopening Pressure) above suppression chamber pressure, rapidly depressurize the RPV using one or more of the following systems (use in order which will minimize radioactive release to the environment): #22

- Main Condenser
- RHR (steam condensing mode)
- Main Steam Line Drains
- HPCI Steam Line
- RCIC Steam Line
- Head Vent

If RPV Flooding is required, enter CONTINGENCY #6.

C2-2 Enter the RPV Control Guideline at Step RC/P-4.

CONTINGENCY #3

STEAM COOLING

C3-1

> If while executing the following steps Emergency RPV Depressurization is required or any system, injection subsystem, or alternate injection subsystem is lined up for injection with at least one pump running, enter CONTINGENCY #2.

When RPV water level drops to 100 inches (Minimum Zero-Injection RPV Water Level) or if RPV water level cannot be determined, open one SRV.

> When RPV pressure drops below 700 psig (Minimum Single SRV Steam Cooling Pressure), enter CONTINGENCY #2.

CONTINGENCY #4

CORE COOLING WITHOUT LEVEL RESTORATION (SPRAY COOLING)

C4-1 Open all ADS valves. | #13 |

If any ADS valve cannot be opened, open other SRVs until seven (number of SRVs dedicated to ADS) valves are open.

C4-2 Operate core spray subsystems with suction from the suppression pool.

When at least one core spray subsystem is operating with suction from the suppression pool and RPV pressure is below 120 psig (RPV pressure for rated core spray flow), terminate injection into the RPV from sources external to the primary containment.

C4-3 When RPV water level is restored to 0 inches (top of active fuel), enter the RPV Control Guideline at Step RC/L.

CONTINGENCY #5

ALTERNATE SHUTDOWN COOLING

C5-1 Initiate suppression pool cooling.

C5-2 Close the RPV head vents, MSIVs, main steam line drain valves, and HPCI and RCIC isolation valves.

C5-3 Place the control switch for one (Minimum Number of SRVs Required for Alternate Shutdown Cooling) SRV in the OPEN position.

C5-4 Slowly raise the RPV water level to establish a flow path through the open SRV back to the suppression pool.

C5-5 Start one core spray or RHR pump with suction from the suppression pool.

C5-6 Slowly increase core spray or RHR injection into the RPV to the maximum.

C5-6.1 If RPV pressure does not stabilize at least 107 psig (Minimum Alternate Shutdown Cooling RPV Pressure) above suppression chamber pressure, start another core spray or RHR pump.

C5-6.2 If RPV pressure does not stabilize below 164 psig (Maximum Alternate Shutdown Cooling RPV Pressure), open another SRV.

C5-6.3 If the cooldown rate exceeds 100°F/hr (maximum RPV cooldown rate LCO), reduce core spray or RHR injection into the RPV until the cooldown rate decreases below 100°F/hr (maximum RPV cooldown rate LCO) or RPV pressure decreases to within 50 psig (Minimum SRV Reopening Pressure) of suppression chamber pressure, whichever occurs first.

C5-7 Control suppression pool temperature to maintain RPV water temperature above 70°F (RPV head-tensioning limit).

C5-8 Proceed to cold shutdown in accordance with GP-05.

CONTINGENCY #6

RPV FLOODING

C6-1 If at least three (Minimum Number of SRVs Required for Emergency Depressurization) SRVs can be opened, close the MSIVs main steam line drain valves, HPCI, RCIC and RHR steam condensing isolation valves.

C6-2 If any control rod is not inserted to position 00 (maximum subcritical banked withdrawal position):

C6-2.1 Terminate and prevent all injection into the RPV except from boron injection systems and CRD.

> If while executing the following step, RPV water level can be determined and RPV Flooding is not required, enter CONTINGENCY #7 and the RPV Control Guideline at Step RC/P-4 and execute these procedures concurrently.

C6-2.2 When RPV pressure is below the Minimum Alternate RPV Flooding Pressure, commence and slowly increase injection into the RPV with the following systems to maintain RPV pressure above the Minimum Alternate RPV Flooding Pressure: #24

Number of Open SRVs	Minimum Alternate RPV Flooding Pressure (psig)
7	100
6	120
5	145
4	190
3	250
2	380
1	770

- Condensate Pumps
- CRD
- RHR

If RPV pressure cannot be maintained above the Minimum Alternate RPV Flooding Pressure, commence and slowly increase injection into the RPV with the following systems to maintain RPV pressure above the Minimum Alternate RPV Flooding Pressure:

- Core Spray
- Fire System
- ECCS Keepfill Systems
- Condensate Transfer System
- RHR Service Water Cross-tie

C6-2.3 When:

- All control rods are inserted to position 00 (maximum subcritical banked withdrawal position), or
- The reactor is shut down and no boron has been injected into the RPV,

continue in this procedure.

C6-3 If RPV water level cannot be determined:

C6-3.1 Commence and increase injection into the RPV with the following systems until at least three (Minimum Number of SRVs Required for Emergency Depressurization) SRVs are open and RPV pressure is not decreasing and is at least 100 psig (Minimum RPV Flooding Pressure) above suppression chamber pressure.

- Core Spray
- RHR
- Condensate Pumps
- CRD
- Fire System
- ECCS Keepfill Systems
- SLC (test tank)
- SLC (boron tank)
- RHR Service Water Cross-tie

C6-3.2 Maintain RPV pressure at least 100 psig (Minimum RPV Flooding Pressure) above suppression chamber pressure by throttling injection.

C6-4 If RPV water level can be determined, commence and increase injection into the RPV with the following systems until RPV water level is increasing:

- Core Spray
- RHR
- Condensate Pumps
- CRD
- Fire System
- ECCS Keepfill Systems
- Condensate Transfer System
- SLC (test tank)
- SLC (boron tank)
- RHR Service Water Cross-tie

C6-5 If RPV water level cannot be determined:

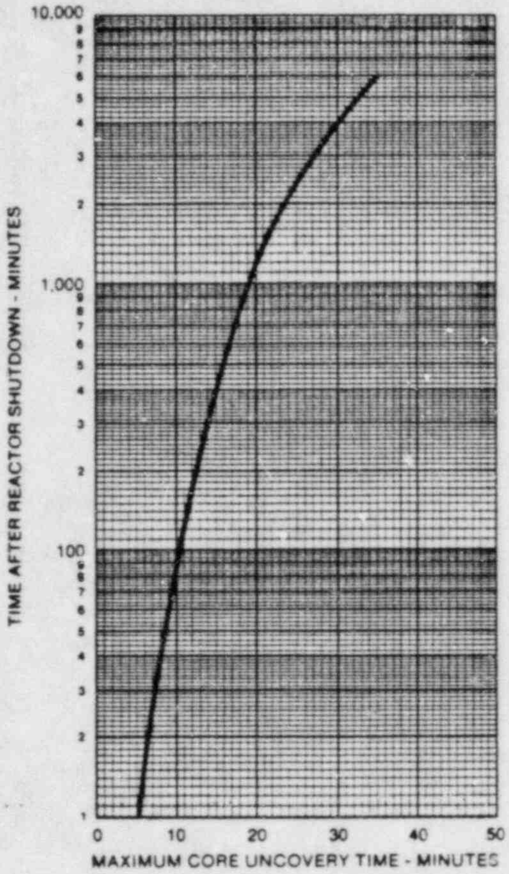
C6-5.1 Fill all RPV level instrumentation reference columns.

C6-5.2 Continue injecting water into the RPV until temperature near the cold reference leg instrument vertical runs is below 212°F and RPV water level instrumentation is available.

> If while executing the following steps, RPV water level can be determined, continue in this procedure at Step C6-6.

C6-5.3 If it can be determined that the RPV is filled or if RPV pressure is at least 100 psig (Minimum RPV Flooding Pressure) above suppression chamber pressure, terminate all injection into the RPV and reduce RPV water level.

C6-5.4 If RPV water level indication is not restored within the Maximum Core Uncovery Time Limit after commencing termination of injection into the RPV, return to Step C6-3.



Maximum Core Uncovery Time

C6-6 When suppression chamber pressure can be maintained below 58 psig (the Primary Containment Pressure Limit), enter RPV Control Guideline at Steps RC/L and RC/P-4 and execute these steps concurrently.

CONTINGENCY #7

LEVEL/POWER CONTROL

> If while executing the following steps:
>
> - RPV water level cannot be determined, RPV FLOODING IS REQUIRED; enter CONTINGENCY #6.
> - RPV flooding is required, enter CONTINGENCY #6.

C7-1 If:

- Reactor power is above 3% (APRM downscale trip) or cannot be determined, and
- Suppression pool temperature is above 110°F (Boron Injection Initiation Temperature), and
- Either an SRV is open or opens or drywell pressure is above 2.0 psig (high drywell pressure scram setpoint).

lower RPV water level by terminating and preventing all injection into the RPV except from boron injection systems and CRD until either: #25

- Reactor power drops below 3% (APRM downscale trip), or
- RPV water level reaches 0 inches (top of active fuel), or
- All SRVs remain closed and drywell pressure remains below 2.0 psig (high drywell pressure scram setpoint).

> If while executing the following steps Emergency RPV Depressurization is required, continue in this procedure at Step C7-2.1.

If while executing the following step:

- Reactor power is above 3% (APRM downscale trip) or cannot be determined, and
- RPV water level is above 0 inches (top of active fuel), and
- Suppression pool temperature is above 110°F (Boron Injection Initiation Temperature), and
- Either an SRV is open or opens or drywell pressure is above 2.0 psig (high drywell pressure scram setpoint),

Return to Step C7-1.

C7-2 Maintain RPV water level either: #9, #10, #11, #24

- If RPV water level was deliberately lowered in Step C7-1, at the level to which it was lowered, or
- If RPV water level was not deliberately lowered in Step C7-1, between +162.5 inches (low level scram setpoint) and +208 inches (high level trip setpoint),

with the following systems:

System	RPV Pressure Range For System Operation	
Condensate	200-0 psig	
Condensate/Booster	350-0 psig	
Feed Pumps	1250-0 psig	
CRD	1490-0 psig	#12
RCIC	1190-62 psig	
HPCI	1280-120 psig	
RHR	200-0 psig	

If RPV water level cannot be so maintained, maintain RPV water level above 0 inches (top of active fuel).

If RPV water level cannot be maintained above 0 inches (top of active fuel), EMERGENCY RPV DEPRESSURIZATION IS REQUIRED:

C7-2.1 Terminate and prevent all injection into the RPV except from boron injection systems and CRD.

C7-2.2 When RPV pressure is below the Minimum Alternate RPV Flooding Pressure, commence and slowly increase injection into the RPV with the following systems to restore and maintain RPV water level above 0 inches (top of active fuel): #24

Number of Open SRVs	Minimum Alternate RPV Flooding Pressure (psig)
7	100
6	120
5	145
4	190
3	250
2	380
1	770

- Condensate/Feedwater System
- CRD
- RCIC
- HPCI
- RHR

If RPV water level cannot be restored and maintained above 0 inches (top of active fuel), commence and slowly increase injection into the RPV with the following systems to restore and maintain RPV water level above 0 inches (top of active fuel):

- Core Spray
- Fire System

- ECCS Keepfill Systems
- Condensate Transfer System
- RHR Service Water Cross-tie

> If while executing the following step reactor power commences and continues to increase, return to Step C7-1.

C7-3 When 287 pounds (Hot Shutdown Boron Weight) of boron have been injected or all control rods are inserted to position 00 (maximum subcritical banked withdrawal position), restore and maintain RPV water level between +162.5 inches (low level scram setpoint) and +208 inches (high level trip setpoint).

If RPV water level cannot be restored and maintained above +162.5 inches (low level scram setpoint), maintain RPV water level above 0 inches (top of active fuel).

If RPV water level cannot be maintained above 0 inches (top of active fuel), EMERGENCY RPV DEPRESSURIZATION IS REQUIRED; return to Step C7-2.1).

> If Alternate Shutdown Cooling is required, enter CONTINGENCY #5.

C7-4 Proceed to cold shutdown in accordance with the End Path procedure.

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

APPENDIX II

WRITERS' GUIDE

FOR

EMERGENCY OPERATING PROCEDURES

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ABBREVIATIONS

ADS - Automatic Depressurization System

ANS - American Nuclear Society

ANSI - American National Standards Institute

AOP - Abnormal Operating Procedure

APRM - Average Power Range Monitor

ASDC - Alternate Shutdown Cooling

ATWS - Anticipated Transient Without Scram

BOP - Balance of Plant

CAC - Containment Atmospheric Control

CAD - Containment Atmospheric Dilution

CCP - Containment Control Procedure

COND - Condensate

CONV - Conventional

CRD - Control Rod Drive

CS - Core Spray

CST - Condensate Storage Tank

DW/T - Drywell Temperature

EBOP - Emergency Bearing Oil Pump

ECCS - Emergency Core Cooling System

EI - Emergency Instruction

EOP - Emergency Operating Procedure

EPP - End Path Procedure

E&RC - Environmental & Radiation Control

ESOP - Emergency Seal Oil Pump

EXCH - Exchanger

FW - Feedwater

GM - General Manager

GP - General Plant Operating Procedure

HCLL - Heat Capacity Level Limit

HCTL - Heat Capacity Temperature Limit

HCU - Hydraulic Control Unit

HDR - Header

HI - High

HPCI - High Pressure Coolant Injection

HX - Heat Exchanger

IA - Instrument Air

IAN - Instrument Air Noninterruptible

IRM - Intermediate Range Monitor

KV - Kilovolt

LCO - Limiting Condition for Operation

LEP - Local Emergency Procedure

LOCA - Loss of Coolant Accident

LPCI - Low Pressure Coolant Injection

LPCS - Low Pressure Core Spray

MCC - Motor Control Center

MG - Motor Generator

MSIV - Main Steam Isolation Valves

MSL - Main Steam Line

NDTT - Nil-Ductility Transition Temperature

NPSH - Net Positive Suction Head

NUC - Nuclear

PC/P - Primary Containment Pressure

PEP - Plant Emergency Plan

RAD - Radiation

RBCCW - Reactor Building Closed Cooling Water

RCIC - Reactor Core Isolation Cooling

RC/L - Reactor Control Level

RC/P - Reactor Control Pressure

RC/Q - Reactor Control Power

RECIRC - Recirculation

RHR - Residual Heat Removal

RPS - Reactor Protection System

RPV - Reactor Pressure Vessel

RSCS - Rod Sequence Control System

RTGB - Reactor Turbine Gauge Board

RWCU - Reactor Water Cleanup

RWM - Rod Worth Minimizer

RX - Reactor

SA - Service Air

SAT - Startup Auxiliary Transformer

SBGT - Standby Gas Treatment

SJAE - Steam Jet Air Ejector

SLC - Standby Liquid Control

SRM - Source Range Monitor

SORV - Stuck Open Relief Valve

SOS - Shift Operating Supervisor

SP/L - Suppression Pool Level

SP/T - Suppression Pool Temperature

SRP - System Recovery Procedure

SRV - Safety Relief Valve

SULCV - Startup Level Control Valve

TBCCW - Turbine Building Closed Cooling Water

TIP - Traversing In-Core Probe

FIGURES AND TABLES

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide administrative and technical guidance on the preparation of Emergency Operating Procedures (EOPs) to ensure that they are complete, accurate, convenient, readable, and acceptable to the BSEP Control Room personnel.

1.2 SCOPE

This Writers' Guide applies to the writing of BSEP EOPs; i.e., flowcharts and the associated written instructions which are in the End Path Manuals.

2.0 ORGANIZATION OF EMERGENCY OPERATING PROCEDURES

The EOPs shall consist of symptomatic or function-oriented procedures which are in flowchart format and End Path Manuals which are in written format.

3.0 ORGANIZATION OF BSEP FLOWCHARTS

The BSEP Flowcharts shall consist of function-oriented paths.

The EOP Users' Guide outlines the Brunswick EOPs and describes how these procedures are to be used by the Control Room personnel to handle emergency and potential emergency situations.

3.1 DESIGNATION AND NUMBERING

The flowcharts are the procedures that govern the plant operation during emergency conditions and specify immediate operator actions to be taken to bound the problem and to return the plant to a stable condition.

Each flowchart shall be uniquely identified (see Figure 1). This identification permits easy administration of the process of procedure preparation, review, revision, distribution, and operator use.

The identification shall be located at the upper left of each flowchart.

FIGURE 1

The flowcharts shall not have other identifying titles. The philosophy is for the operator to immediately enter any flowchart when the EOP entry condition occurs. Once the operator enters the flowchart, it will lead to the proper procedural steps.

3.2 REVISION AND AUTHORIZATION

Each flowchart shall include information which identifies the current revision designation and authorized signatures. This information shall be located at the upper right of each flowchart (see Figure 1).

3.3 UNIT IDENTIFICATION FOR FLOWCHARTS

The flowcharts are identical for both units and no unit identifier is needed. If a step applies to one unit only, the following format shall be used:

___ 19. Unit 2 only - START one RHR pump

If a step applies to both units and there is a need to differentiate between units due to nomenclature, valve number, etc., the following format shall be used:

___ 21. Unit 1 only - OPEN HPCI outboard injection valve E41-F007

___ 22. Unit 2 only - OPEN HPCI outboard injection valve E41-F006

3.4 PAGE IDENTIFICATION

There shall be no page identification on the flowcharts. The Immediate Action Steps for each flowchart shall be included on one page.

3.5 FORMAT

The flowcharts shall utilize standard logic symbols (see Figure 2).

These symbols shall be arranged in a decision tree type flowchart consisting of Information/Caution, Decision, and Action Steps that provide the operator with guidance intended to bound the problem and get the plant into a safe condition quickly, systematically, and consistently (see Figure 1).

3.6 DECISION SYMBOL

This symbol shall contain a question which the operator is to answer YES or NO. The question shall pertain to a plant parameter, setpoint, switch position, or system condition.

FIGURE 2

Standard Logic Symbols

If the particular step is designated as a key or path-specific parameter, it should have an action symbol superimposed over the standard decision symbol. These important steps are further highlighted by making the decision symbol lines heavier than normal (see Figure 2). The operator may be required to return to these steps.

3.7 ACTION SYMBOL

This symbol shall contain a specific action, command, or verification which the operator should perform.

3.8 INFORMATION SYMBOL

This symbol shall contain information which may be useful to assist the operator in diagnosing plant conditions. The symbol is also used to provide operator cautions. If the symbol is used for information, "INFORMATION" shall be the first word in the block

3.9 ARROW SYMBOLS

There shall be two basic types of arrow symbols used on the flowcharts (see Figure 2).

The path-to-path arrows guide the operator from one flowchart to another. The path-to-end-path arrow guides the operator from the Immediate Action Steps (flowcharts) to the appropriate Subsequent Action Steps (End Path Procedures).

3.10 CONNECTING LINES

There shall be two basic line widths used to guide the operator through the flowchart. The operator should follow these lines, always entering the symbols at the top and exiting the symbols at the sides or bottom.

The wide line, Yellow Brick Road, represents the expected plant response for each flowchart.

The narrow lines are equally important. They represent possible response of the plant for many situations on each flowchart.

No lines shall cross or intersect on the flowcharts, except where two or more enter the same symbol.

3.11 ENTRY CONDITION FOR FLOWCHARTS

The entry conditions shall be, "Any Reactor Scram."

The entry condition for each flowchart is identical (see Figure 1).

3.12 KEY PARAMETERS

Each flowchart shall have identical initial formats; i.e., the entry conditions followed by the key parameters (see Figure 1).

The key parameters are very important. They establish the priority of actions and guide the operator to the appropriate procedure.

3.13 PATH-SPECIFIC PARAMETERS

The path-specific parameters are located on the Yellow Brick Road of the flowcharts. These steps are emphasized by the use of heavy decision symbols and superimposed action symbols.

3.14 AUTOMATIC ACTIONS

The following automatic actions shall be verified on the flowcharts:

Group Isolations
ECCS Actuation
Diesel Generator Auto Start

These actions should be placed on the flowcharts at points where it is known that the condition for the automatic action has been met. As an example, if Path 4 is entered, it is known that reactor water level has decreased below +112". This requires isolation of valve Groups 1, 2, 3, 6, and 8; auto start of HPCI and RCIC; recirc. pump start; etc. These actions should be verified or manually initiated on Path 4.

3.15 IMMEDIATE OPERATOR ACTIONS

The steps on the flowcharts are the Immediate Operator Action Steps. These operator actions are taken to stop further degradation of existing conditions and to mitigate their consequences or to bound the problem.

The immediate operator actions shall be visible to the operator; therefore, no need or requirement exists to memorize these actions.

3.16 OPERATOR CAUTIONS

Operator cautions shall be included on the flowcharts where appropriate. The cautions are enclosed in information symbols. If the symbol is used as a caution, the word "CAUTION" shall be the first word in the symbol. Cautions shall be placed prior to the step to which they apply.

3.17 PLACE KEEPING AIDS

The flowcharts shall be mounted on a lightweight surface such as styrofoam and covered with a thin transparent layer of plastic, which can be marked on with a felt-tip pen or grease pencil. The operator shall check off the steps of the flowchart as they are performed. Felt-tip pen ink and grease pencil are easily erased.

3.18 WRITING STYLE FOR FLOWCHARTS

The flowchart steps shall be written in a style that presents the information in a simple, familiar, specific, and unambiguous manner.

The flowchart steps should be brief and exact. The following guidelines should be used for flowchart development:

a. Decision and Action Steps shall deal with only one idea.

b. Complex evolutions should be prescribed in a series of steps, if possible.

c. Operator actions should be specifically stated.

d. Identification of components should be in everyday terms; i.e., operator language.

e. Expected results of routine tasks need not be stated.

f. Words and meanings shall be consistent throughout the flowcharts.

g. Use only accepted abbreviations that are familiar to the operator; i.e., the ones listed in this Writers' Guide.

h. Avoid the use of time-dependent operator actions.

i. Use units of measure that are familiar to the operator. The operator should be able to relate the units to those referenced on the plant instrumentation without conversion, translation, or mental manipulation.

j. Generally, notes and tables should not be used on flowcharts. However, it is permissible to use them if this simplifies the procedure.

k. Word order should be selected to require a minimum of punctuation on the flowcharts.

3.19 VOCABULARY

Words used in the steps of the flowcharts should convey precise understanding to the trained operator. The following rules are to be used:

a. Use simple words. Simple words are usually short words of few syllables. Simple words are generally common words.

b. Use common usage if it makes the procedure easier to understand.

c. Use words that are concrete, rather than vague, specific rather than general, familiar rather than formal, precise rather than blanket.

d. Verbs with specific meaning should be used. Some examples of suitable verbs are listed in Table 1.

e. Equipment status shall be denoted as operable, available, or running, depending upon the specific condition of the equipment.

   Operable and available mean that the system, component, or device is capable of performing its intended function(s) in the intended manner.

   Running denotes that the system, component, or device is performing its intended function(s).

3.20 SEQUENCING

Tasks and Action Steps shall be sequenced according to technical necessity, which should be the overriding consideration. Additionally, the physical layout and organization of the Control Room is an important consideration in sequencing tasks for optimal staff movement and monitoring when performing a sequence of tasks and actions.

Table 1. Examples of Action Verbs

Verb	Application
ADJUST	To regulate or bring to a more satisfactory state; for example, "ADJUST CAD Tank pressure to 100 psig"
ALIGN	To place a system in proper or desired configuration for an intended purpose; for example, "ALIGN CAD Vaporizer to Reactor Building"
ALLOW	To permit a stated condition to be achieved prior to proceeding; for example, "ALLOW discharge pressure to stabilize"
CHECK	To perform a comparison with a procedural requirement; for example, "CHECK Reactor Building Area Radiation and Vent Radiation Monitors"
CLOSE	To change the physical position of a mechanical device so that it prevents physical access or flow or permits passage of electrical current; for example, "CLOSE Valve FW-V177"
COMPLETE	To accomplish specific procedural requirements; for example, "COMPLETE data report QA-1, "COMPLETE Steps 7 through 9 of Section III"
ESTABLISH	To make arrangements for a stated condition; for example, "ESTABLISH communication with the Control Room"
INSPECT	To measure, observe, or evaluate a feature or characteristic for comparison with specific limits; method of inspection should be included; for example, "visually INSPECT for leaks"
ISOLATE	To close one or more valves in a system for the purpose of separating or setting apart a complete system or a portion of the system from the rest; for example, "ISOLATE Interruptible Instrument Air Header using RTGB Controls"
MAINTAIN	To keep in an existing state; for example, MAINTAIN the reactor vessel water level between +162 and +208 inches, with one or more of the following systems . . ."

Table 1. Examples of Action Verbs (Continued)

Verb	Application
OPEN	To change the physical position of a mechanical device, such as valve or door, to the unobstructed position that permits access or, prevents passage of electrical current; for example, "OPEN Valve FW-V177"
PLACE	To put in a particular position; for example, "PLACE mode switch to 'SHUTDOWN'"
RECORD	To document specified condition or characteristic; for example, "RECORD discharge pressure"
REDUCE	To cause a parameter to decrease in value; for example, "REDUCE reactor pressure with Bypass Valve Manual Jack"
SET	To physically adjust to a specified value an adjustable feature; for example, "SET HPCI Speed Controller to maintain RPV water level near normal"
START	To originate motion of an electric or mechanical device directly or by remote control; for example, "START RHR and Core Spray Pumps"
STOP	Opposite of start; for example, "STOP the Condensate Pumps"
SYNCHRONIZE	To make synchronous in operation; for example, "SYNCHRONIZE the Diesel Generator to the (E) Bus"
THROTTLE	To operate a valve in an intermediate position to obtain a certain flow rate; for example, "THROTTLE Valve E11-F017A to . . ."
TRIP	To manually activate a semi-automatic feature; for example, "TRIP incoming Feeder Breakers to 4KV Emergency (E) Busses"
VENT	To permit a gas or liquid confined under pressure to escape at a vent; for example, "VENT CRD Scram Air Headers"
VERIFY	To observe the expected condition or characteristic; for example, "VERIFY on OR START both CRD Pumps"

3.21 VERIFICATION STEPS

Verification Steps are used to determine whether the objective of a task or a sequence of actions has been achieved. This is easily accomplished on the flowchart; e.g., "Manually start HPCI" followed by "HPCI Start Successful?" In this example the operator would check off the Command Step, enter the Verification Step, check it off, then continue following the appropriate route.

This arrangement ensures that equipment response and operator actions have occurred and are correct for given situations.

If an Action Step cannot be accomplished, the operators are trained to so indicate; i.e., circle the step and continue on through the procedure.

3.22 LOCATION INFORMATION

The flowchart steps shall provide necessary information on the location of equipment, controls, or displays that are infrequently used, are in out-of-the-way places, or are otherwise difficult to find. Additional location information should be provided in the End Path Manuals, Operator Training, and at remote locations.

3.23 NUMERICAL VALUES

The use of numerical values shall be consistent with the following rules:

a. Arabic numerals shall be used.

b. For numbers less than unity, the decimal point shall be preceded by a zero; for example, 0.1.

c. The number of significant digits shall be equal to the number of significant digits available from the display and reading precision of the operator.

d. Acceptance values should be specified in such a way that addition and subtraction by the user is avoided, if possible. This can generally be done by stating acceptance values as limits. Examples are as follows: +170 inches minimum, +200 inches maximum, +170 inches to +200 inches. A statement of midpoint and the upper and lower limits may be used when appropriate; for example, 10 milliamperes (9.5 to 10.5). Avoid using +.

e. Engineering units should always be specified for numerical values of process variables. They should be the same as those used on the Control Room displays; for example, psig instead of psi.

3.24 ABBREVIATIONS, LETTER SYMBOLS, AND ACRONYMS

The use of unfamiliar abbreviations should be avoided because they may be confusing to those who are to use the procedures. Abbreviations may be used, where necessary, to save time and space and when their meaning is unquestionably clear to the operator. Consistency should be maintained throughout the flowcharts (see Abbreviation List in this document).

Capitalization of abbreviations should be uniform. The period should be omitted in abbreviations, except in cases where the omission would result in confusion.

Abbreviations, symbols, and acronyms should not be overused. Their use should be for the benefit of the reader. They can be beneficial by saving reading time and ensuring clarity when space is limited.

3.25 TYPING FLOWCHART STEPS

Gothic elite, pitch 12, typewriter element shall be used.

The flowchart steps should be typed on Standpat Applique System pressure sensitive sheets. The words of each step should be arranged; i.e., centered to best utilize the available space. Avoid typed information touching the symbol borders.

3.26 PREPARING AND MOUNTING FLOWCHARTS

The flowcharts' layout (i.e., symbols and connecting lines) are prepared on sheets of 3 mil matte polyester drafting film (mylar) using standard drafting instruments; i.e., a special template and filmograph drawing leads such as Berol No. 6375 E1.

The typed steps are then transferred to the drawing film.

The completed flowcharts shall be reduced by 50% and mounted on lightweight boards such as styrofoam.

Each board shall then be laminated with a thin, transparent plastic material. Each flowchart board may be framed with lightweight aluminum for additional strength.

3.27 REPRODUCTION OF FLOWCHARTS

Reproduction of the flowcharts may be done on a standard blueprint copier. All copies of flowcharts must be legible and readable under expected conditions of use. Reduced flowcharts on film (mylar) should be used for the original.

3.28 REVISIONS TO FLOWCHARTS

The current revision of each flowchart shall be maintained on film (mylar), both full size and half size, and be kept in the plant vault along with paper reproductions of prior revisions.

When changes occur in the plant design, Technical Specifications, Technical Guidelines, Writers' Guide, other plant procedures or Control Room that will affect the flowcharts, the flowcharts should be revised on a timely basis to reflect these changes. In addition, when operating and training experience, simulator exercises, control room walk-throughs or other information indicates that incorrect or incomplete information exists in the flowcharts, the flowcharts should be revised on a timely basis. These changes should be reviewed to ensure consistency with the Technical Guidelines and the Writers' Guide. Operators should be encouraged to suggest improvements to the flowcharts.

3.29 LOCATION OF FLOWCHARTS

The flowcharts and End Path Manuals shall be located conveniently to the operator. A table that is dedicated for EOP use only shall be located in the Control Room for each unit. This table shall be large enough to accommodate the End Path Manual when it is fully extended. Each table shall have one complete set of EOP-01. Additional copies of procedures shall be maintained in Operations working files.

Each table shall have a chart rack. This rack will hold all flowcharts. The rack will be staggered in a manner that makes the path number of each flowchart visible.

4.0 ORGANIZATION OF BSEP END PATH MANUALS

The Brunswick End Path Manuals consist of the following written procedures:

a. End Path Procedures (EPP)

b. Containment Control Procedures (CCP)

c. System Recovery Procedures (SRP)

d. Local Emergency Procedures (LEP)

e. Contingency Procedures (CP)

The above procedures shall be in identical format. The five sections of the End Path Manual shall be located as indicated by Figure 3.

FIGURE 3

4.1 DESIGNATION AND NUMBERING

The End Path Manuals contain the instructions that govern the plant operation during emergency conditions and specify the subsequent operator actions to be taken to return the plant to a stable condition.

Each procedure shall be uniquely identified. This identification permits easy administration of the process of procedure preparation, review, revision, distribution, and operator use (see Section 4.0).

4.2 COVER SHEET

Every End Path Manual Procedure shall have a cover sheet (see Figure 4). The purposes of this cover sheet are: (1) to identify the procedure and (2) to indicate the approval status. A descriptive title is to be used that identifies the procedure.

4.3 REVISION SHEET

Every procedure shall have a revision sheet (see Figure 5). The revision sheet will be the second page of each procedure.

4.4 PROCEDURE DESIGNATION AND NUMBERING

The identifying number and designation for all procedures in the End Path Manuals shall include the information contained in the following example:

Example: BSEP/VOL VI/EOP-01/EPP-2A

Specific Identification
End Path Procedure 2A

Procedure Designation

Plant Operating Manual
Volume

Plant Designation

4.5 REVISION NUMBERING AND DESIGNATION

The latest revision shall be indicated on the cover sheet for each procedure (see Figure 4).

FIGURE 4

Cover Sheet

FIGURE 5

List of Effective Pages

The second sheet of each procedure shall be the revision sheet (see Figure 5). This sheet contains a list of effective pages and revision numbers.

At the lower right hand corner of each page of the procedure, with the exception of the cover page, the abbreviation "REV" will be used, followed by digits denoting the current revision for each page.

To identify revisions to the text of the procedure a change bar, located in the right margin alongside the text change, will be used to indicate a change in the text (see Figure 6).

4.6 PAGE IDENTIFICATION AND NUMBERING

Each page of the procedure shall be identified by: (1) the procedure designator and number (located on lower left of sheet), (2) the page number specified as "Page __ of __" (this information shall be centered at the bottom of each page, as shown in Figure 6), and a revision number on the lower right of each sheet; i.e., REV. 01.

4.7 FORMAT

The format for each procedure in the End Path Manual shall be consistent.

4.7.1 Page Format

A sentence format shall be used for all procedures in the End Path Manual. A sample page format is presented in Figure 6.

4.7.2 Procedure Organization

The following section headings shall be used for all procedures in the End Path Manual:

a. TITLE - The title shall be stated for operator association with the entry conditions.

The example title (Figure 6) represents a title for an End Path Procedure. Other examples of procedures in the End Path Manual:

Example A: Drywell Temperature Control

Example B: System Recovery Procedure for TBCCW

FIGURE 6

Example Procedure

b. PLANT CONDITION OR ENTRY CONDITION - The entry conditions for the End Path Procedures are the plant conditions which exist at the exit point from the flowchart. Figure 6 is an example of an End Path Procedure for which the plant condition (entry condition) is exit point A on Flowchart 2.

Another example of an entry condition is as follows:

Example: Drywell temperature above 135°F

The entry conditions should include alarms, indications, operating conditions, automatic system actions, or other unique symptoms that the operator is to use. These conditions guide the operator whether or not to execute the procedure.

c. OPERATOR ACTIONS - The operator actions will be short, concise, identifiable instructions that give appropriate direction to the user.

4.7.3 Section and Step Numbering

Instructional steps will be numbered and indented as follows:

C. OPERATOR ACTIONS

___ 1. VERIFY . . .

___ a. CHECK . . .

___ (1) POSITION . . .

Operator place keeping aids are indicated by a horizontal line as shown above.

4.8 WRITING INSTRUCTIONAL STEPS

Writing instructional steps shall be consistent in the End Path Manuals.

4.8.1 Instructional Step Length and Content

Instructional steps will be concise and precise. Conciseness denotes brevity; preciseness means exactly defined. Thus, instructions should be short and exact. General rules to be used in meeting these objectives are as follows:

a. Instructional steps should deal with only one idea.

b. Short, simple sentences should be used in preference to long, compound, or complex sentences.

c. Complex evolutions should be prescribed in a series of steps, with each step made as simple as practicable.

d. Objectives of operator actions should be specifically stated. This includes identification of exactly what is to be done and to what.

e. For instructional steps that involve an action verb relating to three or more objects, the objects will be listed with space provided for operator checkoff.

f. Limits should be expressed quantitatively whenever possible (refer to Subsection 3.23).

g. Mandatory sequence of steps is assumed unless otherwise stated.

h. Identification of components and parts should be complete. Equipment and system names should be highlighted by initial capitalization.

i. Instruction content should be written to communicate to the user.

j. Expected results of routine tasks need not be stated.

k. When actions are required based upon receipt of an annunciated alarm, list the setpoint of the alarm for ease of verification.

l. When requiring resetting or restoration of an alarm or trip, list the expected results immediately, following the resetting or restoration, if it would be beneficial to the operator.

m. When considered beneficial to the user for proper understanding and performance, describe the system response time associated with performance of the instruction.

n. When system response dictates a time frame within which the instruction must be accomplished, prescribe such time frame. If possible, however, avoid using time to initiate operator actions. Operator actions should be related to plant parameters.

o. When additional confirmation of system response is considered necessary, prescribe the backup readings to be made.

4.8.2 Use of Logic Terms/Statements

The logic terms AND, OR, NOT, IF NOT, WHEN, THEN, and IF are often necessary to describe precisely a set of conditions or sequence of actions. When logic statements are used, logic terms will be highlighted so that all the conditions are clear to the operator. Emphasis will be achieved by using capitalization and underlining. All letters of the logic terms shall be capitalized, and the words will be underlined.

Use logic terms as follows:

a. Use of AND:

When attention should be called to combinations of conditions, the word AND shall be placed between the description of each condition.

Example:

___ 16. IF RWCU has isolated AND a break in the RWCU System is not suspected, THEN RESET the Group 3 isolation AND RESTART RWCU. (OP-14)

The word AND shall not be used to join more than three conditions. If more than three conditions need to be joined, a list format shall be used. The list format may be used to join less than four conditions when it makes the procedure more readable.

Example:

___ 22. WHEN:

___ a. Reactor vessel level can be maintained above +170 inches AND

___ b. Reactor pressure can be maintained below 1045 psig AND

___ c. Primary containment parameters are within the limits specified in the Containment Control Procedure, THEN EXIT this procedure AND ENTER the appropriate section of the General Plant Operating Procedure for hot standby or cold shutdown as directed by the SOS.

When used as a single or compound conjunction, the word "and" need not be emphasized.

Example:

___ 12. TRIP HPCI turbine and place in "STANDBY".

b. Use of OR:

The word OR shall be used when calling attention to alternate combinations of conditions. The use of the word OR shall be in the inclusive sense.

Example:

___ 14. IF:

___ a. All control rods are fully mounted OR

___ b. The reactor is shutdown and no boron has been injected

THEN continue in the procedure Step 20.

The use of OR in the exclusive sense will be avoided whenever possible. To specify the exclusive "OR", the following may be used: "either A OR B but not both."

c. Use of IF, IF NOT, WHEN, and THEN

When Action Steps are contingent upon certain conditions or combinations of conditions, the step shall begin with the words IF or WHEN followed by a description of the condition or conditions (the antecedent), a comma, the word THEN, followed by the action to be taken (the consequent). WHEN is used for an expected condition. IF is used for an unexpected but possible condition.

Example:

___ 15. IF the MSIVs are open, THEN rapidly DEPRESSURIZE the reactor with the bypass valve opening jack.

___ 18. WHEN reactor pressure is below 200 psig, THEN PLACE control switches for three SRVs to "OPEN."

Use of IF NOT should be limited to those cases in which the operator must respond to the second of two possible conditions. IF should be used to specify the first condition.

Example:

IF reactor vessel level is increasing, THEN TRIP one RHR pump. IF NOT, THEN START one RHR pump.

THEN shall not be used at the end of an Action Step to instruct the operator to perform the next step because it runs actions together.

Example:

___ 12. Verify all control rods are fully inserted, THEN commence a reactor dispressurization per GP-05.

Actions which are imbedded this way (1) may be overlooked and not be performed, (2) make it difficult to verify the performance of each action when a checkoff or sign-off is used, and (3) can be confused with a logic statement.

d. Combinations of Logic Terms

The use of AND and OR, along with IF and THEN, within the same step should be avoided. When AND and OR are used together, the logic statements can be confusing and ambiguous. For example:

IF condition A AND condition B OR condition C occurs, THEN go to Step 5.3.6

This statement has two possible meanings:

(1) IF both condition A AND condition B occur, THEN go to Step 5.3.6

(2) IF both condition A AND condition B occur, THEN go to Step 5.3.6

OR

IF both condition A AND condition C occur, THEN go to Step 5.3.6.

If the use of AND and OR within the same step cannot be avoided, the more explicit form (as illustrated in examples 1 and 2 above) should be used.

4.8.3 Cautions

End Path Manual cautions shall be included in the written procedure in a format that makes them stand out from the steps of a procedure.

The cautions shall be placed immediately before the procedural steps to which they apply.

The caution in its entirety shall be completed on the same page as the instructional step to which it applies.

The cautions should have a row of asterisks before and after them.

Cautions shall extend across the entire page and shall be highlighted as shown in Figure 6. This placement of cautions helps ensure that the procedure user observes the caution before performing the step. It should be used to denote a potential hazard to equipment or personnel associated with or consequent to the subsequent instructional step. A caution statement should not include an action.

Example Caution:

****

CAUTION

Large reactor power oscillations may be observed while executing this step.

****

4.8.4 Notes

If additional information other than cautions is necessary to support an action instruction, a note should be used. A note should present information only, not instructions. The note should be centered and indented approximately eight spaces from the margin. The note in its entirety shall be completed on the same page as the instructional step to which it applies.

Example Note:

NOTE

The reactor head flange and head temperatures should be maintained greater than 70°F when head bolts are tensioned.

4.8.5 Calculations

Mathematical calculations should be minimized in the EOPs. If a value has to be determined in order to perform a procedural step, a chart or graph should be used whenever possible.

4.8.6 Use of Underlining

Underlining will be used for emphasis of logic terms, cautions, notes, miscellaneous emphasis, and conditional statements.

4.8.7 Referencing and Branching to Other Procedures or Steps

a. Referencing

Referencing implies that an additional procedure or additional steps will be used as a supplement to the procedure presently in use. Referencing other steps within the procedure being used, either future steps or completed steps, should be minimized. When only a few steps are involved in the referencing, the steps should be stated in the procedure wherever they are needed.

If referencing cannot be avoided, the following format should be used:

To reference a step within the same procedure:

___ 1. IF all control rods are fully inserted, THEN CONTINUE in this procedure at Step 15.

To reference steps contained in another procedure:

___ 5. IF suppression pool temperature AND reactor pressure CANNOT be restored AND maintained in the "SAFE" region of the Heat Capacity Temperature Limit graph, (see Figure 1, SP/T), THEN reactor depressurization is required. DEPRESSURIZE the reactor per Step 6 in the "End Path Procedure."

b. Branching

Example of concurrent procedure use: IF while executing this procedure, any of the following primary containment parameters are exceeded, THEN ENTER the associated procedure in the Containment Control Section of this End Path Manual and EXECUTE it concurrently with this procedure.

Example of branching from one procedure to another: IF reactor vessel level CANNOT be maintained above 0 inches, THEN EXIT this End Path Procedure and ENTER the "Level Restoration Procedure" in the Contingency Section of this End Path Manual.

Use quotation marks to emphasize the title of the referenced or branched procedure; for example, THEN EXIT this procedure and ENTER the "Steam Cooling Procedure" in the Contingency Section of this End Path Manual.

4.8.8 Component Identification

With respect to identification of components, the following rules are to be followed:

a. Equipment, controls, and displays will be identified in operator language (common usage) terms. These terms may not always match engraved names on panels but will be complete.

b. When the engraved names and numbers of panel placards and alarm windows are specifically the item of concern in the procedure, the engraving should be quoted verbatim and emphasized by using all capitals.

c. The names of plant system titles are emphasized by initial capitalization.

d. If the component is seldom used or it is felt that the component would be difficult to find, location information should be given in parentheses following the identification.

4.8.9 Level of Detail

Too much detail in EOPs should be avoided in the interest of being able to effectively execute the instructions in a timely manner. The level of detail required is the detail that a newly trained and licensed operator would desire during an emergency condition.

To assist in identifying the appropriate level of detail, the following examples of verb use may be used:

a. For power-driven rotating equipment, use START, STOP.

b. For valves, use OPEN, CLOSE, THROTTLE open, THROTTLE close, THROTTLE.

c. For power distribution breakers, use SYNCHRONIZE, CLOSE, and TRIP.

d. For control switches with a position placement that establishes a condition, the verb "PLACE" should be used, along with the engraved name of the desired position; i.e., PLACE the Mode Switch to "SHUTDOWN."

e. Standard practices for observing abnormal results need not be prescribed within procedural steps. For example, observation of noise, vibration, erratic flow, or discharge pressure need not be specified by steps that start pumps.

4.8.10 Printed Operator Aids

Printed operator aids should be used in order to avoid calculations in the EOP, assist operator decision making, or consolidate information.

When information is presented using graphs, charts, tables, and figures, these aids must be self-explanatory, legible, and readable under the expected conditions of use and within the reading precision of the operator.

a. Units of Measure

Units of measure on figures, tables, and attachments should be given for numerical values that represent observed, measurement data, or calculated results. A virgule (slant line) should be used instead of "per."

Examples: ft/sec, lbs/hr

b. Titles and Headings

Capitalization should be used for references to tables and figures within text material and column headings with a table.

Examples: Refer to Figure 201 for . . . .
. . . as shown in Table 201, Equipment Power Supplies, the . . . .

c. Figure, Table, and Attachment Numbering

Sequential arabic numbers should be assigned to figures, tables, and attachments in separate series. The sequence should correspond with the order of their reference in the text. The symbol "#" and abbreviation "No." are unnecessary and should not be used. The number alone suffices.

following formats may be used for these steps:

___ 3. IF while executing this procedure, reactor vessel level CANNOT be determined OR reactor vessel flooding is required, THEN EXIT this End Path Procedure AND ENTER the "Flooding Procedure" in the Contingency section of this End Path Manual.

___ 6. MAINTAIN reactor pressure below 950 psig with SRVs. Use opening sequence A, E, J, B, F, D, G, C, H.

4.8.14 Equally Acceptable Steps

Equally acceptable steps are those for which a number of alternate steps may be equally acceptable. The most acceptable method should be the first step. If this step cannot be accomplished, an alternate method should be provided.

5.0 MECHANICS OF STYLE

5.1 SPELLING

Spelling should be consistent with modern usage. When a choice of spelling is offered by a dictionary, the first spelling should be used.

5.2 HYPHENATION

Hyphens are used between elements of a compound word when usage calls for it. The following rules should be followed for hyphenation:

a. When doubt exists, the compound word should be restructured to avoid hyphenation.

b. Hyphens should be used in the following circumstances:

- In compound numerals from twenty-one to ninety-nine; for example: one hundred thirty-four

- In fractions; examples: one-half, two-thirds.

- In compounds with "self"; examples: self-contained, self-lubricated.

- When the last letter of the first word is the same vowel as the first letter of the second word--as an alternative, two words may be used; example: fire-escape or fire escape.

- When misleading or awkward consonants would result by joining the words; example: bell-like.

- To avoid confusion with another word; examples: re-cover to prevent confusion with recover, pre-position to avoid confusion with preposition.

- When a letter is linked with a noun; examples: X-ray, O-ring, U-bolt, I-beam.

- To separate chemical elements and their atomic weight; examples: Uranium-235, U-235.

5.3 PUNCTUATION

Punctuation should be used only as necessary to aid reading and prevent misunderstanding. Word order should be selected to require a minimum of punctuation. When extensive punctuation is necessary for clarity, the sentence should be rewritten and possibly mad into several sentences. Punctuation should be in accordance with the following rules:

5.3.1 Brackets

Do not use brackets.

5.3.2 Colon

Use a colon to indicate that a list of items is to follow; for example, RESTORE cooling flow as follows:

5.3.3 Comma

Use of many commas is a sign the instruction is too complex and needs to be rewritten. Therefore, evaluate the number of commas to ensure the instruction is not too complex.

Use a comma after conditional phrases for clarity and ease of reading. Example: WHEN level decreases to 60 inches, THEN START pump . . . .

5.3.4 Parentheses

Parentheses shall be used to indicate alternative items in a procedure, instruction, or equipment numbers.

5.3.5 Period

Use a period at the end of complete sentences and for indicating the decimal place in numbers.

5.4 VOCABULARY

Words used in procedures should convey precise understanding to the trained person. The following rules apply:

a. Use simple words. Simple words are usually short words of few syllables. Simple words are generally common words.

b. Use common usage if it makes the procedure easier to understand.

c. Use words that are concrete rather than vague, specific rather than general, familiar rather than formal, precise rather than blanket.

d. Define key words that may be understood in more than one sense.

e. Verbs with specific meaning should be used. Examples are listed in Table 1.

f. Equipment status should be denoted as follows:

- Available or operable - These words mean that a system, subsystem, train, component, or device is capable of performing its specified function(s) in the intended manner. Implicit in this definition is the assumption that all necessary attendant instrumentation, controls, normal and emergency electrical power sources, cooling or seal water, lubrication, or other auxiliary equipment required for the system, subsystem, train component, or device to perform its function(s) are also capable of performing related support function(s).

5.5 NUMERICAL VALUES

The use of numerical values should remain consistent with those rules mentioned in Subsection 3.23.

5.6 ABBREVIATIONS, LETTER SYMBOLS, AND ACRONYMS

The use of abbreviations, letter symbols, and acronyms should remain consistent with those rules mentioned in Subsection 3.24.

6.0 <u>TYPING FORMAT</u>

6.1 GENERAL TYPING FORMAT

For the End Path Manual Procedures, the following general requirements shall be followed:

a. Paper size should be 8 1/2 x 11 inches.

b. White bond paper should be used.

c. Procedures may be typed on an electric typewriter or word processor.

d. Elite, 12 pitch typewriter element may be used.

6.2 PAGE ARRANGEMENT

a. Page margins are 1 inch from the left edge of paper and 1 inch from the right edge of paper.

b. Page identification information will be centered and 1 inch from the bottom of the page.

c. The text will begin 1 1/4 inches from the top of the paper and end at least three line spaces above the page information. Tables and figures shall be readable with the page so arranged. Rotation of printed matter should be minimized for Emergency Instructions.

6.3 HEADING AND TEXT ARRANGEMENT

Block style, as illustrated in Figure 6, is to be used. Section headings shall be in full capitals, with an underscore.

a. Section numbers shall begin 1 inch from the left edge of page.

b. Two line spaces shall be allowed between headings and respective text.

c. Two line spaces shall be allowed between paragraphs.

d. Text will be typed using one-line spacing.

6.4 BREAKING OF WORDS

Breaking of words shall be avoided to facilitate operator reading.

6.5 ROTATION OF PAGES

If pages need to be rotated, these rules shall be followed:

a. The top of the page with rotated print is the normal left-hand edge.

b. The page margins do not rotate.

c. Page identification and numbering will not be rotated.

6.6 PRINTED OPERATOR AIDS

6.6.1 Figures

Figures include graphs, drawings, diagrams, and illustrations. The following rules are established:

a. The figure number and its title are placed three line spaces below the figure field.

b. The figure number and title should be of elite type, 12 pitch.

c. The figure field must not violate specified page margins.

d. The figure field should be of sufficient size to offer good readability.

e. The essential message should be clear; simple presentations are preferred.

f. Grid lines of graphs should be at least 1/8 inch apart; numbered grid lines should be bolder than unnumbered grid lines.

g. Labeling of items within the figure should be accompanied by arrows pointing to the item.

h. The items within the figure should be oriented naturally insofar as possible. For example, height on a graph should be along the vertical axis.

i. In general, items within the figure should be labeled. Typed labels should use elite type, 12 pitch. Handwritten labels should be printed, using all capitals, with letters and numbers at least 1/8 inch high.

j. All lines in figures should be reproducible.

6.6.2 Tables

Tables should be typed using the following rules:

a. Type style and size should be the same as that for the rest of the procedure when possible.

b. The table number and title should be located above the table field and three line spaces below preceding text.

c. A heading should be entered for each column and centered within the column; the first letter of words in the column headings should be capitalized.

d. Horizontal lines should be placed above and below the column headings; vertical lines, while desirable, are not necessary or required.

e. Tabular headings should be aligned as follows:

- Horizontally by related entries.

- Vertically by decimal point for numerical entries.

- Vertically by first letter for word entries; however, run-over lines should be indented three spaces.

f. Double spacing between horizontal entries suffices to segregate such entries, although horizontal lines may also be used if desired. If used, double horizontal lines should be used above and below the column headings.

g. There should not be a vacant cell in the table. If no entry is necessary, "NA" should be entered to indicate not applicable.

6.7 CAUTIONS AND NOTES

All notes and cautions should be distinguishable from the rest of the text by using the following format (see Subsection 4.8.3).

a. The applicable headings "NOTE" and "CAUTION" should be capitalized, centered.

b. The text of the note or caution should be block format, single-spaced.

c. Cautions shall be further highlighted by asterisks two line spaces above the heading and two spaces below the last line of the text.

d. Cautions should be extended across the entire page.

e. Notes should be centered and indented eight spaces from the margin (see Subsection 4.8.4).

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

APPENDIX III

VALIDATION/VERIFICATION PROGRAM FOR EMERGENCY OPERATING PROCEDURES

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A. <u>Desk Top Review</u>

The Desk Top Review of the Brunswick EOPs consisted of the classroom training sessions conducted at the plant training facility.

The following classroom training sessions were conducted:

1. Initial classroom training from February 1982 to March 1982. This training introduced operators to the flowcharts and techniques of flowchart use.

2. Generic guideline training from December 1982 to May 1983. This training introduced operators to the concepts of the generic guidelines and how they are used in the Brunswick EOP.

3. Preimplementation training from November 1983 to December 1983. This training involved all procedures associated with the EOP. Each procedure was reviewed in the classroom, step by step, to ensure they are usable and the language and level of detail in the EOP was compatible with the experience of the operating staff.

During each of these training sessions, trainees were encouraged to ask questions and make comments concerning the new EOPs. These comments were of both technical and human engineering nature.

All important comments and recommendations were recorded by the instructor and used to revise the EOPs when desirable or appropriate.

Some examples of licensed personnel comments and the EOP development group's response are included as follows:

1. Is it necessary to manually scram the reactor as the first action on the flowcharts?

   Response:

   Yes. This is a conservative action as a backup to the automatic scram.

2. Some old EIs require the operator to execute a manual scram. Where is this guidance to be located in the new procedures?

   Response:

   This guidance will be contained in annunciator procedures or abnormal operating procedures.

3. The mode switch step appears too soon on the flowcharts. This could result in a Group 1 isolation on Unit 2 due to high steam line flow.

   Response:

   This step will be relocated on the next revision to the flowcharts.

4. Should a reference be made on the flowcharts to operating or other procedures?

   Response:

   If the actions on the flowcharts do not reference operating procedures and the operator feels it necessary, these procedures may be used.

5. The reactor should not be suddenly depressurized (manual ADS) unless it is absolutely necessary.

   Response:

   The flowcharts will be revised to prevent unnecessary manual ADS.

6. Why is the service water supply to the vital header not checked on the flowcharts?

   Response:

   The flowcharts will be revised to include steps concerning the vital header.

7. The flowcharts should contain earlier guidance for reactor water level control.

   Response:

   Revisions will be made on the flowcharts to provide guidance for earlier level control.

8. When placing the RHR System in suppression pool cooling, it is unclear which loop to use and exactly when the lineup should be.

   Response:

   Loop selection will be left to the operator's discretion. Specifying a certain loop would unnecessarily restrict the operator's ability to recognize plant conditions.

9. Is it necessary to monitor the diesel load when starting small motors such as the drywell cooling fan?

Response:

Yes. The diesels could be heavily loaded at the time the fan motors are started.

10. After a loss of off-site power and automatic diesel generator start, the RPS MG sets should be started locally to allow resetting of RPS and group isolations.

Response:

This step has been added on the flowcharts.

11. Should there be guidance provided to the operator which would prevent the second opening of an SRV shortly after it has been opened?

This would minimize the hazard of the SRV opening when the tail pipe contains an above normal amount of water.

Response:

The SRV opening sequence is specified on the flowcharts and will be posted in the Control Room. This, in conjunction with the SRV memory lights, should be sufficient guidance.

12. Color code or change the path-to-path arrow symbols to geometric symbols; e.g., circle, square, triangle, etc.

Response:

The path-to-path arrows will be color coded on the flowcharts that are used in the Control Room.

13. The path specific parameters should be highlighted.

Response:

These parameters have been highlighted by using heavy lines for the decision symbol.

14. At the exit points from the flowcharts the word "Procedure" is confusing; it is suggested that the words "End Path Manual" be used.

Example: GO TO END PATH
MANUAL 5 SECTION MM

Response:

This has been revised on the new flowcharts.

15. The connecting lines at the lower right portion of Flowchart 3 are too close.

Response:

This situation has been corrected on the latest revision of Flowchart 3.

B. Simulator Exercises

During the early stages of the Brunswick EOP development process, the Browns Ferry simulator was used several times for conducting simulated emergency exercises, using both the old event-oriented emergency instructions and the new symptomatic or function-oriented EOPs.

The following multiple failure exercises (problems) are examples of the scenarios used for simulator validation of the new EOPs:

Problem 1

Initial Conditions:	100% Power
Equipment Failures:	Loss of Off-Site Power Failure of Two Diesels Loss of HPCI Break in the Drywell

Problem 2

Initial Conditions:	100% Power
Equipment Failures:	Loss of RBCCW Loss of Drywell Coolers

Problem 3

Initial Conditions:	100% Power
Equipment Failures:	Loss of Off-Site Power Failure of Two Diesels Loss of HPCI

Problem 4

Initial Conditions:	100%
Equipment Failures:	Large Condenser Tube Leak Loss of RCIC Loss of HPCI

The conclusions following these initial simulator exercises indicated that the Brunswick approach; (i.e., flowcharts for immediate action steps) to symptom-based EOPs was a viable solution to the EOP problem and that the operators quickly adapted to the new format.

The Limerick simulator was used in 1982 for training all licensed personnel in the use of the new EOPs. A list of simulator exercises was developed which provided adequate exposure to all portions of the Brunswick flowcharts.

The 1983 simulator training was conducted at the Hatch simulator. The new EOPs were again used for this training.

The simulator exercises used were chosen from the following list:

Exercise No.	Description
1	Loss of Instrument Air - Manual Scram
2	Loss of CRD Pumps - Manual Scram
3	IRM Failure - Automatic Reactor Scram
4	Loss of Feedwater - Startup Mode
5	Loss of Feedwater - Run Mode
6	EHC Failure - Bypass Valves Fail Closed
7	EHC Failure - Bypass Valves Fail Open Loss of HPCI Loss of RCIC
8	EHC Failure - Bypass Valves Fail Closed Loss of Off-Site Power
9	LOCA - Small
10	Loss of Feedwater LOCA
11	Loss of Off-Site Power Loss of HPCI Loss of RCIC
12	Stuck Open SRV - Manual Scram
13	Turbine Trip Bypass Valves Fail Closed

Exercise No.	Description
14	Turbine Trip Stuck Open Bypass Valve LOCA - Small
15	Turbine Trip - High Power
16	Fuel Cladding Failure
17	Loss of Coolant - Small
18	EHC System Malfunction - Pressure Regulator Oscillation
19	Loss of Feedwater
20	Steam Leak Outside Containment
21	LOCA
22	Loss of Vacuum
23	Loss of Feedwater Loss of HPCI Loss of RCIC
24	Condenser Tube Leak Loss of HPCI Loss of RCIC LOCA
25	Turbine Trip Stuck Open Relief Valve (SORV)
26	Turbine Trip Turbine Bypass Valves (BPV) - Failed Closed Loss of HPCI
27	Turbine Trip Feedwater Regulator Failure
28	Steam Line Break Loss of HPCI Loss of RCIC
29	Loss of Feedwater LOCA
30	High Conductivity - Manual Scram

Exercise No.	Description
31	MSIV Closure LOCA
32	EHC Failure - Pressure Regulator Failure - Low EHC Pressure Regulator Fails - High
33	Turbine Trip LOCA
34	Recirculation Pump Trip

During each of these simulator training sessions, trainees were encouraged to ask questions and make comments concerning the new EOPs. These comments were of both technical and human engineering nature.

These simulator training sessions have indicated that there is a high level of assurance that the procedures will guide the operator in mitigating transients and accidents.

An example of a simulator exercise is included (see Figure 1).

FIGURE 1

SIMULATOR EXERCISE

EXERCISE: EHC Failure - Bypass Valves Fail Open
Loss of HPCI
Loss of RCIC

FILE NO. 7-3F6.7

OBJECTIVES: Upon completion of this exercise the student will be able to:

Enter the EOP's (flowcharts) upon reactor scram and return the plant to a safe shutdown condition by correct execution of the EOP steps.

REFERENCES - RELATED LER's:

References: BSEP Symptomatic EOP Training Course
Related LER's: None

INITIAL CONDITIONS:

Power: 8%
Turbine on turning gear.
Mode switch in startup.

INSTRUCTOR GUIDE:

Direct the trainees to continue the startup.
Activate BPV failure.
Activate the other malfunctions after reactor scram.

SHIFT TURNOVER INFORMATION:

None

MALFUNCTIONS	OVERRIDES	REMOTE OPS.
Turbine Bypass Valves Fail Open		
HPCI Trip		
RCIC Trip		

SUPPLEMENTAL INFORMATION:

Fail HPCI and RCIC after the reactor scram has occurred.

EXPECTED RESPONSE: AS PER SERIAL RELATED CHECKOFF

Enter Path 2.

SUCCESSFUL COMPLETION OF THIS EXERCISE FULFILLS THE FOLLOWING NRC AND INPO REQUIREMENTS:

Harold Denton letter (NRC), March 28, 1980 - Enclosure 4, Items 16, 23 & 25.

C. Control Room Walk-Through

The NRC guideline for preparation of emergency operating procedures (i.e., NUREG-0899) recommends that the licensee conduct Control Room walk-throughs as one method of the validation/verification of the plant-specific emergency operating procedures.

The purpose of the Control Room walk-through is to establish the accuracy of information and instruction contained in the Brunswick EOPs, to determine that the procedure can be accurately and efficiently carried out, and to demonstrate that the procedures are adequate to mitigate transients and accidents. Both technical and human engineering adequacies have been addressed during this walk-through.

The objectives of the walk-through were as follows:

1. Ensure the Brunswick EOPs are usable; i.e., they can be understood and followed without confusion, delays, errors, etc.

2. Ensure there is correspondence between the procedures and the Control Room/hardware; i.e., control/equipment/indications that are referenced are available (inside and outside of the Control Room), use the same designations, use of the same units of measure, and operate as specified in the procedures.

3. Ensure the language and level of information presented in the EOPs is compatible with the minimum number, qualifications, training, and experience of the operating staff.

The walk-through consisted of the following portions:

1. Control Room Walk-Through Phase I (Operational Scenarios)

   This phase of the V&V process involved SROs and ROs walking through the EOP on the Brunswick site-specific simulator. Figure 2 was used as a check sheet for this walk-through.

2. Control Room Walk-Through Phase II (Check of Each Step of the EOP)

   The purpose of this walk-through was to ensure that there is a correspondence between the procedures and the Control Room hardware. Each step of the EOP was checked to ensure the instrumentation and controls referenced by the EOP were available, use the same designations, use the same units of measure, and operate as specified in the EOP. Figure 3 was used as a check sheet for this walk-through.

3. Back Panel Walk-Through

   Since not all instrumentation referenced by the EOP is contained in the Control Room (or simulator), a back panel walk-through was conducted to ensure this instrumentation was available and adequate. Figure 4 was used as a check sheet for this walk-through.

4. Outside Control Room Walk-Through

Various evolutions in the EOP must be performed outside the Control Room. To ensure these procedures are usable and correct, a walk-through of each of these procedures was performed. Figure 4 was used as a check sheet for these walk-throughs.

The following is a list of the exercises used for the Control Room walk-through Phase I.

1. Manual Scram at Low Power (Startup Mode) Due to Loss of Instrument Air

2. Turbine Trip at 100% Power

3. Loss of Feedwater at Low Power (Startup Mode)

4. Loss of Feedwater at 100% Power

5. Fuel Cladding Failure at 100% Power

6. Steam Leak Inside Containment (Small Leak Assumed)

7. Loss of Coolant Accident Inside Drywell

8. Main Steam Line Rupture

9. EHC System Failure at 100% Power (Turbine Control and Bypass Valves Fail Open)

10. EHC System Failure at Low Power (Turbine Bypass Valves Fail Closed While Turbine is on Turning Gear)

11. Loss of Condenser Vacuum

12. Anticipated Transient Without Scram at 100% Power

13. Manual Scram Due to High Conductivity

14. Loss of Feedwater
    Loss of HPCI
    Loss of RCIC

15. Turbine Trip
    Stuck Open SRV

16. Turbine Trip
    Turbine Bypass Valves Fail Closed
    Loss of HPCI

17. Loss of Off-Site Power
    Loss of HPCI
    Loss of RCIC

An example of the Control Room walk-through exercise is included (see Figure 2).

Discrepancies that were noted during these walk-throughs were recorded on EOP discrepancy sheets (Figure 5).

FIGURE 2

CONTROL ROOM EOP WALK-THROUGH EXERCISE (g)

1. Assumed initial condition (i.e., power level, general state of the plant, etc.) 100% power

2. Assumed malfunctions: LOSS OF COOLANT ACCIDENT - RECIRCULATION PUMP SUCTION PIPING RUPTURE

3. Procedures used (i.e., flowcharts and end path manual procedures):

4. Exercise checkoffs:

	YES	NO
a. Easily Read	____	____
b. Read Rapidly Without Interruption	____	____
c. Precisely Understood	____	____
d. Understood Without Aid of Additional Material	____	____
e. Reader Accepts Information Presented	____	____
f. Technically Correct	____	____
g. Nomenclature Correct	____	____
h. Units of Measure Consistent	____	____
i. Physical Conflicts Between Staff Avoided	____	____
j. Duplication of Tasks Avoided	____	____
k. Supervisor Able to Keep Up With Staff Actions	____	____

5. Remarks:

6. Exercise Performed By:

SRO ______________________________

RO ______________________________

RO ______________________________

FIGURE 2

CONTROL ROOM EOP WALK-THROUGH EXERCISE (g)

1. Assumed initial condition (i.e., power level, general state of the plant, etc.) 100% power

2. Assumed malfunctions: LOSS OF COOLANT ACCIDENT - RECIRCULATION PUMP SUCTION PIPING RUPTURE

3. Procedures used (i.e., flowcharts and end path manual procedures):

4. Exercise checkoffs:

		YES	NO
a.	Easily Read	____	____
b.	Read Rapidly Without Interruption	____	____
c.	Precisely Understood	____	____
d.	Understood Without Aid of Additional Material	____	____
e.	Reader Accepts Information Presented	____	____
f.	Technically Correct	____	____
g.	Nomenclature Correct	____	____
h.	Units of Measure Consistent	____	____
i.	Physical Conflicts Between Staff Avoided	____	____
j.	Duplication of Tasks Avoided	____	____
k.	Supervisor Able to Keep Up With Staff Actions	____	____

5. Remarks:

6. Exercise Performed By:

SRO ______________________________

RO ______________________________

RO ______________________________

FIGURE 3

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

CONTROL ROOM WALK-THROUGH VALIDATION FORM

EOP - 1

PROCEDURE TITLE ____

WALK-THROUGH CHECKOFFS	YES	NO
a. Can step be performed with existing instrumentation and controls?	____	____
b. Is nomenclature consistent?	____	____
c. Units of measure consistent?	____	____

REMARKS

WALK-THROUGH PERFORMED BY

SRO ________________________________ DATE ______________

RO ________________________________ DATE ______________

FIGURE 4

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

EOP WALK-THROUGH VALIDATION FORM

For instrumentation and controls, panels, cabinets, and terminal boards outside the Control Room

EOP - 1

PROCEDURE TITLE ______________________________ REV. ______

FLOWCHART COORDINATE ______________________ PAGE ______ STEP ______

PLANT WALK-THROUGH CHECKOFFS

		YES	NO
a.	Can the step be performed with existing instrumentation and controls?	____	____
b.	Are instrumentation, controls, panels, cabinets, and terminal boards clearly identified.	____	____
c.	Is nomenclature consistent?	____	____
d.	Can jumpers and inhibits be easily installed?	____	____

REMARKS

WALK-THROUGH PERFORMED BY

SRO ______________________________ DATE ____________

FIGURE 5

BRUNSWICK STEAM ELECTRIC PLANT
EOP DISCREPANCY SHEET

PATH NO. ______________________ PROCEDURE _______________ REVISION ________

FLOWCHART COORDINATE _________________________________ PAGE _____ STEP _____

DISCREPANCY FOUND DURING: Desk Top Review ☐ Control Room W/T ☐

Other ☐ Simulator Training ☐ Control Room Use ☐

DISCREPANCY ____

____

____

____

____

____

ORIGINATOR ____ DATE ____________

RESOLUTION ____

____

____

____

____

APPROVED YES __ NO __ (Check one)

MANAGER - OPERATIONS ______________________________________ DATE __________

PROCEDURE REVISED BY ______________________________________ DATE __________

FORM ____

D. Preimplementation Review of Brunswick EOPs

Immediately prior to the implementation of the Brunswick EOPs, an extensive review was conducted by four groups; i.e., Operations, Technical Support (Engineering), Quality Assurance, and On-Site Nuclear Safety.

A committee was formed to coordinate the preimplementation review.

1. EOP Review Committee

Purpose

The purpose of this committee is to maintain a documented program for an ongoing evaluation and update of the Brunswick emergency operating procedures.

Membership

The committee is comprised of the following:

a. Chairman

b. Assistant to the Chairman

c. Operations Representative

d. Quality Control Representative

e. Engineering Representative

f. On-Site Nuclear Safety Representative

Each member should have a designated alternate. All changes in membership of the committee should be approved by the Manager - Operations.

Training

The committee members and the designated alternates should attend a training session designed to familiarize them with the background development of BSEP EOPs and the review/revision process.

Committee Responsibilities

The committee should establish and maintain a documented program for an ongoing evaluation and update of the EOPs as follows:

Document Control of Procedure:

The BSEP EOPs are controlled within the existing plant Document Control system and will be consistent with the plant's Administrative Manual.

Reproduction of Procedures:

All copies of the BSEP EOPs shall be clearly legible. When it is necessary to replace an entire procedure or make partial revisions, as a result of use, wear, etc., the replacement copy shall be equal to the quality of the original.

Ongoing Evaluation:

Brunswick has established a program for the ongoing evaluation of emergency operating procedures. The program consists of the following considerations:

Evaluation of the technical adequacy of the EOPs in light of operational experience, use, training experience, any simulator exercises, and/or Control Room walk-throughs.

Evaluation of the organization, format, style, and content as a result of using the procedures during operations, training, simulator exercises, and walk-throughs.

Evaluation of staffing and staff qualifications relevant to using the EOPs.

Updating EOPs:

When changes occur in the plant design, technical specifications, technical guidelines, Writers Guide, other plant procedures, or Control Room that will affect the EOPs, these procedures should be revised on a timely basis to reflect these changes. In addition, when operating and training experience, simulator exercises, Control Room walk-throughs, or other information indicates that incorrect or incomplete information exists in the emergency operating procedures, they should be revised as necessary. All changes should be reviewed to ensure consistency with the Brunswick Technical Guidelines and the Writers Guide. Operator feedback will be needed to assure that the EOPs are adequately maintained and amended as required.

Plant Administrative Procedures for EOPs:

The committee members should be cognizant of the plant administrative procedures for EOPs:

Volume I, Book 1 of the plant Administrative Procedures Manual contains the following statement:

"When any revision is made to the Brunswick EOPs, it shall be consistent with the EOP Writers Guide and the Plant EOP Technical Guidelines." The Brunswick Plant Specific EOP Technical Guidelines must be consistent with General Electric's Topical Report NEDO-24934, Emergency Procedure Guidelines, except as noted in the Emergency Procedures Generation Package.

Member Responsibilities

The following representatives have responsibilities as indicated:

Chairman

- The chairman or his alternate shall coordinate committee activities, assign tasks, and EOP revisions prior to submitting for final plant approval.

Assistant to Chairman

As primary aide to the chairman, the Assistant should attend EPG related meetings, maintain cognizance of generic guidelines, and stay abreast of INPO developments. He should also be knowledgeable about NRC activities related to emergency operating procedures.

Operations Representative

This person will assist the committee relative to usability, operational correctness, operating experience feedback, and training feedback.

Quality Assurance Representative

The QA individual shall be concerned with written correctness per EOP Writers Guide.

Technical Support Representative

Through this representative, BSEP Technical Support can assure accuracy of BSEP plant-specific calculations and plant modifications that may affect the EOPS.

On-Site Nuclear Safety Representative

ONS shall communicate all current safety - technical specifications and license conditions as related to the Brunswick EOPs, via this representative.

Each representative is responsible to ensure the entire EOP is reviewed prior to implementation. Individual check sheets are used for each group (see Figures 6-19). All discrepancies are noted on the EOP discrepancy sheet and resolved prior to implementation.

FIGURE 6

OPERATIONS EOP VERIFICATION CHECK SHEET

	YES	NO
I. USABILITY		
A. Level of Detail		
1. Is there sufficient information to perform the specified actions at each step?	____	____
2. Are the alternatives adequately described at each decision point?	____	____
3. Are the labeling, abbreviations, and location information as provided in the EOP sufficient to enable the operator to find the needed equipment?	____	____
4. Is the EOP missing information needed to manage the emergency condition?	____	____
5. Are the contingency actions sufficient to address the symptoms?	____	____
6. Are the titles and numbers sufficiently descriptive to enable the operator to find referenced and branched procedures?	____	____
B. Understandability		
1. Is the EOP easy to read?	____	____
2. Are the figures and tables easy to read with accuracy?	____	____
3. Can the values on figures and charts be easily determined?	____	____

FORM ____

FIGURE 7

		YES	NO
4.	Are cautions and note statements readily understandable?	____	____
5.	Are the EOP steps readily understandable?	____	____

II. OPERATIONAL CORRECTNESS

A. Plant Compatibility

		YES	NO
1.	Can the actions specified in the procedure be performed in the designated sequence?	____	____
2.	Are there alternate success paths that are not included in the EOPs?	____	____
3.	Can the information from the plant instrumentation be obtained, as specified by the EOP?	____	____
4.	Are the plant symptoms specified by the EOP adequate to enable the operator to select the applicable EOP?	____	____
5.	Are the EOP entry conditions appropriate for the plant symptoms displayed to the operator?	____	____
6.	Is information or equipment not specified in the EOP required to accomplish the task?	____	____
7.	Do the plant responses agree with the EOP basis?	____	____
8.	Are the instrument readings and tolerances stated in the EOP consistent with the instrument values displayed on the instruments?	____	____

FORM ____

FIGURE 8

	YES	NO
9. Is the EOP physically compatible with the work situation (too bulky to hold, binding would not allow them to lay flat in work space, no place to lay the EOPs down to use)?	____	____
10. Are the instrument readings and tolerances specified by the EOP for remotely located instruments accurate?	____	____

B. Operator Compatibility

	YES	NO
1. If the time intervals are specified, can the procedure action steps be performed on the plant within or at the designated time intervals?	____	____
2. Can the procedure action steps be performed by the operating shift?	____	____
3. If specific actions are assigned to individual shift personnel, does the EOP adequately aid in the coordination of actions among shift personnel where necessary?	____	____
4. Can the operating shift follow the designated action step sequences.	____	____
5. Can the particular steps or sets of steps be readily located when required?	____	____
6. Can procedure exit point be returned to without omitting steps when required?	____	____
7. Can procedure branches be entered at the correct point?	____	____
8. Are EOP exit points specified adequately?	____	____

FORM ____

FIGURE 9

III. TECHNICAL ACCURACY	YES	NO
1. Entry Conditions or Symptoms Information		
a. Are the entry conditions of the EOP listed correctly?	____	____
b. If additional entry conditions have been added, do they comply with the following:		
(1) Appropriate entry conditions for which EOP should be used?	____	____
(2) Not excessive.	____	____
2. Instructional Step, Caution, and Note Information		
a. Are EOP differences:		
(1) Documented	____	____
(2) Explained	____	____
b. Is the EOP technical foundation (strategy) changed by the following changes in EOP steps, cautions, or notes:		
(1) Elimination	____	____
(2) Addition	____	____
(3) Sequence	____	____
(4) Alteration	____	____
c. Are correct, plant-specific adaptations incorporated per EOP:		
(1) Systems	____	____
(2) Instrumentation	____	____
(3) Limits	____	____
(4) Controls	____	____
(5) Indications	____	____

FORM ________

FIGURE 10

	YES	NO
3. Plant Hardware Information		
a. Is the following plant hardware specified in the EOP available for operator use:		
(1) Equipment	___	___
(2) Controls	___	___
(3) Indicators	___	___
(4) Instrumentation	___	___

FORM ____

FIGURE 11

ENGINEERING EOP VERIFICATION CHECK SHEET

Quantitative Information:

A. Do the quantitative values, including tolerance bands, used in the EOP comply with the calculation procedure for EOP guidelines?

B. Where calculation procedure for EOP guideline values are not used in the EOP, are the EOP values computed accurately?

C. When calculations are required by the EOP, are equations presented with sufficient information for operator use?

D. When jumpers or inhibits are used in the EOPs, are the instructions accurate, e.g., cabinet designation and terminal points?

COMMENTS ____

____

____

____

____

____

____

____

____

____

FORM _____

FIGURE 12

QUALITY ASSURANCE EOP VERIFICATION CHECK SHEET

	YES	NO
I. PROCEDURE-GENERAL		
A. Written Correctness		
1. Legibility		
Are the text, tables, graphs, figures, and charts legible to the evaluator?	____	____
2. EOP Format Consistency		
Do the following sections exist in each EOP:		
(1) Title	____	____
(2) Entry Conditions or Plant Condition	____	____
(3) Operator Actions	____	____
3. Identification Information		
a. Is the procedure title descriptive of the purpose of the procedure.	____	____
b. Does the cover sheet correctly provide the following:		
(1) Procedure Title	____	____
(2) Procedure Number	____	____
(3) Unit Number	____	____
(4) Revision Number	____	____
(5) Number of Pages	____	____

FORM ____

FIGURE 13

	YES	NO
c. Does each page correctly provide the following:		
(1) Procedure Designator	____	____
(2) Revision Number	____	____
(3) Page ____ of ____ Numbers	____	____
d. Does the procedure have all its pages?		

II. STEP, CAUTION, NOTE-SPECIFIC

A. Written Correctness

1. Information Presentation

	YES	NO
a. Are instruction steps numbered correctly?	____	____
b. Are operator-optional sequence steps identified?	____	____
c. Are instruction steps constructed to comply with the following:		
1) Steps deal with only one idea	____	____
2) Sentences are short and simple	____	____
3) Operator .tions are specifically stated	____	____
(4) Objects of operator actions are specifically stated	____	____
(5) Objects of operator actions are adequately stated	____	____
(6) If there are three or more objects, they are listed (and space is provided for operator check-off)	____	____
(7) Punctuation and capitalization are proper	____	____

FORM ____

FIGURE 14

	YES	NO
(8) Abbreviations are correct and understandable to the operator.	____	____
d. Do instruction steps make proper use of logic structure?	____	____
e. When an action instruction is based on receipt of an annunciator alarm, is the setpoint of the alarm identified?	____	____
f. Are precautions and cautions used appropriately?	____	____
g. Are precautions and cautions placed properly?	____	____
h. Are precautions and cautions constructed to comply with the following:		
1.) They do not contain operator actions	____	____
2.) They do not use extensive punctuation for clarity	____	____
3.) They make proper use of emphasis	____	____
i. Are notes properly used?	____	____
j. Are notes properly placed?	____	____
k. Are notes worded so that they do not contain operator actions?	____	____
l. Are numerical values properly written?	____	____
m. Are values specified in such a way that mathematical operations are required of the user?	____	____

FORM ____

FIGURE 15

		YES	NO
n.	Is a chart or graph provided in the procedure for necessary operator calculations?	____	____
o.	Are units of measure in the EOP the same as those used on equipment?	____	____

FORM _____

FIGURE 16

		YES	NO
2.	Procedure Referencing and Branching		
a.	Do the referenced and branched procedures identified in the EOPs exist for operator use?	____	____
b.	Is the use of referencing minimized?	____	____
c.	Are referencing and branching instructions correctly worded?	____	____
	(1) "go to" (branching)		
	(2) "refer to" (referencing)		
d.	Do the instructions avoid routing users past important information such as cautions preceding steps?	____	____
e.	Are the exit conditions compatible with the entry conditions of the referenced or branched procedure?	____	____

FORM ____

FIGURE 17

ON-SITE NUCLEAR SAFETY EOP VERIFICATION CHECK SHEET

	YES	NO	N/A
I. Evaluation:			
A. Does the procedure conform to the current technical specifications?	___	___	___
B. Does the procedure reflect the as-built condition of the unit?	___	___	___
C. Does the procedure (or related data or work-sheet) provide for the independent verification and sign-off of computations (Volume I, Section 11.8)?	___	___	___
D. If any follow-up action, test, or procedure must be performed upon the completion for this procedure, does the procedure or a related document (e.g., work order) instruct the user regarding what follow-up action is required and whom to notify?	___	___	___
E. Does the procedure prohibit isolation or prohibit defeat of redundant safety systems when required to be operable?	___	___	___
F. Does the procedure provide sign-off steps for returning safety systems to service (Volume I, Section 11.8, and OI-01)?	___	___	___
G. Does the procedure require notification of the Shift Operating Supervisor/Shift Foreman prior to defeating or testing of safety systems?	___	___	___
H. Have provisions for independent verification of affected valve and switch positions, prior to returning the system to service, been provided (Volume I, Section 11.8)?	___	___	___

FORM ____

FIGURE 18

	YES	NO	N/A
I. Acceptance criteria of procedure matches technical specifications requirements?	___	___	___
J. Does the procedure meet the ANSI-18.7, Section 5.3 (1976) requirements?	___	___	___
II. <u>Safety Evaluation Adequacy</u>			
A. The procedure/change does not prevent conformance to or require a change to technical specifications?	___	___	___
B. The procedure/change does not create an unreviewed safety question?	___	___	___
C. The safety analysis provides a written basis for the determination that the procedure does not constitute an unreviewed safety question?	___	___	___

FORM _____

FIGURE 19

BRUNSWICK EOP VERIFICATION

I.

PATH NUMBER ____________________ PROCEDURE ____________ REV. ________

FLOWCHART COORDINATE OR PAGE AND STEP NUMBER ____________ ____________

VERIFICATION BY OPS __ QA __ ENG __ ONS __

II. EOP SOURCE DOCUMENT USED

__ A. GE NEDO-24934 (Rev. 2) Emergency Procedures Guideline

__ B. Brunswick Specific EOP Technical Guideline

__ C. Brunswick EOP Writers Guide

__ D. Brunswick Plant- Specific Calculations for EOP

__ E. Brunswick Technical Specifications

__ F. Brunswick FSAR

__ G. Other ____

__ H. Other ____

EVALUATOR ____________________________________ DISCREPANCIES ____________
(Signature) (Identify)

DATE ________________

FORM _____

E. GENERAL PHYSICS HUMAN FACTORS EVALUATION OF BRUNSWICK EMERGENCY INSTRUCTION FLOWCHARTS

General Physics Corporation has conducted a human factors evaluation of the Brunswick EOP flowcharts. The technical approach used was to conduct a literature review to develop a set of human factor guidelines for evaluating the format and implementation of EOP flowcharts.

The guidelines were divided into eight areas: identification information, content, symbol coding, nomenclature/punctuation, functional flow and branching, readability, ease of use, and accommodation of revisions/multi-unit concerns.

The guidelines generated from the literature review were then compared to the latest revisions of the EOP flowcharts.

Control Room operators who had simulator experience and training in flowchart use were also interviewed.

As a result of the human factors study, several changes have been made to the format and style of the flowcharts. These changes, such as highlighting key areas, have enhanced the usability of the flowcharts. All areas of concern identified by the human factors study have been satisfactorily resolved.

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

ATTACHMENT A

APPENDIX III

SOURCE OF PARAMETERS USED IN THE
PLANT-SPECIFIC TECHNICAL GUIDELINE

SOURCE OF PARAMETERS USED IN THE
PLANT-SPECIFIC TECHNICAL GUIDELINE (PSTG)

A. CAUTIONS

1. Caution No. 6

Parameter/Value: Temperature and indicated levels

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.1

2. Caution No. 8

Parameter/Value: Net positive suction head curves

Source: Core Spray, Calculation Procedure for Guidelines (Appendix C), Section 4.2

HPCI, Calculation Procedure for Guidelines (Appendix C), Section 4.2

RCIC, Calculation Procedure for Guidelines (Appendix C), Section 4.2

RHR, Calculation Procedure for Guidelines (Appendix C), Section 4.2

3. Caution No. 9

Parameter/Value: Suppression pool high level suction interlocks

Source: Brunswick Technical Specification Table 3.3.3-2, page 3/4 3-35

Parameter/Value: CST low level suction interlock

Source: Brunswick System Description 32.1, page 15

4. Caution No. 11

Parameter/Value: Drywell pressure which initiates ECCS

Source: Brunswick Technical Specification Table 3.3.3-2, 2.a, page 3/4 3-34

5. Caution No. 12

Parameter/Value: HPCI and RCIC minimum speed

Source: Brunswick Operating Procedures
HPCI, OP-19, Section 2.6, page 1
RCIC, OP-16, Section 2.6, page 1

6. Caution No. 13

Parameter/Value: Reactor cooldown rate

Source: Brunswick Technical Specification
3.4.6.1, page 3/4 4-13

7. Caution No. 14

Parameter/Value: HPCI low pressure isolation setpoint

Source: Brunswick Technical Specification
Table 3.3.2-2, 4.a.2, page 3/4 3-19

8. Caution No. 15

Parameter/Value: SRV opening sequence

Source: Brunswick Drawing 9527-D-2793
Brunswick Drawing 9527-F-1131

9. Caution No. 17

Parameter/Value: Reactor cooldown rate

Source: Brunswick Technical Specification
Limiting Condition for Operation
3.4.6.1, page 3/4 4-13

10. Caution No. 23

Parameter/Value: Elevation of bottom of Reactor Building to suppression chamber vacuum breakers

Source: Brunswick Drawing 9527-F-2813

B. RPV CONTROL GUIDELINE

Purpose

Parameter/Value: Cold shutdown condition

Source: Brunswick Technical Specification
Table 1.2, page 1-8

1. Reactor Control/Level

RC/L-2

Parameter/Value: Reactor scram - low water level

Source: Brunswick Technical Specification
Table 2.2.1-1, page 2-4

Parameter/Value: Turbine trip - high reactor water level

Source: Brunswick System Description 19
Table 2.4, page 22

Parameter/Value: Condensate/Feedwater System

Source: Brunswick System Description 32
Section 3.2.7, page 64

Parameter/Value: CRD System

Source: Brunswick System Description 08
Section 3, page 21

Parameter/Value: RCIC System

Source. Brunswick System Description 16
Low: Table 2.4, page 35
High: Section 3.1, page 44

Parameter/Value: HPCI System

Source: Brunswick System Description 19
Low: Table 2.4, page 22
High: Section 3.2, page 37 and
Section 3.3, page 38

Parameter/Value: Core Spray System

Source: Brunswick System Description 18
Section 3.2.1, page 15

Parameter/Value: RHR System

Source: Brunswick System Description 17
Section 3.2.1, page 42

2. Reactor Control/Pressure

RC/P-1

Parameter/Value: RPV pressure at which all turbine bypass valves are fully open

Source: Brunswick General Plant Operating Procedure 01, Section B.4.5.19

RC/P-2

Parameter/Value: Lowest SRV lifting pressure

Source: Brunswick System Description 20
Section 3.1, page 23

RC/P-3

Parameter/Value: Cold shutdown weight of boron

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.4

Parameter/Value: RPV cooldown rate LCO

Source: Brunswick Technical Specification 3/4.4.6, page 3/4 4-13

3. Reactor Control/Power

RC/Q-3

Parameter/Value: APRM downscale trip

Source: Brunswick System Description 09
Section 2.4, page 2-5

RC/Q-4

Parameter/Value: Boron injection initiation temperature

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.5

RC/Q-4.3

Parameter/Value: Cold shutdown weight of boron

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.4

RC/Q-5.1

Parameter/Value: Fuses which deenergize RPS scram solenoids

Source: Unit 1 - Brunswick Drawing FP-50015
Unit 2 - Brunswick Drawing FP-55046

Parameter/Value: Scram air header supply valve

Source: Unit 1 - Brunswick Drawing 9527-D-2517
Unit 2 - Brunswick Drawing 9527-D-25017

RC/Q-5.2

Parameter/Value: HCU accumulator charging water header valve

Source: Unit 1 - Brunswick Drawing 9527-D-2516
Unit 2 - Brunswick Drawing 9527-D-25016

RC/Q-5.6

Parameter/Value: CRD withdrawal line vent

Source: Unit 1 - Brunswick Drawing 9527-D-2517
Unit 2 - Brunswick Drawing 9527-D-25017

C. CONTAINMENT CONTROL GUIDELINE

1. Entry Conditions

Parameter/Value: Most limiting suppression pool temperature LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

Parameter/Value: Drywell temperature LCO

Source: Brunswick Technical Specification 3.6.1.1, page 3/4 6-8

Parameter/Value: High drywell pressure scram setpoint

Source: Brunswick Technical Specification Table 2.2.1-1, page 2-5

Parameter/Value: Maximum suppression pool water level LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

Parameter/Value: Minimum suppression pool water level LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

2. <u>Suppression Pool Temperature</u>

SP/T-2

Parameter/Value: Most limiting suppression pool temperature LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

SP/T-3

Parameter/Value: Boron injection initiation temperature

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.5

SP/T-4

Parameter/Value: Heat capacity temperature limit curve

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.2

3. <u>Drywell Temperature</u>

DW/T-1

Parameter/Value: Drywell temperature LCO

Source: Brunswick Technical Specification 3.6.1.1, page 3/4 6-8

DW/T-2

Parameter/Value: Drywell temperature near cold reference leg vertical runs

Source: Elevation and azimuth of condensing chamber and vertical runs, Brunswick Drawing 9527-LL-70080, sheets 6, 6A, and 15

Elevation and azimuth of drywell temperature detectors, Brunswick Drawing 9525-F-35036

DW/T-3

Parameter/Value: Maximum drywell design temperature

Source: Final Safety Analysis Report, page 6.2.1-4

Parameter/Value: Drywell spray initiation pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.8

4. Primary Containment Pressure

PC/P-2

Parameter/Value: Suppression chamber spray initiation pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.9

PC/P-3

Parameter/Value: Suppression chamber spray initiation pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.9

Parameter/Value: Drywell spray initiation pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.8

PC/P-4

Parameter/Value: Pressure suppression pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.0

PC/P-5

Parameter/Value: Primary containment design pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.11

The operating margin gained through the use of a curve for this parameter does not warrant the additional complications imposed by a two-dimensional limit. Therefore, the curve has not been used, and RPV flooding is required at the most limiting suppression chamber pressure.

PC/P-6

Parameter/Value: Primary containment pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.12

The operating margin gained through the use of a curve for this parameter does not warrant the additional complications imposed by a two-dimensional limit. Therefore, the curve has not been used, and spraying of the primary containment is required at the most limiting suppression chamber pressure.

Parameter/Value: Drywell spray initiation pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.8

PC/P-7

Parameter/Value: Primary Containment pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.12

The operating margin gained through the use of a curve for this parameter does not warrant the additional complications imposed by a two-dimensional limit. Therefore, the curve has not been used, and venting of the primary containment is required at the most limiting suppression chamber pressure.

5. Suppression Pool Level

SP/L-1

Parameter/Value: Maximum suppression pool water level LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

Parameter/Value: Minimum suppression pool water level LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

SP/L-2

Parameter/Value: Heat capacity level limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.13

SP/L-3

Parameter/Value: Maximum suppression pool water level LCO

Source: Brunswick Technical Specification 3.6.2.1, page 3/4 6-9

SP/L-3.2

Parameter/Value: Suppression pool load limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.3

SP/L-3.3

Parameter/Value: Elevation of bottom of Mark I internal suppression chamber to drywell vacuum breakers

Source: Brunswick Drawing 9527-F-2813

Parameter/Value: Drywell spray initiation pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.8

SP/L-3.4

Parameter/Value: Elevation of bottom of Mark I internal suppression chamber to drywell vacuum breakers

Source: Brunswick Drawing 9527-F-2813

D. CONTINGENCIES

1. Level Restoration

C1-2

Parameter/Value:	RPV pressure at which core spray shutoff head is reached
Source:	Brunswick System Description 18 Section 3.2.1, page 15
Parameter/Value:	HPCI low pressure isolation setpoint
Source:	Brunswick System Description 19 Table 2.4, page 22
Parameter/Value:	ADS initiation setpoint
Source:	Brunswick System Description 01 Table 2.4.1, page 40

C1-4

Parameter/Value:	Low level scram setpoint
Source:	Brunswick Technical Specification Table 2.2.1-1, page 2-4

C1-6

Parameter/Value:	HPCI low pressure isolation setpoint
Source:	Brunswick Technical Specification Table 3.3.3-2, 2a, page 3/4 3-34

2. Emergency RPV Depressurization

C2-1.2

Parameter/Value:	Minimum number of SRVs required for emergency depressurization
Source:	Calculation Procedure for Guidelines (Appendix C), Section 4.1.15
Parameter/Value:	SRV reopening pressure
Source:	Calculation Procedure for Guidelines (Appendix C), Section 4.1.16

3. Steam Cooling

C3-1

Parameter/Value:	Minimum zero-injection RPV water level
Source:	Calculation Procedure for Guidelines (Appendix C), Section 4.1.17 The lower range of BSEP RPV level instrumentation is -100 inches.
Parameter/Value:	Minimun single SRV steam cooling pressure
Source:	Through a bounding calculation applicable to all plants, the RPV pressure producing steam flow through one SRV sufficient to limit peak cladding temperature to 2200°F has been determined to be 700 psig. This number is supplied by GE.

4. Core Cooling Without Level Restoration (Spray Cooling)

C4-2

Parameter/Value:	RPV pressure for rated core spray flow
Source:	Core Spray Pump Technical Manual (FP-5700)

5. Alternate Shutdown Cooling

C5-3

Parameter/Value:	Minimum number of SRVs required for shutdown cooling
Source:	Calculation Procedure for Guidelines (Appendix C), Section 4.1.18

C5-6.1

Parameter/Value:	Minimum alternate shutdown cooling RPV pressure
Source:	Calculation Procedure for Guidelines (Appendix C), Section 4.1.18

C5-6.2

Parameter/Value: Maximum alternate shutdown cooling RPV pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.18

C5-6.3

Parameter/Value: Maximum RPV cooldown rate LCO

Source: Brunswick Technical Specification 3.4.6.1, page 3/4 4-13

Parameter/Value: Minimum SRV reopening pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.16

C5-7

Parameter/Value: Head tensioning limit

Source: Brunswick General Plant Operating Procedure 01, Section E.4.28

6. RPV Flooding

C6-1

Parameter/Value: Minimum number of SRVs required for emergency depressurization

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.18

C6-2.2

Parameter/Value: Minimum alternate RPV flooding pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.19

C6-3.1

Parameter/Value: Minimum number of SRVs required for emergency depressurization

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.15

Parameter/Value: Minimum RPV flooding pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.20

C6-3.2

Parameter/Value: Minimum RPV flooding pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.20

C6-5.3

Parameter/Value: Minimum RPV flooding pressure

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.20

C6-5.4

Parameter/Value: Maximum core uncovery time limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.21

C6-6

Parameter/Value: Primary containment pressure limit

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.12

The operating margin gained through the use of a curve for this parameter does not warrant the additional complication imposed by a two-dimensional limit. Therefore, the curve has not been used, and RPV flooding is required at the most limiting suppression chamber pressure.

7. Level/Power Control

C7-1

Parameter/Value: APRM downscale trip

Source: Brunswick System Description 09 Section 2.4, page 2-5

Parameter/Value: Boron injection initiation temperature

Source: Calculation Procedure for Guidelines (Appendix C), Section 4.1.5

Parameter/Value: High drywell pressure scram setpoint

Source: Brunswick Technical Specification
Table 2.2.1-1, page 2-4

C7-2

Parameter/Value: RPV pressure range for system operation

Source: See Reactor Control/Level, Section B.1
page 4 of 15

C7-2.2

Parameter/Value: Minimum alternate RPV flooding pressure

Source: Calculation Procedure for Guidelines
(Appendix C), Section 4.1.19

C7-3

Parameter/Value: Hot shutdown boron weight

Source: Calculation Procedure for Guidelines
(Appendix C), Section 4.1.22

Parameter/Value: Low level scram setpoint

Source: Brunswick Technical Specification
Table 2.2.1-1.4

Parameter/Value: High level trip setpoint

Source: Brunswick System Description 19
Table 2.4, page 22

ATTACHMENT B

APPENDIX III

Use of the Plant-Specific Technical

Guideline in Emergency Operating Procedures

Use of the PSTG in the Emergency Operating Procedures

A. INTRODUCTION

The PSTG was used throughout the Brunswick EOPs. However, the guideline was used as a guide only, not a procedure.

The flowcharts have been designed to eliminate operator confusion associated with when to enter the EOP and exactly what actions should be taken during the initial few minutes following the onset of the potential emergency condition.

When the flowchart steps are completed, the operator will be directed to one of the procedures in the End Path Manual.

The purpose of this document is to assist the procedure writer/reviewer in determining how to convert the PSTG into the EOP. It defines where the PSTG appears in the EOP. It will also serve as part of the verification/validation process by ensuring that all steps from the PSTG are reflected in the EOP.

B. ENTRY CONDITIONS

The entry condition to the Brunswick EOPs is any condition which requires or initiates a reactor scram. The operator then needs only to remember to pick up any one of the five flowcharts following a scram.

C. OPERATOR ACTIONS

1. RC-1 If reactor scram has not been initiated, initiate reactor scram.

   The first action on each Brunswick flowchart directs the operator to manually scram the reactor.

2. Irrespective of the entry condition, execute Steps RC/L, RC/P, and RC/Q, concurrently.

The steps from RC/L, RC/P, and RC/Q are contained on Paths 1, 2, 3, 4, and 5. The key parameters on each flowchart prioritize the order of execution of these sections.

D. RC/L - REACTOR VESSEL LEVEL CONTROL

1. RC/L Monitor and control RPV water level.

The Brunswick operators are trained to constantly monitor and control RPV level.

2. RC/L-1 Confirm initiation of any of the following:

- Isolation
- ECCS
- Emergency Diesel Generator

Initiate any of these which should have initiated but did not.

The flowchart directs the operator to ~~verify~~ automatic actions as required; e.g., on Path 4. The first action step past the key parameters directs the operator to verify automatic start or to manually start HPCI, RCIC, and SBGT. Three steps later the operator is directed to verify closure of Groups 1, 2, 3, 6, and 8 isolation valves. If auxiliary power is not available (on any flowchart), the operator is directed to verify on or to manually start the diesel generators. The operator is also directed to start the diesel generators, RHR, and core spray pumps if the RPV water level decreases to +45 inches. This guidance is on the Yellow Brick Road (i.e., the wide dark line), shortly after the key parameters. Where the flowchart has identified a parameter that an automatic action is associated with, the flowchart should verify that automatic action.

3. If while executing the following step:

- Boron injection is required, enter CONTINGENCY #7.
- RPV water level cannot be determined, RPV FLOODING IS REQUIRED; enter CONTINGENCY #6.
- RPV flooding is required, enter CONTINGENCY #6.

If the reactor does not scram (i.e., all control rods do not insert to position 00) or the power is above 3% following the initiation of a scram signal, the operator is directed to Path 1. If boron injection is then required while on Path 1, the operator is directed to execute the boron injection steps of Contingency #7.

If the RPV water level cannot be determined while on the flowchart, the operators are trained to answer all water level questions as if the level is low and/or decreasing. This will lead through the required steps to line up all high pressure and low pressure ECCS prior to exiting the flowchart. The end path procedure provides the following guidance: "IF while executing this procedure, reactor vessel level CANNOT be determined OR reactor vessel flooding is required, THEN EXIT this End Path Procedure and ENTER the "Flooding Procedure" in the Contingency section of this End Path Manual."

RPV flooding is required for two severe containment problems; i.e., when the primary containment temperature increases to the RPV saturation point and when the primary containment pressure reaches the design pressure.

The Brunswick containment control procedures, primary containment temperature and primary containment pressure control direct the operator to the flooding procedure for each problem.

4.	RC/L-2	Restore and maintain RPV water level between +162.5 inches (low level scram setpoint) and +208 inches (high level trip setpoint) with one or more of the following systems:	#9 #10 #11
		• Condensate/Feedwater System 1250 - 0 psig RPV pressure range for system operation)	
		• CRD System 1490 - 0 (RPV pressure range for system operation)	
		• RCIC System 1190 - 62 psig (RPV pressure range for system operation)	#12
		• HPCI System 1280 - 120 psig (RPV pressure range for system operation)	
		• Core Spray System 300 - 0 psig (RPV pressure range for system operation)	
		• RHR System 200 - 0 psig (RPV pressure range for system operation)	

Rather than merely listing systems to maintain vessel level, the Brunswick flowcharts prioritize the use of systems by defining plant conditions through fault tree logic; e.g., on Path 4 the vessel level has decreased below +112 inches which automatically closes or directs the operator to close the MSIVs. The procedure then directs the operator to use HPCI, RCIC, and CRD to maintain level since the Feedwater System is now unavailable. If the operator is unable to maintain RPV level with high pressure systems, the reactor is depressurized and low pressure systems are used to restore level.

On Paths 2 and 3, if the MSIVs are open or pressure is below 350 psig, the Condensate/Feedwater System is used to maintain RPV level. If the operator is unable to maintain level with Condensate/Feedwater, HPCI and/or RCIC are used. If level still cannot be maintained, the operator will be directed to Path 4 in preparation for LPCI or Core Spray use.

Paths 1 and 5 follow the same pattern; the most desirable system that is available is used to maintain level. Each flowchart specifies level to be maintained between +170 and +200 inches.

Instructions to restore and maintain level between +170 and +200 inches and a list of systems and pressure ranges are included as one of the first steps in each end path procedure.

5. If RPV water level cannot be restored and maintained above +162 inches (low level scram setpoint), maintain RPV water level above 0 inches (top of active fuel).

Each flowchart directs operators to continue increasing injection flow to the reactor until level is either increasing, stable, or above the high level trip setpoint. Each end path procedure provides guidance to maintain level between +170 and +200 inches. If this level cannot be maintained, the alternate band (above 0 inches) is specified.

6. If RPV water level can be maintained above 0 inches (top of active fuel) and the ADS timer has initiated, prevent automatic RPV depressurization by resetting the ADS timer.

Flowcharts 2, 3, and 4 do not contain this step since a high drywell pressure signal is necessary to initiate the ADS timer. Flowcharts 1 and 5 contain this step.

If level control problems are encountered while in the End Path Manuals, operators will be directed to the Level Restoration Contingency, which contains the guidance to prevent automatic initiation of ADS if RPV level can be maintained above 0 inches.

7. If RPV water level cannot be maintained above 0 inches (top of active fuel), enter CONTINGENCY #1.

If, while using the flowcharts, the RPV water level cannot be maintained in the normal range, the operator is directed to the level restoration actions (Contingency #1).

All end path procedures direct operators to Contingency #1 if level cannot be maintained above 0 inches.

8. If alternate shutdown cooling is required, enter CONTINGENCY #5.

End path procedures direct operators to GP-05 for the purpose of taking the reactor to cold shutdown. If normal shutdown cooling cannot be established, Abnormal Operating Procedure 15 would be entered. AOP-15 prioritizes which method of alternate shutdown cooling is appropriate.

9. RC/L-3 Proceed to cold shutdown in accordance with GP-05.

When the emergency conditions no longer exist (i.e., the RPV level, pressure, and power are under control (normal) and no containment problems exist), the operator exits the EOP and enters the General Operating Procedure to take the plant to the desired mode; e.g., hot standby or cold shutdown.

10. Cautions associated with Step RC/L.

a. Caution #9 is to be covered in training and indicated on the RTGB.

b. Caution #10 is placed in each End Path Manual prior to the first Operator Action Step.

c. Caution #11 is to be covered in training and included in the Users' Guide.

d. Caution #12 is to be placed on the RTGB near the HPCI and RCIC Speed Controllers.

E. REACTOR CONTROL/PRESSURE

1. RC/P Monitor and control RPV pressure.

The Brunswick Operators are trained to constantly monitor and control RPV pressure while executing the steps of the EOP.

2. If while executing the following steps:

- Emergency RPV depressurization is anticipated, rapidly depressurize the RPV with Main Turbine Bypass Valves. #13

- Emergency RPV depressurization or RPV flooding is required and less than seven (number of SRVs dedicated to ADS) SRVs are open, enter CONTINGENCY #2.

- RPV flooding is required and at least seven (number of SRVs dedicated to ADS) SRVs are open, enter CONTINGENCY #6.

Emergency RPV depressurization is not expected to be required within the first few minutes following a reactor scram; i.e, while the operators are using the flowcharts. The only times the operator is directed to rapidly depressurize the RPV on the flowcharts is in extremely degraded, low water level situations; e.g., the water level is below the top of active fuel or the RPV pressure must be maintained below 350 psig to accommodate low pressure system injection.

It is unlikely that the main condenser would be available in this case. If depressurization is required while in the end path procedure, the operator is directed to first attempt to use the main turbine bypass valves and then the SRVs.

In both flowcharts and end path procedures, if depressurization is required and cannot be accomplished with SRVs or to the main condenser, the operators are directed to Contingency #2 (Emergency Depressurization Procedure).

If flooding is required, the operator will be directed to Contingency #6 (Flooding Procedure) from the end path procedure. The Depressurization Steps are contained in Contingency #6. This simplifies the procedure by not going from an end path procedure, to a depressurization procedure, and then to a flooding procedure.

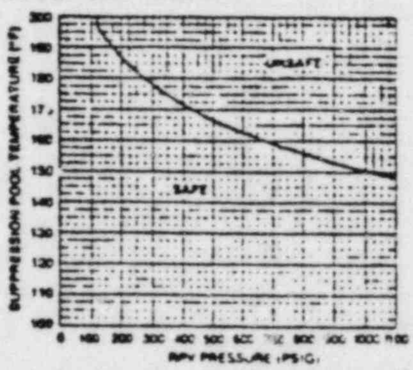
3. RC/P-1 If any SRV is cycling, manually open SRVs until RPV pressure drops to 950 psig (RPV pressure at which all Turbine Bypass Valves are fully open).

The flowchart directs the operator to prevent SRV cycling; e.g., immediately following the key parameters, the HPCI, RCIC, and SRVs are used to control RPV pressure below 950 psig. This guidance is repeated several times throughout the flowchart at the appropriate locations. The end path procedures also contain adequate RPV pressure control guidance.

4. If while executing the following steps:

- Suppression pool temperature cannot be maintained below the heat capacity temperature limit, maintain RPV pressure below the limit.

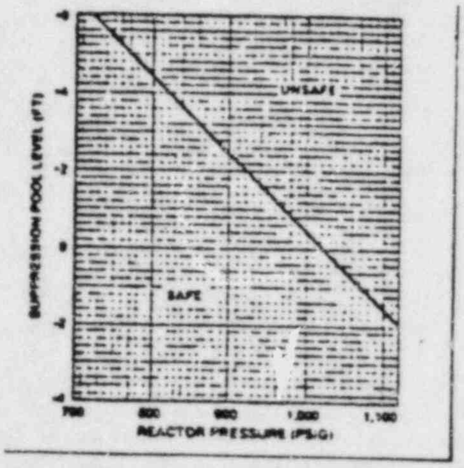
#8
#13
#14



Heat Capacity Temperature Limit

The heat capacity temperature limit is included in the Brunswick Containment Control Procedure (Suppression Pool Temperature Control-SP/T) as follows: Step 3 of SP/T-IF suppression pool temperature CANNOT be maintained below the heat capacity temperature limit (See Figure 1, SP/T), REDUCE reactor pressure with the Bypass Valve Opening Jack or SRVs to maintain reactor pressure below the limit.

- Suppression pool water level cannot be maintained below the suppression pool load limit, maintain RPV pressure below the limit. #13 #14



Suppression Pool Load Limit

The suppression pool load limit guidance is included in the Suppression Pool Level Control - High Level (SP/L) Procedure in the End Path Manual as follows: Step 4 of SP/L-High - IF suppression pool water CANNOT be maintained below the suppression pool limit (see Figure 1, SP/L-High), REDUCE reactor pressure with the Bypass Valve Opening Jack or SRVs to maintain reactor pressure below the limit.

- Steam cooling is required, enter procedure developed from CONTINGENCY #3.

If steam cooling is required, the operator is directed to leave the Level Restoration Procedure as follows: IF no high pressure, low pressure, or alternate coolant injection system is available, THEN EXIT this procedure and ENTER the "Steam Cooling Procedure" in the Contingency section of this End Path Manual.

5. If while executing the following steps:

- Boron injection is required, and
- The Main Condenser is available, and
- There has been no indication of gross fuel failure or steam line break,

open MSIVs to reestablish the Main Condenser as a heat sink. #16

When entering the Brunswick EOPs, if an ATWS condition exists, the operator is quickly directed to Path 1 by the first (highest priority) key parameter. Path 1 directs the operator to reopen the MSIVs and to reestablish the main condenser as a heat sink whether or not boron injection is required. At all locations in the EOPs, when this guidance is provided, the operator is directed to check the availability of the condenser and to check for indications of fuel failure or steam line break.

6. RC/P-2 Control RPV pressure below 1105 psig (lowest SRV lifting pressure) with the Main Turbine Bypass Valves. #14

RPV pressure control may be augmented by one or more of the following systems:

- SRVs. If the continuous SRV pneumatic supply is or become unavailable, depressurize with sustained SRV opening. #15
- HPCI
- RCIC #12
- RWCU (recirculation mode) if no boron has been injected into the RPV.
- Main Steam Line Drains
- RWCU (blowdown mode) if no boron has been injected into the RPV. Refer to sampling procedures prior to initiating blowdown.

All flowcharts contain Pressure Control Steps following the key parameters. The instruction is to maintain pressure below 950 psig with SRVs, if necessary. Following a scram, the main turbine bypass valves should automatically control reactor pressure if the MSIVs are open. If the bypass valves fail to control reactor pressure or the MSIVs close, it is appropriate to use SRVs to control pressure at this early point in a transient. All flowcharts also contain instructions to use HPCI and RCIC for pressure control if required. Flowcharts 1, 3, 4 and 5 also attempt to restore the main condenser as a heat sink if plant conditions allow.

The End Path Procedures prioritize the systems used for pressure control. The first priority is the main condenser, followed by SRVs, HPCI, RCIC, steam condensing mode, MSL drains, and RWCU. The choice at this point is left to the discretion of the operator.

7. If while executing the following steps the reactor is not shut down, return to Step RC/P-2.

Reactor Pressure Control Steps are repeated throughout the flowcharts and end path procedures to ensure adequate pressure control is maintained.

8. RC/P-3 When RPV water level is stabilized and either:

- All control rods are inserted beyond position 00 (maximum subcritical banked withdrawal position), or
- 570 pounds (cold shutdown boron weight) of boron have been injected into the RPV, or
- The reactor is shut down and no boron has been injected into the RPV,

Depressurize the RPV and maintain cooldown rate below 100°F/hr (RPV cooldown rate LCO). #14, #17

If all control rods inserted past position 00 following a scram, the operator would enter Flowchart 2, 3, 4, or 5. When the reactor and containment parameters have stabilized, the end path procedure will direct operators to GP-01 for hot standby or cold shutdown, as required.

8. RC/P-3 (Cont'd)

If boron has been injected, End Path Manual 1 requires 570 pounds of boron to be injected or all control rods to be inserted to position 00 before a cooldown is commenced.

In either case, cooldown rate is limited to less than 100°F/hr by the procedure.

9. RC/P-4 When the RHR shutdown cooling interlocks clear, initiate the shutdown cooling mode or RHR. #18

If the RHR shutdown cooling mode cannot be established and further cooldown is required, continue to cool down, using one or more of the systems used for depressurization.

If RPV cooldown is required but cannot be accomplished and all control rods are inserted to position 00 (maximum subcritical banked withdrawal position), ALTERNATE SHUTDOWN COOLING IS REQUIRED; enter CONTINGENCY #5.

Shutdown cooling is established per EPP-IN or in End Path Manual 1 if boron has been injected. In either case, if normal shutdown cooling cannot be established, operators are directed to Abnormal Operating Procedure 15 (Alternate Shutdown Cooling Methods) for the proper guidance to establish an alternate means of shutdown cooling.

10. RC/P-5 Proceed to cold shutdown in accordance with GP-05.

End Paths 2, 3, 4, and 5 direct the operator to proceed to cold shutdown per GP-05. If boron has been injected, operators will remain in End Path 1, which contains the necessary guidance to prevent inadvertent criticality and limit the spread of boron to other plant systems.

11. Cautions associated with Step RC/P.

a. Caution #8 is to be placed on the RTGB as NPSH graphs for HPCI, RCIC, RHR, and Core Spray.

b. Caution #12 is to be placed on the RTGB near the HPCI and RCIC Speed Controllers.

c. Caution #13 is included in the Users' Guide. If the reactor is rapidly depressurized, the operator is aware that cooldown rates will be exceeded.

d. Caution #14 is included in the EOPs anytime the reactor is depressurized.

e. Caution #15 is mounted on the RTGB and is included in the flowcharts and End Path Manuals anytime the operator is directed to use the SRVs.

f. Caution #16 is written into the Level/Power Control Flowchart and the associated end path procedures.

g. Caution #17 is included in the Users' Guide. If cooldown rates in excess of 100°F/hr are required, the procedure will direct the operator to do so.

h. Caution #18 is included in the flowcharts and End Path Manuals anytime RHR is to be used in any mode other than LPCI.

F. REACTOR CONTROL/POWER - RC/Q

1. RC/Q Monitor and control reactor power.

The Brunswick Operators are trained to monitor reactor power. The first key parameter on the Brunswick flowchart directs the operator to determine whether or not the control rods are inserted to position 00 and that reactor power is less than 3%.

2. If while executing the following steps:

- All control rods are inserted to position 00 (maximum subcritical banked withdrawal position), terminate boron injection.
- The reactor is shut down and no boron has been injected into the RPV, enter GP-05.

If the reactor fails to shut down upon the initiation of a scram signal, the operator is directed, by the first key parameter, to go to Path 1. If boron is not injected and if the control rods can be fully inserted, the operator will be directed to return to one of the other flowcharts; i.e., Path 2, 3, 4 or 5. However, if boron injection is initiated, the operator remains on Path 1 or End Path Manual 1.

3.	RC/Q1	Confirm or place the Reactor Mode Switch in SHUTDOWN.

All flowcharts require placing the mode switch to shutdown. Path 1 places the mode switch in shutdown only if the MSIVs are closed. This prevents an MSIV closure and subsequent loss of the main condenser as a heat sink.

4.	RC/Q-2	If the Main Turbine Generator is on line and the MSIVs are open, confirm or initiate recirculation flow runback to minimum.

On Path 1, the reactor recirculation pumps are placed at minimum speed as one of the initial actions.

5.	RC/Q-3	If reactor power is above 3% (APRM downscale trip) or cannot be determined, trip the recirculation pumps.

On Path 1, the reactor recirculation pumps are tripped following runback to minimum speed if power is above 3%.

6. | Execute Steps RC/Q-4 and RC/Q-5 concurrently. |
|---|

The Level/Power Control flowchart contains the necessary guidance for boron injection and also requires the execution of Local Emergency Procedure 02 (Alternate Control Rod Insertion) concurrently with the flowchart.

7.	RC/Q-4	If the reactor cannot be shut down before suppression pool temperature reaches 110°F (boron injection initiation temperature), BORON INJECTION IS REQUIRED; inject boron into the RPV with SLC and prevent automatic initiation of ADS.	#19

This guidance is contained on Path 1 and in LEP-02 (alternate control rod insertion).

8.	RC/Q-4.1	If boron cannot be injected with SLC, inject boron into the RPV by one or more of the following methods: • CRD • RWCU • Feedwater • HPCI • RCIC

If neither SLC pump will operate, the Level/Power Control flowchart directs the operator to LEP-03 (Alternate Boron Injection) which contains the steps necessary to inject boron from systems other than SLC.

9.	RC/Q-4.2	If boron is not being injected into the RPV by RWCU, confirm automatic isolation of or manually isolate RWCU.

If boron injection is required and an SLC pump is successfully started, RWCU will be isolated. If an SLC pump cannot be started, RWCU will be isolated in LEP-03, if it is not being used to inject boron.

10.	RC/Q-4.3	Continue to inject boron until 570 pounds (cold shutdown boron weight) of boron have been injected into the RPV.

If boron injection is required, operators will be directed to Contingency #7 (Level/Power Control Flowchart).

11.	RC/Q-5	Insert control rods as follows:

Local Emergency Procedure 02 (Alternate Control Rod Insertion) contains Steps RC/Q-5.1 through RC/Q-5.6. This LEP will be entered anytime all control rods are not inserted past position 00 following a scram.

12. Cautions associated with Step RC/Q.

a. Caution #19 is in Flowchart 1, End Path Procedures.

b. Caution #20 is in LEP-02 (Alternate Control Rod Insertion).

G. CONTAINMENT CONTROL

The Brunswick containment control procedures are located in the Containment Control section of each End Path Manual. These procedures are not expected to be needed immediately following the onset of a potential emergency condition. However, for those conditions requiring entry into the containment control procedures prior to the time the reactor is scrammed, the initial EOP guidance has been included in other procedures. For example, should the suppression pool temperature exceed 95°F during normal operation, an abnormal operating procedure (AOP-14) provides guidance for the operator to initiate suppression pool cooling and to scram the reactor prior to the pool temperature reaching 110°F.

Upon manual scram, the EOP would be entered, Immediate Action (flowchart) Steps executed, and the end path procedure entered, at which time the operator is directed to enter the containment control procedures (if an entry condition exists) and to execute the containment control procedure concurrently with the end path procedure.

The entry conditions and operator actions for the containment control procedures for the Brunswick EOP are identical to the PSTG. Plant-specific information is added as required.

H. LEVEL RESTORATION (CONTINGENCY #1)

Contingency 1 is contained in the Level Restoration procedure in the Contingency section of each End Path Manual. The entry conditions and operator actions are identical to the PSTG with plant-specific information added as required.

I. EMERGENCY DEPRESSURIZATION (CONTINGENCY #2)

Contingency 2 is contained in the Emergency Depressurization procedure in the Contingency section of each End Path Manual. The entry conditions and operator actions are identical to the PSTG with plant-specific information added as required.

J. STEAM COOLING (CONTINGENCY #3)

Contingency 3 is contained in the Steam Cooling Procedure in the Contingency section of each End Path Manual. This procedure has been written in flowchart format.

K. SPRAY COOLING (CONTINGENCY #4)

Contingency 4 is contained in the Spray Cooling Procedure in the Contingency section of each End Path Manual. This procedure has been written in flowchart format.

L. ALTERNATE SHUTDOWN COOLING (CONTINGENCY #5)

Contingency 5 is contained in Abnormal Operating Procedure 15.

M. FLOODING PROCEDURE (CONTINGENCY #6)

Contingency 6 is contained in the Flooding Procedure in the Contingency section of each End Path Manual with plant-specific information added as required.

N. LEVEL/POWER CONTROL (CONTINGENCY #7)

Contingency 7 is contained in the Level/Power Control flowchart. The procedure was written in a flowchart format due to its complexity; i.e., requires many decision and branching points that must be observed during the execution of the procedure. The entry conditions and operator actions are identical to the PSTG with plant-specific information added as required.

ATTACHMENT C

APPENDIX III

Brunswick PSTG Deviations from the Generic Guideline

The emergency procedure guidelines are generic to GE-BWR 1 through 6 designs in that they address all major sys ns which may be used to respond to an emergency. Because no specific plant includes all of the systems in the generic guidelines, the guidelines are applied to individual plants by deleting statements which are not applicable or by substituting equivalent systems where appropriate. For example, plants with no low pressure injection system will delete statements referring to LPCI, and plants with low pressure core flooding will substitute LPCF for LPCI.

This appendix provides a technical basis for the points at which the Brunswick PSTG deviates from generic guidelines.

TABLE OF CONTENTS

I. Operator Precautions

- Caution 23

Generic Guideline

Do not initiate drywell sprays unless suppression pool water level is below [17 feet 2 inches (elevation of bottom of Mark I internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water)].

Brunswick PSTG

Do not initiate drywell sprays unless suppression pool water level is below -1 inch (elevation of bottom of Reactor Building to suppression pool vacuum breakers).

Justification

The purpose of this caution is to prevent negative containment pressure in excess of design limits. At Brunswick, the Reactor Building to suppression pool vacuum breakers are at a lower elevation than the suppression pool to drywell vacuum breakers. The lower of these elevations is therefore used in the Brunswick PSTG.

II. RPV Control Guideline

- Entry Conditions

Generic Guideline

a. RPV high pressure 1045 psig

b. RPV level below +162.5 inches

c. Drywell pressure above 2.0 psig

d. An isolation which requires or initiates a reactor scram

e. A condition which requires a reactor scram and reactor power is above 3% or cannot be determined.

Brunswick PSTG

A condition which requires or has initiated a reactor scram

Justification

The entry condition for Brunswick EOPs is conservatively defined as any reactor scram signal, manual or automatic. If a true emergency condition does not exist, the EOP will be exited when plant parameters are stable. If a true emergency does exist, the operator will be in the proper procedure and taking appropriate steps very early in the accident. The entry condition is also very clear; there is little room for doubt as to which procedure applies.

III. Containment Control Guideline

- Step DW/T-3

Generic Guideline

DW/T-3 Before drywell temperature reaches [340°F (maximum temperature at which ADS qualified or drywell design temperature, whichever is lower)] but only if [suppression chamber temperature and drywell pressure are below the drywell spray initiation pressure limit], [shut down recirculation pumps and drywell cooling fans and] initiate drywell sprays [restricting flow rate to less than 720 gpm (maximum drywell spray flow rate limit)]. #18

Brunswick PSTG

DW/T-3 Before drywell temperature reaches 300°F (maximum drywell design temperature) but only if suppression chamber temperature and pressure are below the drywell spray initiation pressure limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays. #18

Justification

The drywell spray flow rate limit in the generic guideline is the product of two phenomenons associated with spraying the drywell. The first is the convective cooling effect when drywell sprays are initiated following a high energy line break in the drywell. The final pressure will be a function of the total air mass in the containment; a lower initial air mass will result in a lower final pressure. The suppression chamber to drywell vacuum breakers are sized to accommodate the pressure drop resulting from spraying the drywell following a LOCA with all noncondensables purged to the suppression chamber. However, if the initial air mass was very low, the final containment pressure may decrease below atmospheric at a rate beyond the capacity of the Reactor Building to suppression chamber vacuum breakers. Drywell spray must therefore not be initiated unless the total air mass in the containment is sufficient to ensure the negative pressure limit will not be exceeded when drywell temperature decreases to the spray temperature.

The second phenomenon, evaporative cooling, occurs if the drywell sprays are actuated in a hot, low humidity environment. The pressure drop associated with this mode of cooling is potentially so rapid that negative containment pressures in excess of design may occur within a few tenths of a second following spray initiation. This transient is beyond the capabilities of the suppression pool to drywell vacuum breakers.

These two limits are so restrictive as to all but preclude initiation of drywell sprays under all conditions. One solution is to limit the flow rate of drywell sprays, thereby reducing convective and evaporative cooling rates. This method is not feasible at Brunswick due to system design.

A second solution is to calculate the maximum pressure drop that could occur due to the evaporative cooling effect. If this pressure drop is less than the maximum negative pressure capability of the suppression pool to the drywell boundary, the evaporative cooling effect is not a concern and the drywell may be sprayed at rated flow if the limits of the convective cooling effect are met. These calculations were performed at Brunswick. The maximum pressure drop from the evaporative cooling effect has been determined to be less than the maximum negative pressure capability of the suppression pool to drywell boundary. The Brunswick PSTG therefore sprays the drywell at rated flow if the mass of noncondensables in the containment is sufficient to prevent negative pressures in excess of design.

- PC/P-2

Generic Guideline

PC/P-2	Before suppression chamber pressure reaches [17.4 psig (Suppression Chamber Spray Initiation Pressure)], but only if [suppression chamber pressure is above 1.7 psig (Mark III Containment Spray Initiation Pressure Limit)] [suppression pool water level is below 24 feet 6 inches (elevation of suppression pool spray nozzles)], initiate suppression pool sprays.	#8, #18

Brunswick PSTG

PC/P-2	Before suppression chamber pressure reaches 16.5 psig (Suppression Chamber Spray Initiation Pressure) initiate suppression pool sprays.	#8, #18

Justification

The suppression pool spray nozzles at Brunswick are at elevation +12 feet 10 inches. The upper end of the suppression pool level instrument's range is +6 feet. If suppression pool level increases above +6 feet, the operator would not be able to determine the actual suppression pool level. Since the only concern with initiating suppression pool sprays with the nozzles submerged is that is would have no effect upon containment pressure, it is more conservative to simply require spraying in an attempt to control containment pressure.

- PC/P-3

Generic Guideline

PC/P-3 If suppression chamber pressure exceeds [17.4 psig (Suppression Chamber Spray Initiation Pressure)] but only if [suppression chamber temperature and drywell pressure are below the drywell spray initiation pressure limit], [shut down recirculation pumps and drywell cooling fans and] initiate drywell sprays [restricting flow rate to less than 720 gpm (maximum drywell spray flow rate limit)]. #18

Brunswick PSTG

PC/P-3 If suppression chamber pressure exceeds 16.5 psig (suppression chamber spray initiation pressure) but only if suppression chamber temperature and pressure are below the drywell spray initiation pressure limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays. #18

Justification

See justification for DW/T-3, page 4 of 13.

- PC/P-5 The wording of the steps in the generic guideline and the Brunswick PSTG are identical. The deviation in the step is due to the PSTG using a numerical limit rather than a graph.

Justification

The suppression chamber design pressure is an absolute value based upon an assumed maximum suppression pool level. A higher water level, however, will increase the hydrostatic head exerted upon submerged locations at a rate of 0.433 psi per foot of level increase. Since this increased pressure cannot be detected by instruments located above the water surface, the design pressure must be derated accordingly. Once the suppression pool water level reaches the elevation of the suppression chamber pressure instrument tap, further increases in hydrostatic head will be sensed directly by the instrument and continued deration is unnecessary. This is the basis for the graph contained in the generic guidelines.

At Brunswick, use of this graph would result in an additional margin of 3.41 psi. This small increase in margin does not warrant the additional complication of using a two-dimensional limit during the highly stressful situation of primary containment pressure approaching design limits. Brunswick has therefore opted to derate the primary containment design pressure by 4 psi and use this absolute limit. This provides the operator with a clear point at which positive action should be taken.

- PC/P-6

Generic Guideline

PC/P-6 If suppression chamber pressure cannot be maintained below the primary containment pressure limit, then irrespective of whether adequate core cooling is assured:

- If suppression pool water level is below [24 feet 6 inches (elevation of suppression pool spray nozzles)], initiate suppression pool sprays.
- If [suppression chamber temperature and drywell pressure are below the drywell spray initiation pressure limit], [shut down recirculation pumps and drywell cooling fans and] initiate drywell sprays [restricting flow rate to less than 720 gpm (maximum drywell spray flow rate limit)].

Brunswick PSTG

PC/P-6 If suppression chamber pressure cannot be maintained below 58 psig (the primary containment pressure limit), then irrespective of whether adequate core cooling is assured:

- Initiate suppression pool sprays.
- If suppression chamber temperature and pressure are below the drywell spray initiation pressure limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays.

Justification

First bullet, see justification for PC/P-2, page 5 of 13. Second bullet, see justification for DW/T-3, page 4 of 13.

- PC/P-6

Primary Containment Pressure Limit (PCPL)

Generic Guideline

The generic guideline differentiates between the design pressure of containment and the PCPL with PCPL being a higher limit.

Brunswick PSTG

The Brunswick PSTG treats the design pressure and PCPL as one limit.

Justification

The PCPL is defined as the suppression chamber pressure beyond which primary containment integrity can no longer be assured. Primary containment integrity must be maintained, even at the expense of adequate core cooling, to provide protection against the potential uncontrolled release of radioactivity to the environment. This rationale is appropriate because no assurance can be provided that adequate core cooling will be maintained in the event of containment failure since the containment failure mechanism or location cannot be predicted and will probably result in subsequent loss of adequate core cooling due to loss of the source of water for ECCS, loss of ECCS pumps or piping integrity, or loss of RPV support and integrity. Brunswick is currently using design pressure as the PCPL. This is the only limit that is technically justifiable at this time. Brunswick is currently evaluating containment vent valves, SRV solenoids, containment penetrations, etc., for pressures and temperatures in excess of design. Brunswick is also involved with developing a generic basis for this limit with the BWROG Emergency Procedures Committee. We will continue with the effort to upgrade the PCPL. When sufficient technical justification is available to support a higher limit, Brunswick will update the PSTG. In the interim, Brunswick will use design pressure as the PCPL. Allowing pressure in excess of design could lead to failure of containment vent valves or loss of SRV operability which could lead to ultimate containment failure or an uncontrolled release of radioactivity.

- SP/L-3.3

Generic Guideline

SP/L-3.3 Before suppression pool water level reaches [17 feet 2 inches (elevation of bottom of Mark I internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water)] but only if [suppression chamber temperature and drywell pressure are below the drywell spray initiation pressure limit], [shut down recirculation pumps and drywell cooling fans and] initiate drywell sprays [restricting flow rate to less than 720 gpm (maximum drywell spray flow rate limit)]. #18

Brunswick PSTG

SP/L-3.3 Before suppression pool water level reaches 7 inches (elevation of bottom of Mark I suppression chamber vacuum breakers) but only if suppression chamber temperature and pressure are below the drywell spray initiation pressure limit, shut down recirculation pumps and drywell cooling fans and initiate drywell sprays. #18

Justification

Vacuum breaker elevation, see justification for caution 23, page 1 of 13.

Drywell spray flow rate, see justification for DW/T-3, page 4 of 13.

- SP/L-3.4

Generic Guideline

SP/L-3.4 If suppression pool water level exceeds [17 feet 2 inches (elevation of bottom of Mark I internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water)] continue to operate drywell sprays [below 720 gpm (maximum drywell spray flow rate limit)]. #23

Brunswick PSTG

SP/L-3.4 If suppression pool water level exceeds -1 inch (elevation of bottom of Mark I Reactor Building to suppression chamber vacuum breakers), continue to operate drywell sprays. #23

Justification

See justification for caution 23, page 1 of 13.

- SP/L-3.5

Generic Guideline

SP/L-3.5 When primary containment water level reaches [104 feet (maximum primary containment water level limit)], terminate injection into the RPV from sources external to the primary containment irrespective of whether adequate core cooling is assured.

Brunswick PSTG

This step is deleted from the Brunswick PSTG.

Justification

Instrumentation is not provided at Brunswick to measure the water level to the top of the drywell. The calculation procedure for the technical guideline has shown that the hydrostatic pressure resulting from complete flooding of the drywell will not exceed design pressure. In addition, the suppression pool level control procedure will require terminating injection from sources external to primary containment if suppression pool level is above +6 feet and adequate core cooling is assured.

IV. Contingency Procedures

- Contingency 1

Step C1-7 of generic guideline, Step C1-6 of Brunswick PSTG.

NOTE: The difference in step numbers in this contingency is due to the generic guideline requiring initiation of IC in Step C1-1. Brunswick does not have an IC and this step has been deleted.

Generic Guideline

C1-7 RPV WATER LEVEL DECREASING, RPV PRESSURE HIGH OR INTERMEDIATE

If HPCI or RCIC is not operating, restart whichever is not operating.

If no CRD pump is operating but at least two injection subsystems are lined up for injection with pumps running, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV water level is increasing or RPV pressure drops below [100 psig (HPCI or RCIC low pressure isolation setpoint, whichever is higher)], return to Step C1-3.

If no CRD pump is operating and no injection subsystem is lined up for injection with at least one pump running, start pumps in alternate injection subsystems which are lined up for injection.

When RPV water level drops to [-164 inches (top of active fuel)]:

- If no system, injection subsystem or alternate injection subsystem is lined up with at least one pump running, STEAM COOLING IS REQUIRED. WHen any system, injection subsystem or alternate injection subsystem is lined up with at least one pump running, return to Step C1-3.

- Otherwise, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV water level is increasing or RPV pressure drops below [100 psig (HPCI or RCIC low pressure isolation setpoint, whichever is higher)], return to Step C1-3.

Brunswick PSTG

C1-6 RPV WATER LEVEL DECREASING, RPV PRESSURE HIGH OR INTERMEDIATE

If HPCI and RCIC are not operating, restart whichever is not operating. If no CRD pump is operating and no injection subsystem is lined up for injection with at least one pump running, start pumps in alternate injection subsystems which are lined up for injection.

When RPV water level drops to 0 inches (top of active fuel):

- If no system, injection subsystem, or alternate injection subsystem is lined up with at least one pump running, STEAM COOLING IS REQUIRED. When any system, injection subsystem, or alternate injection subsystem is lined up with at least one pump running, return to Step C1-3.

- If any RPV injection exists, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. When RPV water level is increasing or RPV pressure drops below 120 psig (HPCI low pressure isolation setpoint), return to STEP C1-3.

Justification

The Brunswick PSTG delays RPV depressurization until RPV level decreases to the top of the active fuel for the following reasons:

1. Adequate core cooling is maintained so long as RPV water level remains above the top of active fuel.

2. The time during which RPV water level decreases to the top of the active fuel can best be used to line up alternate methods of RPV injection to reverse the decreasing RPV water level trend.

   This is also the method used in revision 3 of the generic guideline which has been approved by the NRC.

- Contingency 2

  Step C2-1.2 of generic guideline
  Step C2-1.1 of Brunswick PSTG

  NOTE: The difference in the step numbers in this contingency is due to the generic guideline requiring initiation of IC in Step C2-1.1. Brunswick does not have an IC and this step has been deleted.

Generic Guideline

C2-1.2 If suppression pool water level is above [4 feet 9 inches (elevation of top of SRV discharge device)]:

- Open all ADS valves.
- If any ADS valve cannot be opened, open other SRVs until [seven (number of SRVs dedicated to ADS)] valves are open.

Brunswick PSTG

C2-1.1 Open all ADS valves.

If any ADS valve cannot be opened, open other SRVs until seven (number of SRVs dedicated in ADS) valves are open.

Justification

The suppression pool at Brunswick is encased in concrete. Each room below the suppression pool elevation is independent; i.e., flooding in one room will not cause all rooms to be flooded. If an unisolable leak were to occur in four of the five rooms simultaneously, they could equalize with the suppression pool and the T-quencher would remain covered. If the fifth room was also flooded by a leak from the suppression pool, i.e., the entire area below the suppression pool elevation was flooded, the T-quencher would only be partially covered.

The elevation at the top of the T-quencher is 9 feet. The Brunswick EOPs, i.e., suppression pool low level procedure, directs the operator to depressurize the reactor at 6 feet 6 inches. In order for the suppression pool level to be below the top of the T-quencher, a simultaneous leak would have to occur in both RHR rooms, both core spray rooms, and the HPCI room. This is not considered credible; therefore, this step has been deleted from the Brunswick EOPs.

- Contingency 7 - Level/Power Control - Box Preceding Step C7.1

Generic Guideline

If while executing the following steps RPV flooding is required or RPV water level cannot be determined, control injection into the RPV to maintain reactor power above [8% (reactor flow stagnation power)] but as low as practicable.

However, if reactor power cannot be determined or maintained above [8% (reactor flow stagnation power)], RPV FLOODING IS REQUIRED; enter [procedure developed from CONTINGENCY No. 6].

Brunswick PSTG

If while executing the following steps:

- RPV water level cannot be determined, RPV flooding is required; enter contingency No. 6.

- RPV flooding is required, enter contingency No. 6.

Justification

The requirement to attempt to maintain reactor power above 8% if RPV flooding were required while injecting boron was based upon the assumption that if RPV water level were reduced sufficiently, natural circulation flow would stagnate and reactor power would stabilize at a constant of 8% known as the "reactor flow stagnation power." Later analysis has shown that the reactor power may actually vary from 6% to 30% under this condition, depending upon the initial conditions and analysis assumptions chosen. For this reason, the Brunswick PSTG does not attempt to maintain power at 8% if flooding is required while injecting boron. Rather, the Brunswick PSTG requires that the flooding procedure be entered if flooding is required while injecting boron.

The steps in the flooding procedure will remain unchanged. However, the basis for the minimum alternate RPV flooding pressure must be redefined. The original basis was that if the differential pressure between the RPV and the suppression pool is maintained equal to or greater than the specified value, the resulting steam flow through the open SRVs will be equivalent to 8% reactor power. Since this 8% number is no longer valid, the minimum alternate RPV flooding pressure has been defined to be the minimum RPV pressure at which steam flow through the open SRVs is sufficient to remove all decay heat from a completely uncovered core by steam heat transfer alone ten minutes after a shutdown from 100% power with no clad temperatures in excess of 1500°F. This pressure is based on the assumption, supported by extensive test data, that fuel perforations will not occur if peak clad temperature is maintained below 1500°F. Thus maintaining RPV pressure above the minimum alternate RPV flooding pressure assures that no fuel damage will occur even if the reactor is not shut down during the flooding evolution.

This deviation is considered to be conservative, even though not NRC approved, since the 8% power assumption has been proven to be incorrect. The approach used in the Brunswick PSTG is also the same approach that is in revision 4 of the generic guideline.