

NINE MILE POINT NUCLEAR STATION UNIT #2

UNIT 1A OPERATIONS

LESSON PLAN

REMOTE SHUTDOWN SYSTEM

02-REQ-001-296-2-00

Prepared By: Nine Mile Point Unit 2
Operations Training Staff

07-191-91

MASTER CONTROLLED DOCUMENT

DATE AND INITIALS

APPROVALS

SIGNATURES

REVISION 4

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Summary of Pages

Revision: 4 (Effective Date: 4/4/88)

Number of Pages: 17

Date

Pages

March 1988

1 - 17

NIAGARA MOHAWK POWER CORPORATION

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DOCUMENT

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ATTACHMENT 6
LESSON PLAN TEMPORARY/PUBLICATION/ADDENDUM CHANGE FORM

The attached change was made to:

Lesson plan title: REMOTE SHUTDOWN SYSTEM

Lesson plan number: 02-REQ-001-296-2-00 REV 4

Name of instructor initiating change: MAT BRIGGS

Reason for the change: INDUSTRY EVENT (TMR-R2-90.037, TMR-02-88.263, TCO-02-REQ-910-037) THIS WAS ADDED AS "ADDENDUM B."

Type of change:

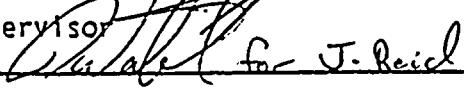
- 1. Temporary change
- 2. Publication change
- 3. Addendum change

Disposition:

- 1. Incorporate this change during the next scheduled revision.
- 2. Begin revising the lesson plan immediately. Supervisor initiate the process.
- 3. To be used one time only.

Approvals:

Instructor:  /Date 7/31/91

Training Area Supervisor (or designee):  for J. Reid /Date 7/31/91



OBJECTIVE APPROVAL

Author: STEVEN DART

Training Dept: Unit 2 Ops Trng

Lesson Title: Remote Shutdown System

Lesson Plan #: DLT-36

Training Setting(s): NLOT, LIC CLASS, REQUAL

Purpose: The instructor shall present information for the student to meet each Student Learning Objective. Additionally, he shall provide sufficient explanation to facilitate the students' understanding of the information presented.

Trainee Job Title: PLANT OPERATOR

<u>Approvals/Review</u>	<u>Signatures</u>	<u>Date</u>
Training Supervisor	<u>[Signature]</u>	<u>5/11/88</u>
Plant Supervisor	<u>[Signature]</u>	<u>6/2/88</u>
Training Analysts Supervisor	<u>[Signature]</u>	<u>5-10-88</u>

When complete, attach this form to the master lesson plan.



I. TRAINING DESCRIPTION

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A. TITLE: Remote Shutdown System

B. PURPOSE: In a lecture presentation, the instructor shall present information for the student to meet each Student Learning Objective. Additionally, he shall provide sufficient explanation to facilitate the student's understanding of the information presented.

C. TOTAL TIME: 2 hours

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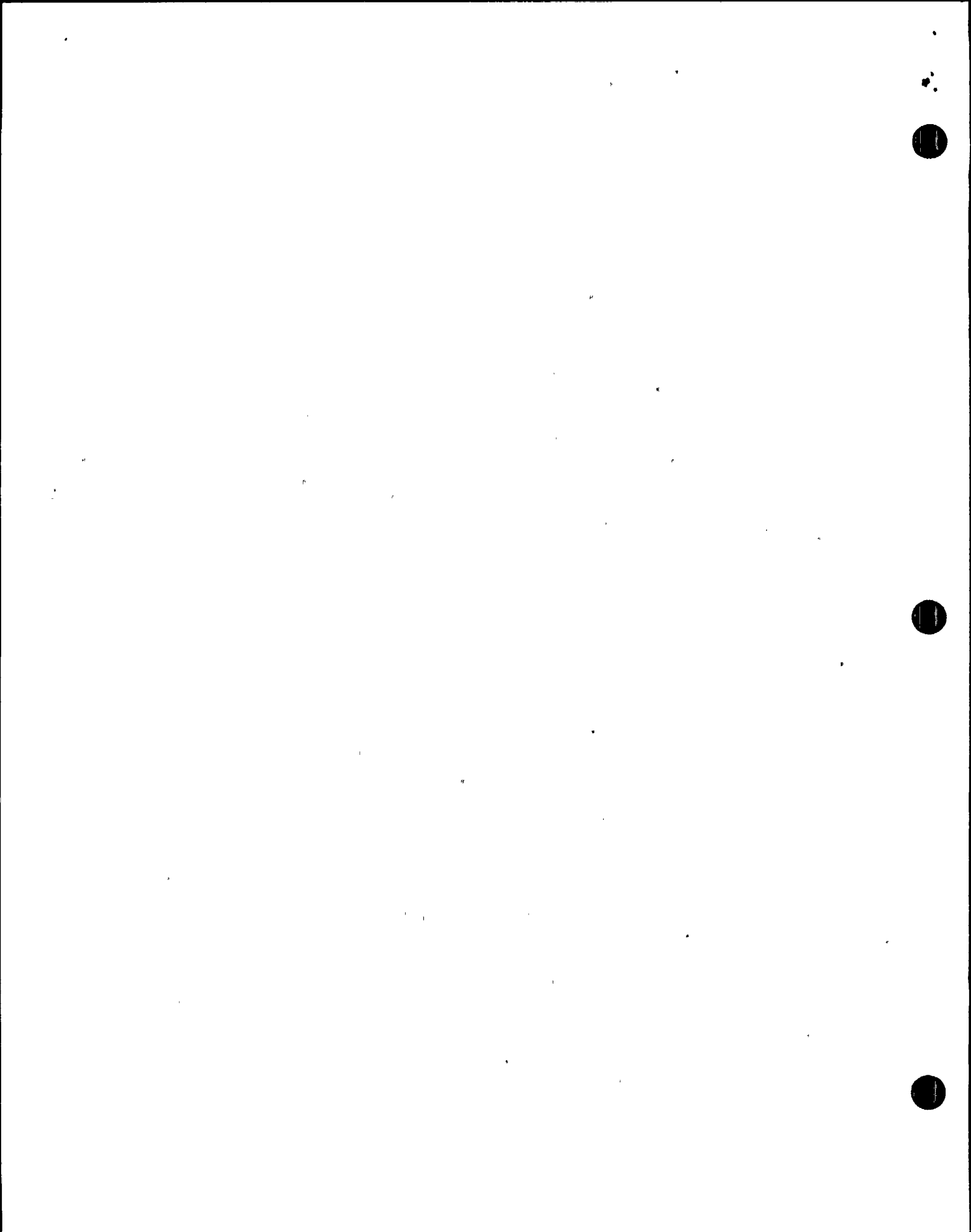
D. TEACHING METHODS:

1. Classroom lecture
2. Assign the Student Learning Objectives as review problems with the students obtaining answers from the text, writing the down and handing them in for grading.

E. REFERENCES:

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1. Technical Specifications
 - a. 3/4.3.7.4 Remote Shutdown System Instrumentation and Controls
2. Procedures
 - a. N2-OP-78 Remote Shutdown System
3. NMP-2 FSAR
 - a. Vol. 16, 7.4.1.4 Systems Required for Safe Shutdown; Remote Shutdown System, Page 7.4-5
4. 10CFR
 - a. Part 50, Appendix R



II. REQUIREMENTS AND PREREQUISITES

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A. REQUIREMENTS FOR CLASS:

1. AP-9.0, Rev. 2, Administration of Training
2. NTP-10, Rev. 3, Training of Licensed Operator Candidates
3. NTP-11, Rev. 4, Licensed Operator Retraining and Continued Training
4. NTP-12, Rev. 2, Unlicensed Operator Training

B. PREREQUISITES:

1. Instructor:

- a. Demonstrated knowledge and skills in the subject, at or above the level to be achieved by the trainees, as evidenced by previous training or education, or
- b. SRO license for Nine Mile Point Unit Two or a similar plant, or successful completion of SRO training including simulator certification at the SRO level for Nine Mile Point Unit Two.
- c. Qualified in instructional skills as certified by the Training Analyst Supervisor.

2. Students

- a. Meet eligibility requirements for 10CFR55, or
- b. Be recommended for this training by Operations Superintendent, his designee, or Training Superintendent.

III. TRAINING MATERIALS

A. TEACHING MATERIALS:

1. Transparency package.
2. Overhead projector
3. Whiteboard and felt tip markers



A. TEACHING MATERIALS: (Cont'd)

4. N2-OLP-36
5. N2-OLT-36
6. See Section I.E.1
7. See Section I.E.2

B. STUDENT MATERIALS:

1. N2-OLT-36
2. See Section I.E.1
3. See Section I.E.2

IV. QUIZZES, TESTS, EXAMS AND ANSWER KEYS

Will be generated and administrated as necessary. They will be on permanent file in the Records Room.



V. LEARNING OBJECTIVES FOR THE REMOTE SHUTDOWN SYSTEM

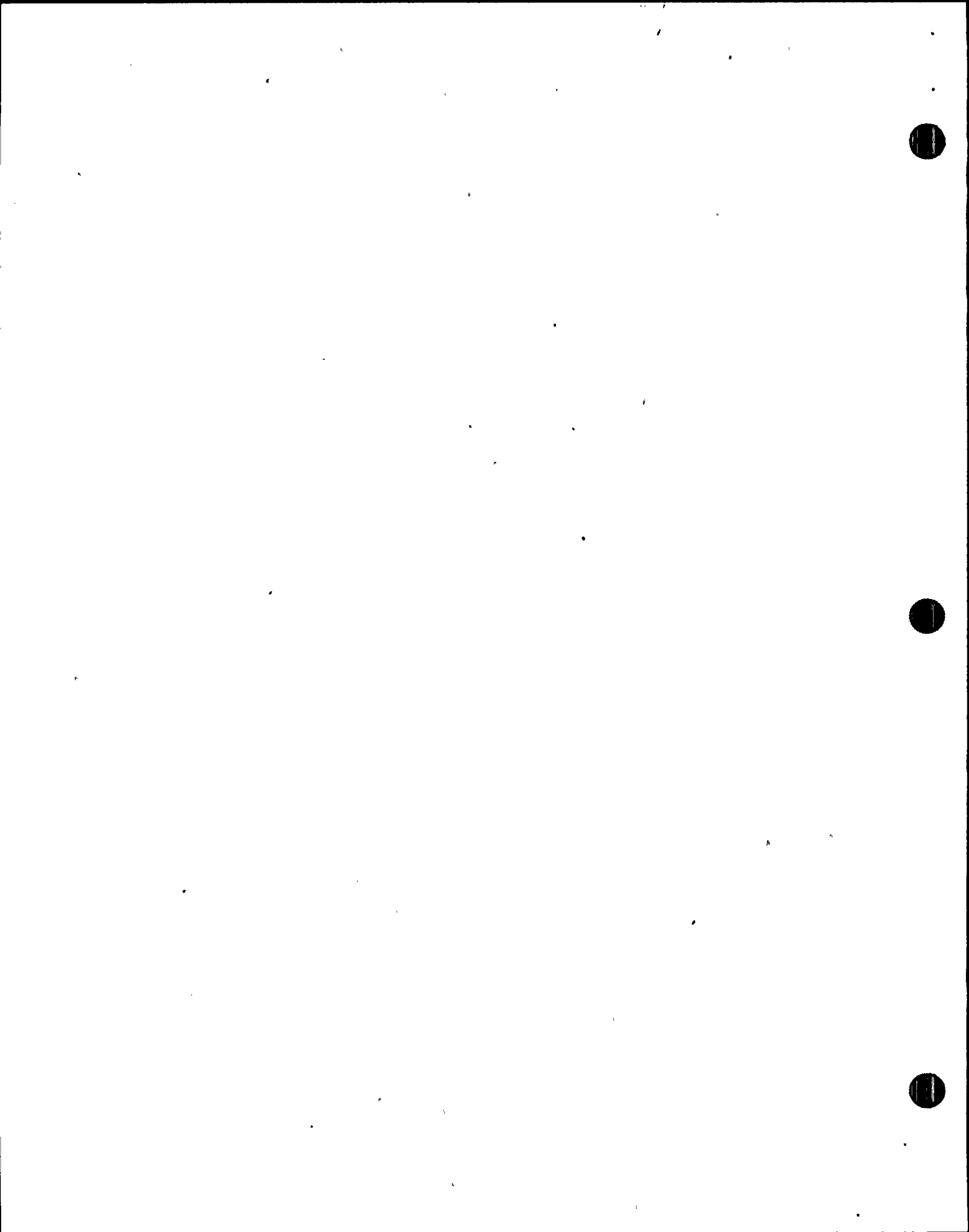
Upon completion of this chapter, mastery of the required system knowledge will be demonstrated by performing the Enabling Objectives listed below:

- 36-1 State the two purposes of the Remote Shutdown System.
- 36-2 State the three purposes of the Appendix "R" disconnect switches.
- 36-3 List five systems that can be controlled from the Remote Shutdown Panel.
- 36-4 State which modes of the Residual Heat Removal System may be operated from the Remote Shutdown Panel.
- 36-5 State the number of Safety Relief Valves (SRV's) that can be operated from the Remote Shutdown Panel, and which solenoids are used for operation of the valves.
- 36-6 List five automatic functions that are bypassed when the Appendix "R" disconnect switches are placed in Actuate.
- 36-7 List three functions that occur when a remote transfer switch is taken to the emergency position.
- 36-8 List two assumptions that are made when it is necessary to evacuate the Control Room and operate in the Remote Shutdown Room.
- 36-9 Given N2-OP-78, Remote Shutdown System, use the procedure to identify the appropriate actions and/or locate information related to:
 - a) Startup
 - b) Normal Operation
 - c) Shutdown
 - d) Off-Normal Operation
 - e) Procedures for correcting alarm conditions



36-10 (SRO Only) Given Technical Specifications, identify the appropriate actions and/or locate information relating to Limiting Conditions for operation, bases, and surveillance requirements for the Remote Shutdown System.

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VI. LESSON CONTENT

<u>Activity</u>	Text Ref. Page	Text Ref. Fig.	<u>S.L.O.</u>
I. <u>INTRODUCTION</u>	i		
A. <u>Student Learning Objectives</u>			4
B. <u>Purpose</u>	1	1	
1. Provides the necessary controls and attendant instrumentation to bring the plant to either a hot shutdown or cold shutdown condition when the main control room becomes inaccessible due to fire, toxic gas or heavy smoke conditions.			
2. Permits a safe shutdown with the designed appendix "R" fire when used in conjunction with the remote disconnect switches.			
C. <u>General Description</u>			
1. Provides alternative to normal system controls			4
a. Permits shutdown and cooldown from a remote location with:			
1. reactor vessel isolated			
2. feedwater unavailable			4
3. normal heat sink lost			
D. <u>Appendix "R"</u>			
1. The term Appendix "R" comes from the Code of Federal Regulations Title 10, part 50, Appendix "R" dealing with the Fire Protection Program for Nuclear Power Facilities operating prior to January 1, 1979.			



Activity

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Fig.

S.L.O.

2. The scenario for an Appendix "R" fire is a fire in which the control room must be evacuated and has the potential to disable systems required for safe shutdown (either hot or cold), by preventing operation or causing misoperation due to Hot Shorts, Open Circuits, or Shorts to ground.

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II. DETAILED DESCRIPTION

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A. Remote Shutdown System - General

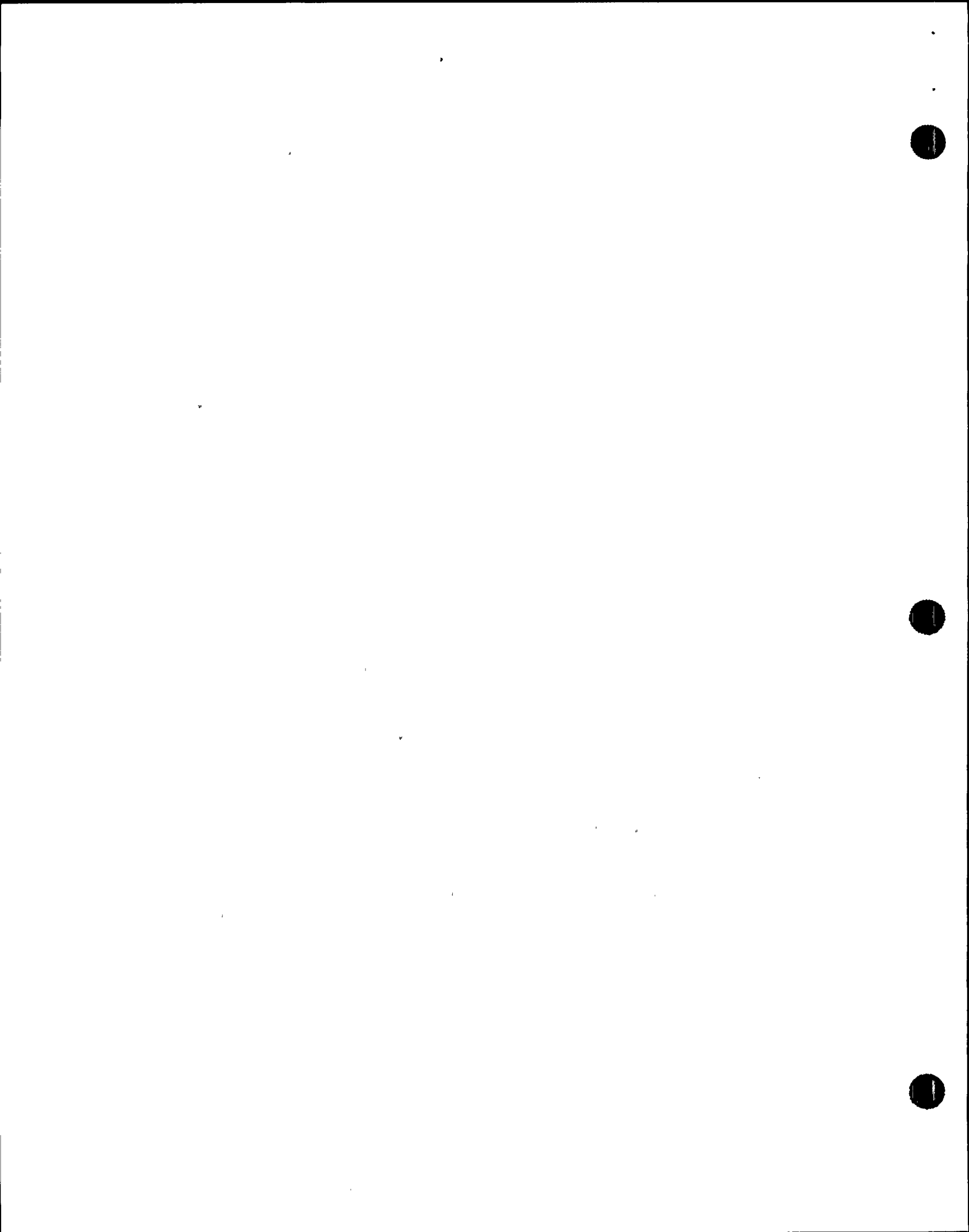
2

1. The Panel is divided into Division I and Division II sections. The divisional sections are separated by a 3 hr. fire wall. Located on elevation 261' of the Control Building.
2. The panels contain the following:
 - a. Control switches - selected safe shutdown components have control switches on the RSP's to facilitate system operations.
 - b. Instrumentation - selected parameters are displayed for monitoring system operation.
 - c. Keylock Transfer Switches - Transfer control of selected components from the control panels to the RSP's.
3. Appendix "R" Disconnect Switches
 - a. Located in locked cabinets mounted on either side of the Control Room in the Cable runs.
 - b. When activated:
 1. Isolates circuits from the Control Room.

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<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
2. Transfers selected component control to the RSP.	2		2
3. Automatically operates selected components to place systems in reliable lineups.			
B. Remote Shutdown Panel - Division I Section			3
1. The Division I RSP has controls and indications for the following systems:			
a. Reactor Core Isolation Cooling (ICS) ICS System maintains adequate water inventory to reactor vessel when normal feed is isolated. The ICS components necessary for ICS operation can be operated from the panel including:			
1) ICS turbine			
2) All valves required for operation.			
b. Residual Heat Removal (RHS) -"A" RHS can be operated in:	3		4
1) suppression pool cooling mode			
2) shutdown cooling mode			
3) "pseudo" LPCI injection mode			
c. Service Water (SWP) Components that can be operated from panel:			
1) SW to RHS "A" heat exchanger			
2) SW to Emergency Diesel Generator EG1			
3) SW pumps 1A, 1C, & 1E			
d. Automatic Depressurization (ADS) Controls and indications are provided for:			5



<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
<ul style="list-style-type: none"> 1) Four ADS function SRV's (PSV121, PSV127, PSV129, PSV137) utilizing the A solenoids. 2) Also available are the IAS containment isolation valves and high flow SOVX 181/186 valves for N² Makeup to ADS. <ul style="list-style-type: none"> e. Remote Shutdown Room HVAC Control for the air conditioning unit in the Division I Room. 2) Also included in the Division I Room: <ul style="list-style-type: none"> a. Process Computer Terminal b. Printer c. Gaitronics Console 	3		5
<u>C. Remote Shutdown Panel - Division II Section</u>			
<ul style="list-style-type: none"> 1. The Division-II RSP has controls and indications for the following systems: <ul style="list-style-type: none"> a. The ICS system controls on the division II panel consist only of a transfer switch. <ul style="list-style-type: none"> 1) Transfer control of the Division II ICS components. b. RHS "B" can be operated in: <ul style="list-style-type: none"> 1) Suppression pool cooling 2) Shutdown cooling <ul style="list-style-type: none"> a. The SDC suction valves MOV-112 and 113 are on this panel. 3) "Pseudo" LPCI injection 			4



<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
c. SWP components	3		4
1) SW to RHS "B" heat exchanger			
2) SW to emergency diesel generator EG-3			
3) SW pumps 1B, 1D and 1F			
d. ADS controls and indications provided for:			5
1) Four ADS function SRV's (PSV 121, 127, 129, 137) utilizing the "B" solenoids.			
e. HVAC control for the Division II Room.			

D. Power Supplies

1. Panels are supplied by divisional A.C. and D. C. power supplies (See OP-78, Table II), and fused in the remote shutdown panel.

III. INSTRUMENTATION, CONTROL AND INTERLOCKS

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A. Instrumentation

1. Div. I and Div. II Panels
 - a. Reactor Pressure
 - b. Rx Level-Narrow Range
 - c. Rx Level-Wide Range
 - d. Service Water Pump Flows
 - e. Suppression Pool Water Level
 - f. Suppression Pool Water Temperature
 - g. CST Level
 - h. RHR Loop Flows
 - i. RHR HX SW Flow
 - j. RHR HX SW Outlet Temperature
 - k. RHR HX Inlet and Outlet Temperature
1. ADS Accumulator Tank Pressures

N2-OLP-36 -10- March 1988



<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
2. Div. I Only	4		
a. RCIC Turbine Speed			
b. RCIC Pump Flow			
c. Rx Vessel Bottom Drain and Shell Temperature.			
B. <u>Controls</u>			
1. Remote Shutdown Transfer Switches	5		4
a. 19 two position (NORMAL/EMERGENCY) switches on the RSP are used to for transfer control of the components from the control room to the RSP			
1) In the NORMAL position the components are controlled from the control room.			
2) In the EMERGENCY position the components are controlled at the RSP.			
2. Remote Disconnect Switches			4
a. 39 Disconnect switches further isolate circuits from control room or provide auto starts for systems without local controls. The disconnect switches are located on PNL-415, 416 and 417 outside the main control room (cable runs).			
C. <u>Interlocks</u>			
1. With ADS initiation signals present, transfer to RSP will not prevent automatic initiation.			
2. When a remote transfer switch is taken to the emergency position:		7	4
a. Associated control room controls are disabled			



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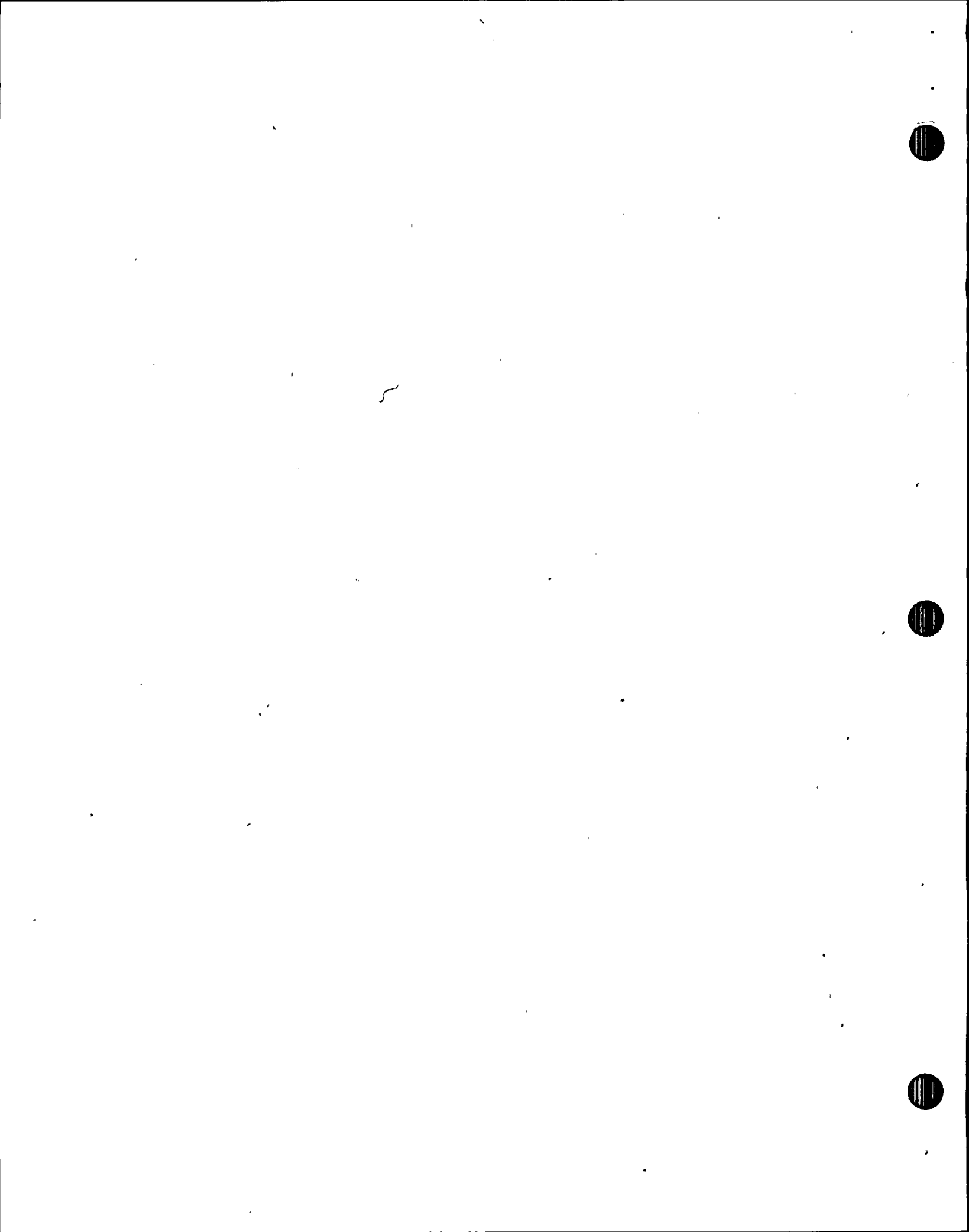
- b) Control room annunciators alarm for Div I and/or Div II switches
- c) Associated remote shutdown switches are enabled.
- 3. Reactor Core Isolation Cooling System
 - a. When operating the RCIC System from the RSS panel in the Appendix "R" mode (disconnect switches in the activated position), all RCIC steam supply isolations and all RCIC turbine trips are negated with the exception of mechanical overspeed and manual trip from the RSS panel. In addition, the auto closure of the steam inlet valve (MOV-120) has been removed, therefore on high level this must be manually accomplished.
- 4. Residual Heat Removal
 - a. When operating the RHS System from RSS panel in the Appendix R mode (disconnect switches in the activated position), all primary containment isolation signals are deactivated for all components located on the RSS panel, and LPCI initiation is disabled.
- 5. Service Water
 - a. If the diesels should start after service water system control has been transferred to the Remote Shutdown Panel, the service water inlet cooling valves to Div. I and Div. II must be manually opened from the RSS panel to provide cooling to the diesels.

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S.L.O.

- b. Prior to transferring the service water pumps to the RSS panel place the control switches for the pumps which are running to the AUTO AFTER START position. 6
6. Automatic Depressurization System |4
- a. When operating in the Appendix R mode (disconnect switches in the activated position), the relief mode and the ADS mode of the pressure relief valves is negated; automatic operation of the pressure relief valves is only in the safety mode. Manual operation of the ADS valves (2MSS*PSV 121, 127, 129 and 137) is available via the ADS solenoids from the Remote Shutdown Panel.
- b. In addition, the nitrogen high load pressure control valves (2IAS*SOVX-181/186) and containment isolation valves (2IAS*SOV 164 and 165) control is transferred to the RSS panel via the disconnect switches.
7. When a remote shutdown transfer switch is returned to normal, control of the affected component is returned to the main control room. Therefore, the control switches in the control room must be in the desired position prior to returning the transfer switch to normal.



<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
8. With the Appendix "R" disconnect switches placed in "ACTUATE" position, the following automatic functions are bypassed; Initiation Function of LPCI, ADS and ICS and Isolation Functions for ICS and ADS N ₂ Supply Valves.	7		6 4

IV. SYSTEM OPERATION

A. Normal Operation

Remote Shutdown Panel is in standby ready for use in the event the main control room is uninhabitable. The remote shutdown transfer switches are in normal.

B. Control Room Evacuation

1. When the control room has to be evacuated, the assumptions are made that the Rx is scrammed and no LOCA has occurred, the operator will use the remote shutdown panel to bring the reactor to a cold shutdown condition.
2. The transfer switches are used to allow system operation from the panel.
3. In an Appendix "R" fire, the scenario requires disconnecting selected equipment using the disconnect switches to allow proper operation and or prevent misoperation.
4. The operator opens the SRV's to depressurize and cooldown the Rx.
 - a. ICS is used to supply makeup water to the Rx.
 - b. RHS is operated to cool the suppression pool.

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<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
5. When the reactor pressure and temperature are low enough, the RHS system is shifted to the Shutdown Cooling mode and used to continue the cooldown of the reactor.	7		

V. SYSTEM INTERRELATIONS

A. Residual Heat Removal System (RHS)

The RHS System can be operated in the suppression pool cooling, shutdown cooling, and alternate shutdown cooling (pseudo-LPCI) modes from the remote shutdown panel.

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B. Reactor Core Isolation Cooling System (ICS)

The ICS System can be used to inject water into the reactor vessel from the remote shutdown panel.

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C. Containment Monitoring System (CMS)

The CMS System provides suppression pool temperature and level measurements to the remote shutdown panel.

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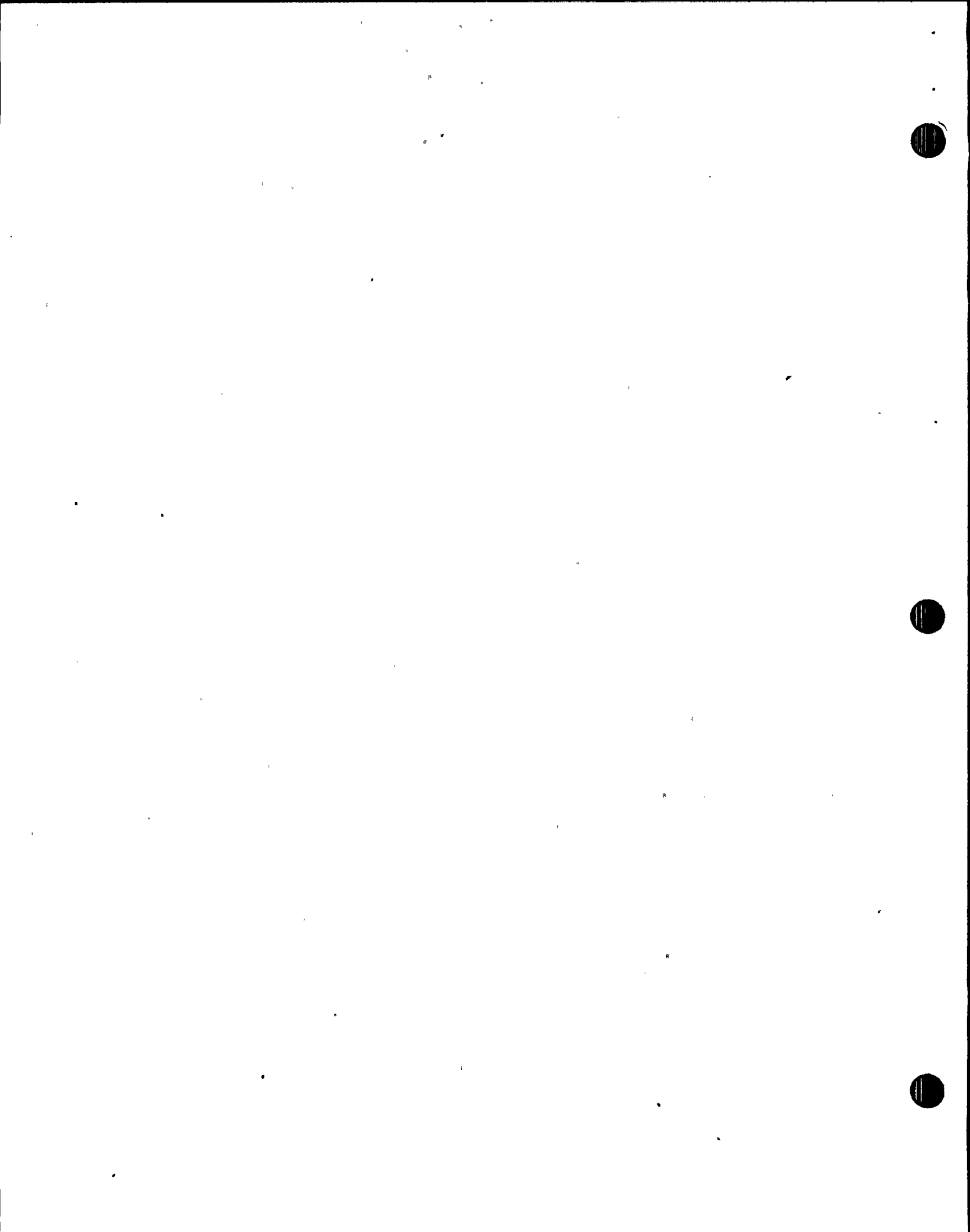
D. Service Water System (SWP)

The SWP System can be operated to cool the RHS heat exchangers and the emergency diesel generators from the remote shutdown panel.

E. Main Steam System (MSS)

4 ADS safety relief valves can be operated from the remote shutdown panel (2MSS*SOV 121A/B, 127A/B, 129A/B, & 137A/B).

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<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
F. <u>Reactor Vessel Instrumentation (RVI)</u> The RVI System provides reactor vessel pressure, level and temperature indication to the remote shutdown panel.	8		
G. <u>Automatic Depressurization System (ADS)</u> The ADS provides indications of ADS accumulator pressure to the remote shutdown panel.			
H. <u>Condenser Transfer and Storage System (CNS)</u> The CNS System provides condensate storage tank level to the remote shutdown panel.			

VI. DETAILED SYSTEM REFERENCE REVIEW

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Review each of the following reference documents with the class:

A. Technical Specifications

10

Specification for:

Applicable Section Including Bases

SL

LSSS

LCO

SR

Remote Shutdown Instrumentation and Controls

3.3.7.4

4.3.7.4

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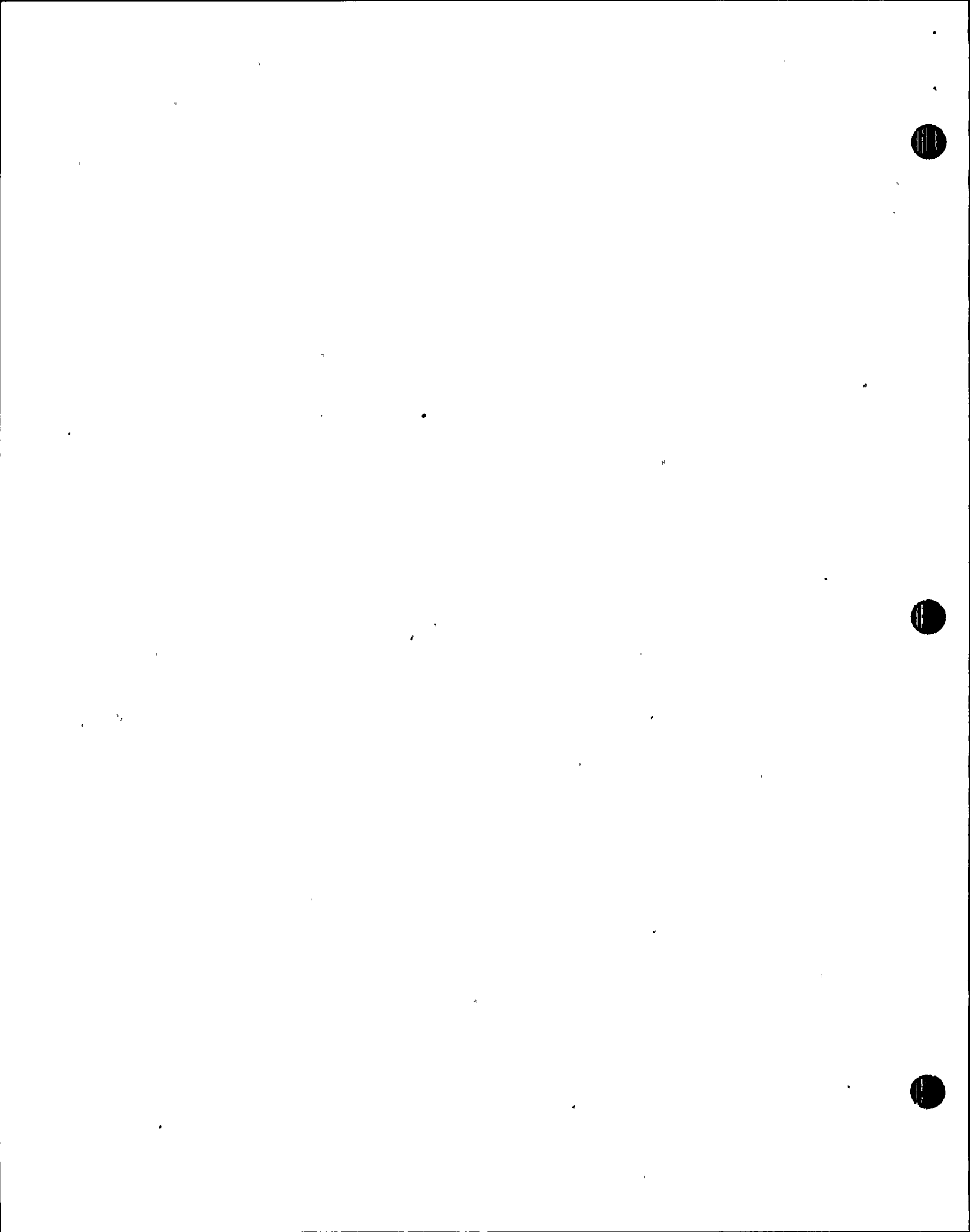
B. PROCEDURES

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1. N2-OP-78, Remote Shutdown System



<u>Activity</u>	<u>Text Ref. Page</u>	<u>Text Ref. Fig.</u>	<u>S.L.O.</u>
<p>VII. <u>RELATED PLANT EVENTS</u> A. Refer to addendum "A" and review related events with the class (if applicable).</p>			4
<p>VIII. <u>SYSTEM HISTORY</u> Refer to addendum "B" and review related modifications with the class (if applicable).</p>			
<p>IX. <u>WRAP-UP</u> A. Review the student learning objectives.</p>			



ADDENDUM "B"

- w
7/1/91
1. SER 29-86 (ATTACHED)

INADVERTANT RAPID COOLDOWN AND DEPRESSURIZATION DURING A REMOTE SHUTDOWN TEST

-EVEN THOUGH THIS EVENT OCCURED AT A PWR, MANY OF THE PROBLEMS WHICH LED TO THE EVENT COULD HAPPEN HERE.

1. TRAINING SHOULD BE COMPLETED PRIOR TO RETURNING A MODIFIED SYSTEM TO SERVICE.
2. COMPONENT/SYSTEM OPERABILITY SHOULD BE PROVEN PRIOR TO CRITICAL TESTS.
3. EXPLICIT TEST TERMINATION CRITERIA MUST BE GIVEN PRIOR TO PERFORMING TESTS.
4. PERSONNEL MUST BE TRAINED AND UNDERSTAND THE DIFFERENCES IN SYSTEM OPERATION AND RESPONSE WHEN OPERATING FROM THE REMOTE SHUTDOWN PANELS.



11
/S

IS 620 FORSYTH (INPO) 12-AUG-86 07:57 PT
Subject: Message deleted by FORSYTH on 12-Aug-86
Information Contact: RICHARD H. REYNOLDS, INPO, 404/953-5392

IS 21 FORSYTH (INPO) 12-AUG-86 08:24 PT
Subject: SER 29-86, RAPID COOLDOWN AND DEPRESSURIZATION

R2-90.037

SUBJECT: INADVERTENT RAPID COOLDOWN AND DEPRESSURIZATION
DURING A REMOTE SHUTDOWN TEST

Remote S/D

UNIT (TYPE): CATAWBA 2
DOC NO/LER NO: 50-414/86028
EVENT DATE: 6/27/86
NSSS/AE: WESTINGHOUSE/DUKE POWER COMPANY

SUMMARY:

DURING THE PERFORMANCE OF A REQUIRED POWER ASCENSION TEST (LOSS OF CONTROL ROOM), THE PRIMARY SYSTEM EXPERIENCED A RAPID COOLDOWN AND DEPRESSURIZATION. AS PART OF THE TEST, THE UNIT WAS TRIPPED AT 24 PERCENT POWER, AND CONTROL WAS TRANSFERRED TO THREE REMOTE SHUTDOWN PANELS. WHEN CONTROL WAS TRANSFERRED, ALL FOUR STEAM GENERATOR POWER-OPERATED RELIEF VALVES (PORVs) OPENED, CAUSING A RAPID DECREASE IN PRIMARY SYSTEM TEMPERATURE AND PRESSURE. AS A RESULT OF THE TEMPERATURE DECREASE, PRESSURIZER LEVEL INDICATION WENT OFFSCALE LOW. WHEN THE TEST WAS TERMINATED AND CONTROL WAS TRANSFERRED BACK TO THE MAIN CONTROL ROOM, AN AUTOMATIC SAFETY

INJECTION

STATION OCCURRED (PER DESIGN) ON LOW STEAM LINE PRESSURE. THE INITIATING CAUSE OF THIS EVENT WAS INADEQUATE IMPLEMENTATION OF A DESIGN MODIFICATION TO THE STEAM GENERATOR PORV CONTROLLERS. AN EQUIPMENT MALFUNCTION, IMPROPER LABELING ON THE REMOTE SHUTDOWN PANELS, AND LACK OF EXPLICIT TEST TERMINATION CRITERIA CONTRIBUTED TO THE EXTENT AND DURATION OF THE EVENT. THIS EVENT IS SIGNIFICANT BECAUSE INADEQUATE DESIGN REVIEW AND CONTROL CREATED A PROBLEM FOR OPERATORS AND IF THE SITUATION HAD REQUIRED AN ACTUAL CONTROL ROOM EVACUATION, EXISTING CONDITIONS COULD HAVE PRECLUDED A SAFE AND ORDERLY UNIT SHUTDOWN.

DESCRIPTION:

ON 6/27/86, CATAWBA UNIT 2 WAS OPERATING AT 24 PERCENT POWER, AND PREPARATIONS WERE UNDERWAY TO PERFORM A LOSS OF CONTROL ROOM TEST. THIS TEST WAS INTENDED TO VERIFY THE ABILITY TO SHUT DOWN THE PLANT FROM OUTSIDE THE CONTROL ROOM. THE OPERATING SHIFT CONDUCTED A PRETEST BRIEFING AND PROCEDURE WALK-DOWN ON THE PREVIOUS AFTERNOON. NO PROBLEMS WERE IDENTIFIED. THE TEST PROVIDED FOR THE NORMAL OPERATING SHIFT TO CONDUCT THE TEST. A MINIMUM NUMBER OF OBSERVERS WERE TO REMAIN IN THE CONTROL ROOM TO MONITOR THE OPERATION OF THE REACTOR COOLANT PUMPS. THESE PUMPS WERE TO REMAIN IN OPERATION TO SIMULATE DECAY HEAT. THE CONTROL ROOM OBSERVERS WERE A SENIOR REACTOR OPERATOR AND A LICENSED REACTOR WHO WERE TO MAINTAIN COMMUNICATIONS WITH THE OPERATING SHIFT. HOWEVER, THEY WERE ONLY TO COMMUNICATE INFORMATION PERTAINING TO THE EQUIPMENT INTENTIONALLY LEFT OPERATING AFTER TEST INITIATION.



AN EQUIPMENT MODIFICATION HAD BEEN IMPLEMENTED BETWEEN HOT FUNCTIONAL TESTING, WHEN THIS TEST HAD PREVIOUSLY BEEN PERFORMED, AND UNIT 2 LICENSING. THIS MODIFICATION CHANGED THE FUNCTIONAL CHARACTERISTICS BUT NOT THE PHYSICAL APPEARANCE OF THE STEAM GENERATOR PORV CONTROLS ON THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL. PRIOR TO THE MODIFICATION, THE CONTROLLERS FUNCTIONED AS STEAM GENERATOR PRESSURE SET POINT CONTROLLERS. IN THIS MODE, THE CONTROLLERS PROVIDED MANUAL ADJUSTMENT OF THE PRESSURE SET POINT AT WHICH THE PORVs WOULD OPEN. THE CONTROLLERS HAD A SINGLE SCALE READING IN UNITS OF PSIG (FULL SCALE BEING 1500 PSIG) AND DUAL POINTERS; ONE POINTER INDICATED STEAM GENERATOR PRESSURE AND THE SECOND INDICATED PRESSURE SET POINT. AFTER THE MODIFICATION, THE CONTROLLERS FUNCTIONED AS DIRECT MANUAL STEAM GENERATOR PORV POSITION DEMAND LOADERS, AND THE SECOND POINTER INDICATED VALVE POSITION DEMAND. HOWEVER, THE SCALE STILL READ IN PSIG UNITS RATHER THAN PERCENT OF VALVE DEMAND. ACCORDING TO THE TEST PROCEDURE, WHICH WAS IN ERROR, THE CONTROLLERS WERE SET AT WHAT WAS BELIEVED TO BE A STEAM GENERATOR PRESSURE SET POINT OF 1125 PSIG. IN REALITY, THIS SETTING PROVIDED A 75 PERCENT OPEN DEMAND SIGNAL TO THE FOUR STEAM GENERATOR PORVs.

A NORMAL SHIFT TURNOVER OCCURRED AT 0700 ON 6/27/86; AND PREREQUISITES FOR THE TEST WERE COMPLETED BETWEEN 0800 AND 0900. THE TEST WAS INITIATED AT 0941 WHEN THE OPERATIONS PERSONNEL WERE DISPATCHED FROM THE CONTROL ROOM TO THEIR ASSIGNED STATIONS. AT THAT TIME, THE PRIMARY PRESSURE WAS 2238 PSIG, TEMPERATURE WAS 560 DEGREES FAHRENHEIT, AND PRESSURIZER LEVEL WAS 78 PERCENT. THE STEAM GENERATOR PRESSURE WAS 1030 PSIG. AT 0942, A LICENSED REACTOR OPERATOR TRIPPED THE REACTOR TRIP BREAKERS IN ACCORDANCE WITH THE TEST PROCEDURE. HE THEN PROCEEDED TO THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL. THIS PANEL IS ONE OF THE THREE AUXILIARY SHUTDOWN PANELS FROM WHICH REMOTE SHUTDOWN IS PERFORMED. ALSO AT 0942, LOCAL CONTROL WAS TAKEN AT AUXILIARY SHUTDOWN PANELS A AND B. THESE TWO PANELS HAVE INDICATIONS AND CONTROLS FOR FUNCTIONS SUCH AS LETDOWN/CHARGING AND SEAL INJECTION. WHEN THIS TRANSFER OF CONTROL WAS PERFORMED, A LETDOWN/CHARGING FLOW MISMATCH OCCURRED. THIS LETDOWN/CHARGING MISMATCH, WHICH WAS GREATER THAN ANTICIPATED, RESULTED IN AN INCREASING VOLUME CONTROL TANK LEVEL AND A DECREASING PRESSURIZER LEVEL. BY 0947, THE PRESSURIZER LEVEL HAD DROPPED TO AN INDICATED 18 PERCENT.

AT 0943, THE LICENSED OPERATOR WHO HAD TRIPPED THE REACTOR TRIP BREAKERS ARRIVED AT THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL, AND TOOK CONTROL. THIS PANEL HAS INDICATION AND CONTROLS ASSOCIATED WITH THE STEAM GENERATOR PORVs AND OTHER FUNCTIONS. WHEN THE LOCAL POWER FEEDER BREAKERS FOR THE STEAM GENERATOR PORVs WERE CLOSED AT APPROXIMATELY 0947, ALL FOUR STEAM GENERATOR PORVs OPENED TO 75 PERCENT FULL OPEN, THE PERCENTAGE OF FULL SCALE AT WHICH THE CONTROLLERS HAD BEEN SET.

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THE OPERATOR AT THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL IMMEDIATELY BECAME AWARE OF THE SUDDEN DECREASE IN STEAM GENERATOR PRESSURE AND, IN AN ATTEMPT TO ENSURE THE PORVs WERE CLOSED, MANUALLY ADJUSTED (WHAT HE THOUGHT TO BE) THE PRESSURE SETPOINT UPWARD. THIS ACTION ACTUALLY CAUSED THE PORVs TO OPEN EVEN MORE. NO DIRECT INDICATION WAS AVAILABLE TO THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL OPERATOR OF VALVE POSITION FOR THE STEAM GENERATOR PORVs. THE CONTROL ROOM OBSERVERS DID



HAVE POSITION INDICATION IN THE FORM OF RED AND GREEN LIGHTS; HOWEVER, THEY WERE RELUCTANT TO COMMUNICATE SUCH INFORMATION TO OPERATORS ON THE REMOTE SHUTDOWN PANELS TO AVOID INVALIDATING THE SET POINT. AT 0950, THE PRESSURIZER PRESSURE HAD DECREASED TO 1845 PSIG AND STEAM LINE PRESSURE TO 725 PSIG, THE SAFETY INJECTION SET POINT. HOWEVER, AUTOMATIC SAFETY INJECTION WAS PARTIALLY BLOCKED (PER DESIGN) BY TRANSFER TO THE REMOTE SHUTDOWN PANELS. AT 0952, THE SRO IN THE CONTROL ROOM ORDERED TEST TERMINATION AND TRANSFER OF CONTROL BACK TO THE MAIN CONTROL ROOM. UPON TRANSFER, AT 0953, AUTOMATIC SAFETY INJECTION ACTUATION WAS UNBLOCKED AND OCCURRED, THE STEAM GENERATOR PORVs CLOSED, AND THE PRESSURIZER PRESSURE AND LEVEL BEGAN RECOVERING. BY 0958, THE PRESSURIZER LEVEL AND PRESSURE HAD RETURNED TO APPROXIMATELY 30 PERCENT AND 1300 PSIG, RESPECTIVELY. AT THIS POINT, THE SAFETY INJECTION WAS RESET AND REACTOR COOLANT TEMPERATURE WAS STABILIZED AT 468 DEGREES FAHRENHEIT.

SUBSEQUENT INVESTIGATION REVEALED THE FOLLOWING FACTORS THAT CONTRIBUTED TO THE PROGRESSION OF THIS EVENT:

- A. THE DESIGN MODIFICATION TO THE STEAM GENERATOR PORV CONTROL SCHEME DID NOT ADEQUATELY ADDRESS THE CHANGES NEEDED TO THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL. FIGURE 2 SHOWS A SIMPLIFIED CONTROL DIAGRAM, BEFORE AND AFTER THE MODIFICATION. THE MODIFICATION REPLACED THE STEAM GENERATOR PORV PRESSURE SET POINT LOADER IN THE CONTROL ROOM WITH A VALVE POSITION DEMAND LOADER AND REMOVED THE PROPORTIONAL CONTROLLER THAT WAS COMMON TO CONTROL ROOM AND AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL OPERATION. THIS RESULTED IN THE PRESSURE SET POINT LOADER, LOCATED ON THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL, FUNCTIONING AS A VALVE POSITION DEMAND LOADER WHEN CONTROL WAS TRANSFERRED TO THIS PANEL. HOWEVER, THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL CONTROLLER WAS NOT REPLACED OR RELABELLED. THE NEED FOR RELABELLING WAS NOT IDENTIFIED DURING THE DESIGN MODIFICATION PROCESS.
- B. THE MODIFICATION WAS MADE KNOWN TO THE PLANT STAFF, AND INPUT FROM THE APPROPRIATE DESIGN PERSONNEL WAS SOLICITED BY THE PLANT TO BE USED FOR ANY REQUIRED PROCEDURAL AND TRAINING REVISIONS. HOWEVER, THERE WAS INADEQUATE TRANSFER OF INFORMATION CONCERNING THE CHANGE IN FUNCTION OF THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL CONTROLLER. BECAUSE THE APPEARANCE OF THE AUXILIARY CONTROLLER HAD NOT BEEN ALTERED, THE PLANT HAD THE IMPRESSION THAT THE FUNCTION OF THE CONTROLLER HAD ALSO REMAINED UNCHANGED. THIS RESULTED IN PROCEDURAL REVISIONS AND OPERATOR TRAINING THAT INCORPORATED THE CONTROL ROOM CONTROLLER PORTION OF THE MODIFICATION IMPACT ON SYSTEM OPERATION, BUT IT DID NOT INCLUDE THE EFFECT ON THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL CONTROLLER.
- C. THE LETDOWN/CHARGING MISMATCH THAT OCCURRED AT THE BEGINNING OF THE EVENT WAS CAUSED WHEN LETDOWN PRESSURE CONTROL VALVE 148, DESIGNED TO PROVIDE BACKPRESSURE FOR THE FLOW ORIFICES IN THE LETDOWN LINE, FAILED OPEN DUE TO A FAULTY ELECTRICAL CONNECTION (SEE FIGURE 1). THE SITUATION WAS COMPLICATED BY THE FOLLOWING:

PRIOR TO TEST INITIATION, CHARGING FLOW CONTROL VALVE 294 HAD



BEEN ADJUSTED TO 32 GPM, AND SEAL INJECTION BACKPRESSURE CONTROL VALVE 309 WAS CLOSED BY ADJUSTMENT OF AUXILIARY SHUTDOWN PANEL "A" CONTROLLERS TO LIMIT THE TRANSIENT EFFECT ON THE REACTOR COOLANT PUMP (RCP) SEALS DURING THE TRANSFER. THE CONTROLLER FOR VALVE 309 ON AUXILIARY SHUTDOWN PANEL "B" WAS LEFT AT ITS NORMAL OPEN SETTING. HOWEVER, UNKNOWN TO THE OPERATOR, VALVE 309 WOULD RESPOND TO THE OPEN CONTROL SIGNAL DUE TO CIRCUIT DESIGN AND SYSTEM CONDITIONS UPON TRANSFER. THIS RESULTED IN THE VALVE GOING TO AN OPEN POSITION, INSTEAD OF THE FULL-CLOSED POSITION THAT WAS DESIRED UPON TRANSFER TO THE AUXILIARY SHUTDOWN PANELS.

WHEN VALVE 309 OPENED, THE OPERATOR ATTEMPTED TO COMPENSATE FOR THE LACK OF FLOW TO SEAL INJECTION BY OPENING VALVE 294; HOWEVER, THE MANUAL VALVE POSITION DEMAND CONTROLLER FOR VALVE 294 ON THE AUXILIARY SHUTDOWN PANEL WAS LABELED BACKWARD (INCREASING AND DECREASING DESIGNATIONS WERE TRANSPOSED). THEREFORE, THE OPERATOR'S ATTEMPTS TO OPEN VALVE 294 RESULTED IN CLOSING IT.

THE PLANT MADE THE NECESSARY EQUIPMENT LABELLING AND PROCEDURAL CHANGES AND CONDUCTED TRAINING TO INCORPORATE THE IMPACT OF THIS MODIFICATION COMPLETELEY. THE LOSS-OF-CONTROL-ROOM TEST WAS SUCCESSFULLY RE-CONDUCTED ON 7/11/86. THE PLANT IS IN THE PROCESS OF REVIEWING ALL MODIFICATIONS PERFORMED BETWEEN COMPLETION OF HOT FUNCTIONAL TESTING AND LICENSING TO DETERMINE IF ANY SIMILAR SITUATIONS EXIST.

MENTS:

1. AN ESSENTIAL ELEMENT OF THE DESIGN MODIFICATION PROCESS IS THE DEVELOPMENT AND DOCUMENTATION OF A BASIC FUNCTIONAL DESCRIPTION. THIS WOULD COMPLEMENT TECHNICAL AND HARDWARE DESCRIPTIONS OF HOW TOTAL SYSTEM OPERATION IS AFFECTED BY A MODIFICATION. ONLY WITH SUCH A FUNCTIONAL DESCRIPTION CAN THE SAFETY IMPACT OF A MODIFICATION BE COMPLETELY EVALUATED. THIS DESCRIPTION SHOULD IDENTIFY NECESSARY REVISIONS TO OPERATING PROCEDURES, MAINTENANCE PROCEDURES, TESTING REQUIREMENTS, AND TRAINING LESSON PLANS, AND SHOULD BE INCLUDED AS PART OF THE MODIFICATION PACKAGE DOCUMENTATION. PROCEDURE CHANGES, DRAWING UPDATES, AND APPROPRIATE TRAINING SHOULD BE COMPLETED PRIOR TO RETURNING A MODIFIED SYSTEM TO SERVICE.
2. FOLLOWING THE MODIFICATION TO THE STEAM GENERATOR PORV CONTROLS, INDIVIDUAL COMPONENT CHECKS WERE MADE, BUT COMPLETE LOOP/SYSTEM TESTING WAS NOT PERFORMED. TO BE COMPLETE, POST-MODIFICATION TESTING SHOULD NOT ONLY VERIFY INDIVIDUAL COMPONENT OPERATION, BUT WHERE APPROPRIATE, SHOULD ALSO VERIFY SYSTEM FUNCTIONAL OPERATION. ADDITIONALLY, APPROPRIATE COMPONENT/SYSTEM OPERABILITY SHOULD BE VERIFIED PRIOR TO CRITICAL TESTS.
3. WHEN APPLICABLE, CRITICAL TEST PROCEDURES SHOULD PROVIDE SPECIFIC CRITERIA FOR TEST TERMINATION AND SPECIFIC STEPS TO ENSURE TERMINATION IS CONDUCTED IN A SAFE AND ORDERLY MANNER. DURING THE CONDUCT OF THE LOSS OF CONTROL ROOM TEST, EXPLICIT TEST TERMINATION CRITERIA WERE NOT GIVEN TO THE SRO OBSERVER IN THE CONTROL ROOM. THIS MAY HAVE RESULTED IN

post mod.
 { Component/loc, tests
 System functional testing
 restoration steps
 test not functional properly or procedures such

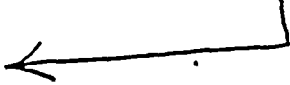


INCREASING THE EXTENT AND DURATION OF THE TRANSIENT.

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4. IT IS IMPORTANT THAT THE APPROPRIATE PLANT PERSONNEL ARE WELL-TRAINED, PRACTICED, AND HAVE A COMPLETE UNDERSTANDING OF THE PROCESS INVOLVED WITH THE EVACUATION OF THE MAIN CONTROL ROOM. AREAS OF IMPORTANCE INCLUDE INDICATIONS AND CONTROLS AVAILABLE AT THE REMOTE SHUTDOWN PANELS AND THE DIFFERENCES BETWEEN A CONTROL ROOM SHUTDOWN AND A REMOTE SHUTDOWN. THIS IS PARTICULARLY IMPORTANT WITH RESPECT TO CONTROLLING THE PLANT UNDER ABNORMAL CONDITIONS.
5. THE HUMAN PERFORMANCE PROBLEMS THAT OCCURRED DURING THIS EVENT HIGHLIGHT THE IMPORTANCE OF THE APPLICATION OF HUMAN FACTORS CONSIDERATIONS TO ALL PANELS IN THE PLANT, NOT JUST THOSE IN THE CONTROL ROOM. THIS IS PARTICULARLY IMPORTANT FOR PANELS USED DURING INFREQUENT OR OFF-NORMAL CONDITIONS SUCH AS REMOTE SHUTDOWN. APPLICATION OF HUMAN FACTORS SHOULD BE AN INTEGRAL PART OF THE DESIGN MODIFICATION PROCESS FOR ALL CONTROLS AND INDICATIONS.

How does training cover this?



AS A MINIMUM, THIS SER SHOULD BE REVIEWED BY PLANT ORGANIZATIONS RESPONSIBLE FOR OPERATIONS, TRAINING, INSTRUMENTATION AND CONTROLS, AND THE DESIGN MODIFICATION PROCESS.

ILLUSTRATIONS, WHICH MAY BE HELPFUL IN UNDERSTANDING THIS SER, ARE BEING TRANSMITTED BY TELECOPY TO THE UTILITY AND PARTICIPANT SEE-IN CONTACTS. RECIPIENTS WHO DO NOT HAVE TELECOPY RECEPTION CAPABILITIES AT THEIR LOCATION CAN OBTAIN A COPY OF THE ILLUSTRATIONS FROM THEIR SEE-IN CONTACT OR JEFF WHEELLOCK, INPO, 404/951-4730. RECIPIENTS WITH TELECOPY RECEPTION CAPABILITIES EXPERIENCE PROBLEMS IN RECEIVING ANY TRANSMISSION SHOULD CONTACT SKIP HEEKE, INPO, 404/953-7675.

INPO'S EVALUATION OF THIS EVENT IS COMPLETE.

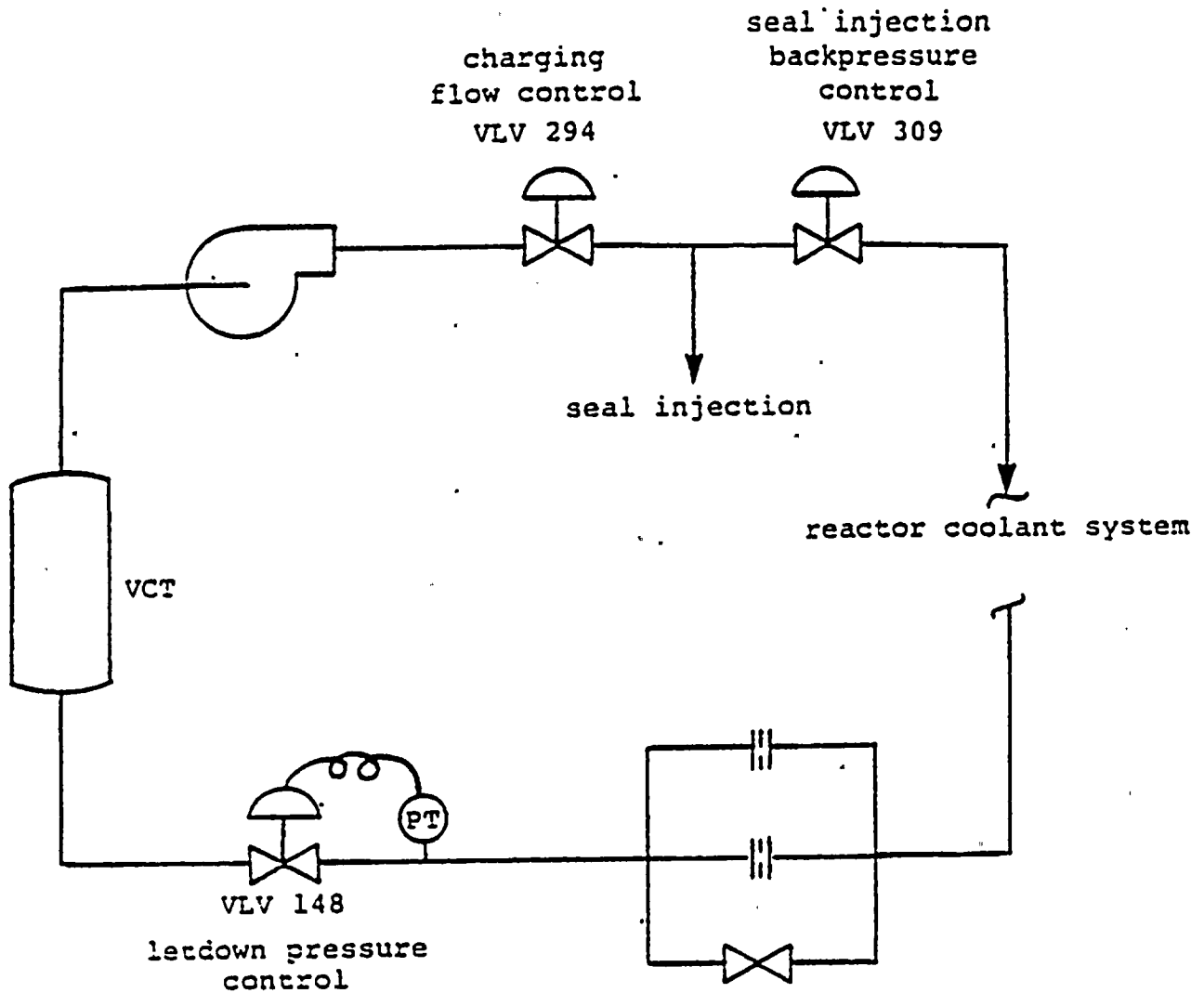
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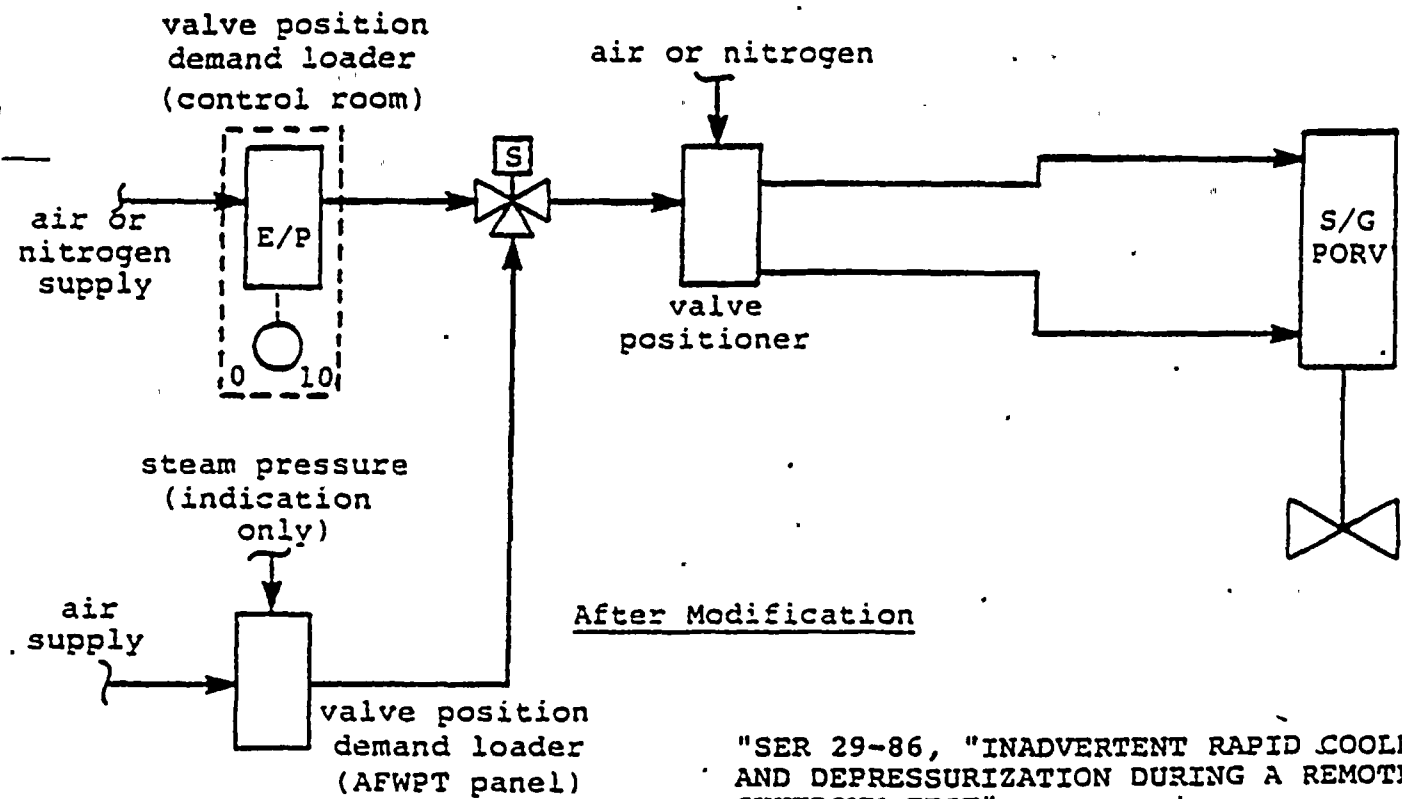
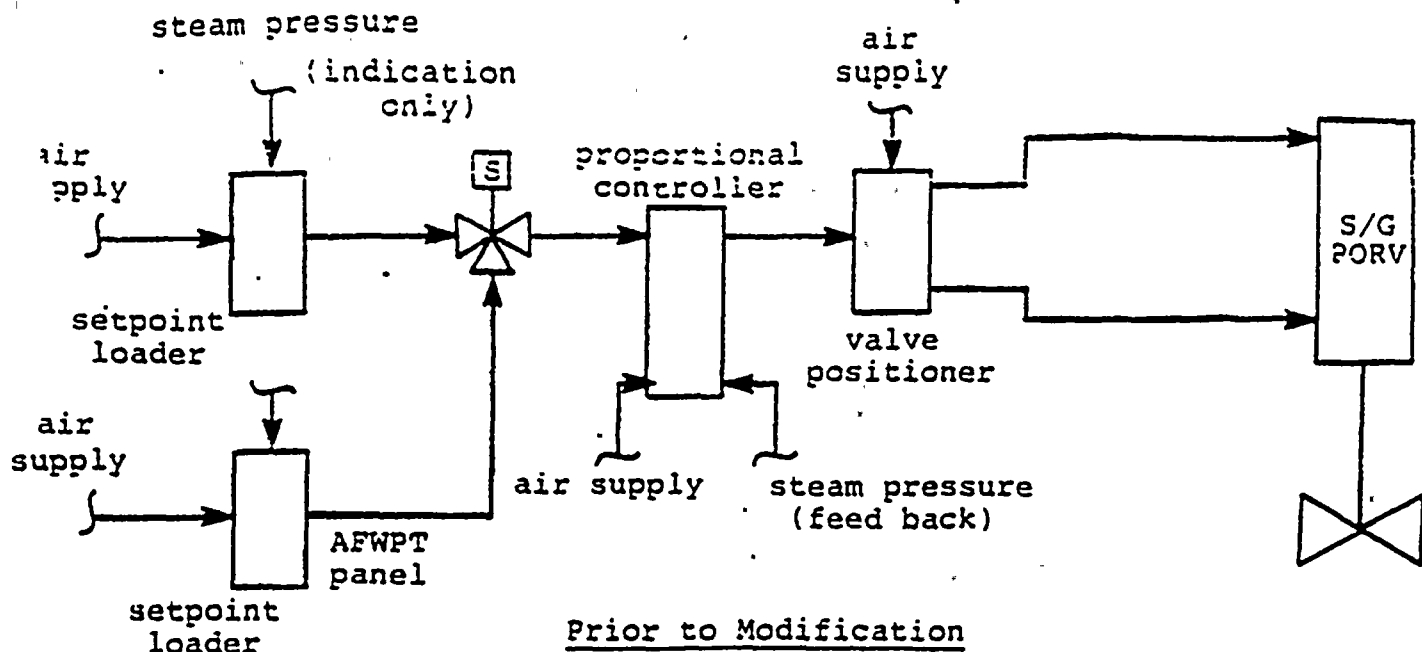


Simplified
Letdown/Charging Diagram

Figure 1

SER 29-86, "INADVERTENT RAPID COOLDOWN AND DEPRESSURIZATION
DURING A REMOTE SHUTDOWN TEST"





Simplified Steam Generator

PORV Control Diagram

Figure 2



15 620 FORSYTH (INPO) 12-AUG-86 07:57 PT
Subject: Message deleted by FORSYTH on 12-Aug-86
Information Contact: RICHARD H. REYNOLDS, INPO, 404/953-5392

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02 Nov 1986 96-2-00

11 FORSYTH (INPO) 12-AUG-86 08:24 PT
ct: SER 29-86; RAPID COOLDOWN AND DEPRESSURIZATION

R2-90.037

SUBJECT: INADVERTENT RAPID COOLDOWN AND DEPRESSURIZATION
DURING A REMOTE SHUTDOWN TEST

Remote S/D

UNIT (TYPE): CATAWBA 2
DOC NO/LER NO: 50-414/86028
EVENT DATE: 6/27/86
NSSS/AE: WESTINGHOUSE/DUKE POWER COMPANY

SUMMARY:

DURING THE PERFORMANCE OF A REQUIRED POWER ASCENSION TEST (LOSS OF CONTROL ROOM), THE PRIMARY SYSTEM EXPERIENCED A RAPID COOLDOWN AND DEPRESSURIZATION. AS PART OF THE TEST, THE UNIT WAS TRIPPED AT 24 PERCENT POWER, AND CONTROL WAS TRANSFERRED TO THREE REMOTE SHUTDOWN PANELS. WHEN CONTROL WAS TRANSFERRED, ALL FOUR STEAM GENERATOR POWER-OPERATED RELIEF VALVES (PORVs) OPENED, CAUSING A RAPID DECREASE IN PRIMARY SYSTEM TEMPERATURE AND PRESSURE. AS A RESULT OF THE TEMPERATURE DECREASE, PRESSURIZER LEVEL INDICATION WENT OFFSCALE LOW. WHEN THE TEST WAS TERMINATED AND CONTROL WAS TRANSFERRED BACK TO THE MAIN CONTROL ROOM, AN AUTOMATIC SAFETY INJECTION OCCURRED (PER DESIGN) ON LOW STEAM LINE PRESSURE.

INITIATING CAUSE OF THIS EVENT WAS INADEQUATE IMPLEMENTATION OF A DESIGN MODIFICATION TO THE STEAM GENERATOR PORV CONTROLLERS. AN EQUIPMENT MALFUNCTION, IMPROPER LABELING ON THE REMOTE SHUTDOWN PANELS, AND LACK OF EXPLICIT TEST TERMINATION CRITERIA CONTRIBUTED TO THE EXTENT AND DURATION OF THE EVENT. THIS EVENT IS SIGNIFICANT BECAUSE INADEQUATE DESIGN REVIEW AND CONTROL CREATED A PROBLEM FOR OPERATORS AND IF THE SITUATION HAD REQUIRED AN ACTUAL CONTROL ROOM EVACUATION, EXISTING CONDITIONS COULD HAVE PRECLUDED A SAFE AND ORDERLY UNIT SHUTDOWN.

DESCRIPTION:

ON 6/27/86, CATAWBA UNIT 2 WAS OPERATING AT 24 PERCENT POWER, AND PREPARATIONS WERE UNDERWAY TO PERFORM A LOSS OF CONTROL ROOM TEST. THIS TEST WAS INTENDED TO VERIFY THE ABILITY TO SHUT DOWN THE PLANT FROM OUTSIDE THE CONTROL ROOM. THE OPERATING SHIFT CONDUCTED A PRETEST BRIEFING AND PROCEDURE WALK-DOWN ON THE PREVIOUS AFTERNOON. NO PROBLEMS WERE IDENTIFIED. THE TEST PROVIDED FOR THE NORMAL OPERATING SHIFT TO CONDUCT THE TEST. A MINIMUM NUMBER OF OBSERVERS WERE TO REMAIN IN THE CONTROL ROOM TO MONITOR THE OPERATION OF THE REACTOR COOLANT PUMPS. THESE PUMPS WERE TO REMAIN IN OPERATION TO SIMULATE DECAY HEAT. THE CONTROL ROOM OBSERVERS WERE A SENIOR REACTOR OPERATOR AND A LICENSED OPERATOR WHO WERE TO MAINTAIN COMMUNICATIONS WITH THE OPERATING SHIFT. HOWEVER, THEY WERE ONLY TO COMMUNICATE INFORMATION RELATING TO THE EQUIPMENT INTENTIONALLY LEFT OPERATING AFTER TEST INITIATION.



AN EQUIPMENT MODIFICATION HAD BEEN IMPLEMENTED BETWEEN HOT FUNCTIONAL TESTING, WHEN THIS TEST HAD PREVIOUSLY BEEN PERFORMED, AND UNIT 2 LICENSING. THIS MODIFICATION CHANGED THE FUNCTIONAL CHARACTERISTICS BUT NOT THE PHYSICAL APPEARANCE OF THE STEAM GENERATOR PORV CONTROLS ON THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL. PRIOR TO THE MODIFICATION, THE CONTROLLERS FUNCTIONED AS STEAM GENERATOR PRESSURE SET POINT CONTROLLERS. IN THIS MODE, THE CONTROLLERS PROVIDED MANUAL ADJUSTMENT OF THE PRESSURE SET POINT AT WHICH THE PORVs WOULD OPEN. THE CONTROLLERS HAD A SINGLE SCALE READING IN UNITS OF PSIG (FULL SCALE BEING 1500 PSIG) AND DUAL POINTERS; ONE POINTER INDICATED STEAM GENERATOR PRESSURE AND THE SECOND INDICATED PRESSURE SET POINT. AFTER THE MODIFICATION, THE CONTROLLERS FUNCTIONED AS DIRECT MANUAL STEAM GENERATOR PORV POSITION DEMAND LOADERS, AND THE SECOND POINTER INDICATED VALVE POSITION DEMAND. HOWEVER, THE SCALE STILL READ IN PSIG UNITS RATHER THAN PERCENT OF VALVE DEMAND. ACCORDING TO THE TEST PROCEDURE, WHICH WAS IN ERROR, THE CONTROLLERS WERE SET AT WHAT WAS BELIEVED TO BE A STEAM GENERATOR PRESSURE SET POINT OF 1125 PSIG. IN REALITY, THIS SETTING PROVIDED A 75 PERCENT OPEN DEMAND SIGNAL TO THE FOUR STEAM GENERATOR PORVs.

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THE OPERATOR AT THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL IMMEDIATELY BECAME AWARE OF THE SUDDEN DECREASE IN STEAM GENERATOR PRESSURE AND, IN AN ATTEMPT TO ENSURE THE PORVs WERE CLOSED, MANUALLY ADJUSTED (WHAT HE THOUGHT TO BE) THE PRESSURE SET POINT UPWARD. THIS ACTION ACTUALLY CAUSED THE PORVs TO OPEN EVEN MORE. NO DIRECT INDICATION WAS AVAILABLE TO THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL OPERATOR OF VALVE POSITION FOR THE STEAM GENERATOR PORVs. THE CONTROL ROOM OBSERVERS DID

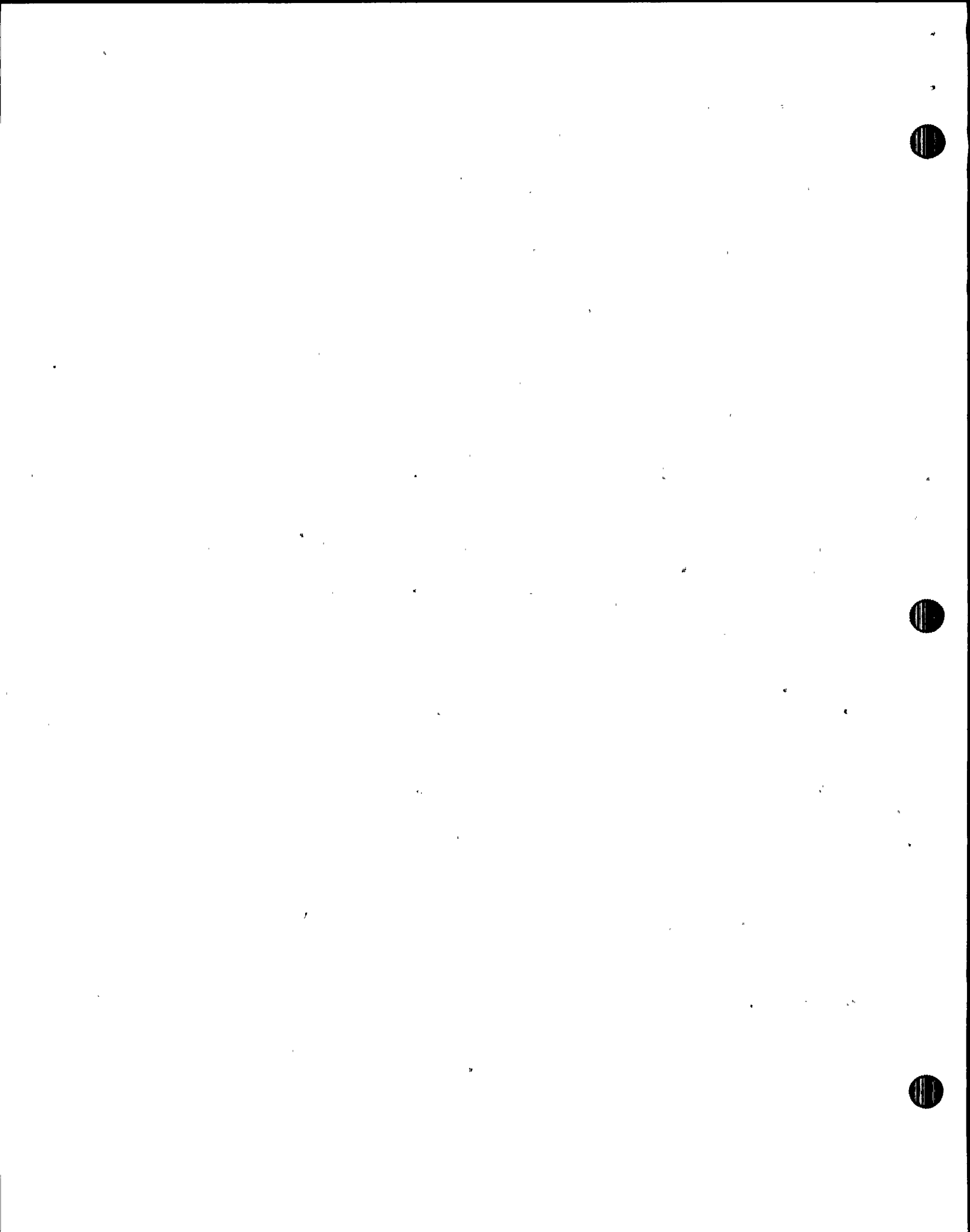


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SUBSEQUENT INVESTIGATION REVEALED THE FOLLOWING FACTORS THAT CONTRIBUTED TO THE PROGRESSION OF THIS EVENT:

- A. THE DESIGN MODIFICATION TO THE STEAM GENERATOR PORV CONTROL SCHEME DID NOT ADEQUATELY ADDRESS THE CHANGES NEEDED TO THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL. FIGURE 2 SHOWS A SIMPLIFIED CONTROL DIAGRAM, BEFORE AND AFTER THE MODIFICATION. THE MODIFICATION REPLACED THE STEAM GENERATOR PORV PRESSURE SET POINT LOADER IN THE CONTROL ROOM WITH A VALVE POSITION DEMAND LOADER AND REMOVED THE PROPORTIONAL CONTROLLER THAT WAS COMMON TO CONTROL ROOM AND AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL OPERATION. THIS RESULTED IN THE PRESSURE SET POINT LOADER, LOCATED ON THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL, FUNCTIONING AS A VALVE POSITION DEMAND LOADER WHEN CONTROL WAS TRANSFERRED TO THIS PANEL. HOWEVER, THE AUXILIARY FEEDWATER PUMP TURBINE CONTROL PANEL CONTROLLER WAS NOT REPLACED OR RELABELLED. THE NEED FOR RELABELLING WAS NOT IDENTIFIED DURING THE DESIGN MODIFICATION PROCESS.
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- C. THE LETDOWN/CHARGING MISMATCH THAT OCCURRED AT THE BEGINNING OF THE EVENT WAS CAUSED WHEN LETDOWN PRESSURE CONTROL VALVE 148, DESIGNED TO PROVIDE BACKPRESSURE FOR THE FLOW ORIFICES IN THE LETDOWN LINE, FAILED OPEN DUE TO A FAULTY ELECTRICAL CONNECTION (SEE FIGURE 1). THE SITUATION WAS COMPLICATED BY THE FOLLOWING:

PRIOR TO TEST INITIATION, CHARGING FLOW CONTROL VALVE 294 HAD



BEEN ADJUSTED TO 32 GPM, AND SEAL INJECTION BACKPRESSURE CONTROL VALVE 309 WAS CLOSED BY ADJUSTMENT OF AUXILIARY SHUTDOWN PANEL "A" CONTROLLERS TO LIMIT THE TRANSIENT EFFECT ON THE REACTOR COOLANT PUMP (RCP) SEALS DURING THE TRANSFER. THE CONTROLLER FOR VALVE 309 ON AUXILIARY SHUTDOWN PANEL "B" WAS LEFT AT ITS NORMAL OPEN SETTING. HOWEVER, UNKNOWN TO THE OPERATOR, VALVE 309 WOULD RESPOND TO THE OPEN CONTROL SIGNAL DUE TO CIRCUIT DESIGN AND SYSTEM CONDITIONS UPON TRANSFER. THIS RESULTED IN THE VALVE GOING TO AN OPEN POSITION, INSTEAD OF THE FULL-CLOSED POSITION THAT WAS DESIRED UPON TRANSFER TO THE AUXILIARY SHUTDOWN PANELS.

WHEN VALVE 309 OPENED, THE OPERATOR ATTEMPTED TO COMPENSATE FOR THE LACK OF FLOW TO SEAL INJECTION BY OPENING VALVE 294; HOWEVER, THE MANUAL VALVE POSITION DEMAND CONTROLLER FOR VALVE 294 ON THE AUXILIARY SHUTDOWN PANEL WAS LABELED BACKWARD (INCREASING AND DECREASING DESIGNATIONS WERE TRANSPOSED). THEREFORE, THE OPERATOR'S ATTEMPTS TO OPEN VALVE 294 RESULTED IN CLOSING IT.

THE PLANT MADE THE NECESSARY EQUIPMENT LABELLING AND PROCEDURAL CHANGES AND CONDUCTED TRAINING TO INCORPORATE THE IMPACT OF THIS MODIFICATION COMPLETELEY. THE LOSS-OF-CONTROL-ROOM TEST WAS SUCCESSFULLY RE-CONDUCTED ON 7/11/86. THE PLANT IS IN THE PROCESS OF REVIEWING ALL MODIFICATIONS PERFORMED BETWEEN COMPLETION OF HOT FUNCTIONAL TESTING AND LICENSING TO DETERMINE IF ANY SIMILAR SITUATIONS EXIST.

COMMENTS:

1. AN ESSENTIAL ELEMENT OF THE DESIGN MODIFICATION PROCESS IS THE DEVELOPMENT AND DOCUMENTATION OF A BASIC FUNCTIONAL DESCRIPTION. THIS WOULD COMPLEMENT TECHNICAL AND HARDWARE DESCRIPTIONS OF HOW TOTAL SYSTEM OPERATION IS AFFECTED BY A MODIFICATION. ONLY WITH SUCH A FUNCTIONAL DESCRIPTION CAN THE (SAFETY) IMPACT OF A MODIFICATION BE COMPLETELY EVALUATED. THIS DESCRIPTION SHOULD IDENTIFY NECESSARY REVISIONS TO OPERATING PROCEDURES, MAINTENANCE PROCEDURES, TESTING REQUIREMENTS, AND TRAINING LESSON PLANS, AND SHOULD BE INCLUDED AS PART OF THE MODIFICATION PACKAGE DOCUMENTATION. PROCEDURE CHANGES, (DRAWING UPDATES) AND APPROPRIATE TRAINING SHOULD BE COMPLETED PRIOR TO RETURNING A MODIFIED SYSTEM TO SERVICE.
2. FOLLOWING THE MODIFICATION TO THE STEAM GENERATOR PORV CONTROLS, INDIVIDUAL COMPONENT CHECKS WERE MADE, BUT COMPLETE LOOP/SYSTEM TESTING WAS NOT PERFORMED. TO BE COMPLETE, POST-MODIFICATION TESTING SHOULD NOT ONLY VERIFY INDIVIDUAL COMPONENT OPERATION, BUT WHERE APPROPRIATE, SHOULD ALSO VERIFY SYSTEM FUNCTIONAL OPERATION. ADDITIONALLY, APPROPRIATE COMPONENT/SYSTEM OPERABILITY SHOULD BE VERIFIED PRIOR TO CRITICAL TESTS.
3. WHEN APPLICABLE, CRITICAL TEST PROCEDURES SHOULD PROVIDE SPECIFIC CRITERIA FOR TEST TERMINATION AND SPECIFIC STEPS TO ENSURE TERMINATION IS CONDUCTED IN A SAFE AND ORDERLY MANNER. DURING THE CONDUCT OF THE LOSS OF CONTROL ROOM TEST, EXPLICIT TEST TERMINATION CRITERIA WERE NOT GIVEN TO THE SRO OBSERVER IN THE CONTROL ROOM. THIS MAY HAVE RESULTED IN

post mod.
Component/loop testing
system functional testing

steps
restoration v. if.
post not functioning
properly or
irreversible safety

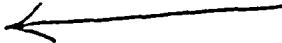


INCREASING THE EXTENT AND DURATION OF THE TRANSIENT.

15
18

4. IT IS IMPORTANT THAT THE APPROPRIATE PLANT PERSONNEL ARE WELL-TRAINED, PRACTICED, AND HAVE A COMPLETE UNDERSTANDING OF THE PROCESS INVOLVED WITH THE EVACUATION OF THE MAIN CONTROL ROOM. AREAS OF IMPORTANCE INCLUDE INDICATIONS AND CONTROLS AVAILABLE AT THE REMOTE SHUTDOWN PANELS AND THE DIFFERENCES BETWEEN A CONTROL ROOM SHUTDOWN AND A REMOTE SHUTDOWN. THIS IS PARTICULARLY IMPORTANT WITH RESPECT TO CONTROLLING THE PLANT UNDER ABNORMAL CONDITIONS.

How does training cover this issue.



5. THE HUMAN PERFORMANCE PROBLEMS THAT OCCURRED DURING THIS EVENT HIGHLIGHT THE IMPORTANCE OF THE APPLICATION OF HUMAN FACTORS CONSIDERATIONS TO ALL PANELS IN THE PLANT, NOT JUST THOSE IN THE CONTROL ROOM. THIS IS PARTICULARLY IMPORTANT FOR PANELS USED DURING INFREQUENT OR OFF-NORMAL CONDITIONS SUCH AS REMOTE SHUTDOWN. APPLICATION OF HUMAN FACTORS SHOULD BE AN INTEGRAL PART OF THE DESIGN MODIFICATION PROCESS FOR ALL CONTROLS AND INDICATIONS.

AS A MINIMUM, THIS SER SHOULD BE REVIEWED BY PLANT ORGANIZATIONS RESPONSIBLE FOR OPERATIONS, TRAINING, INSTRUMENTATION AND CONTROLS, AND THE DESIGN MODIFICATION PROCESS.

ILLUSTRATIONS, WHICH MAY BE HELPFUL IN UNDERSTANDING THIS SER, ARE BEING TRANSMITTED BY TELECOPY TO THE UTILITY AND PARTICIPANT SEE-IN CONTACTS. RECIPIENTS WHO DO NOT HAVE TELECOPY RECEPTION CAPABILITIES AT THEIR LOCATION CAN OBTAIN A COPY OF THE ILLUSTRATIONS FROM THEIR SEE-IN CONTACT OR JEFF WHEELLOCK, INPO, 404/951-4730. RECIPIENTS WITH TELECOPY RECEPTION CAPABILITIES WHO EXPERIENCE PROBLEMS IN RECEIVING ANY TRANSMISSION SHOULD CONTACT SKIP HEEKE, INPO, 404/953-7675.

INPO'S EVALUATION OF THIS EVENT IS COMPLETE.

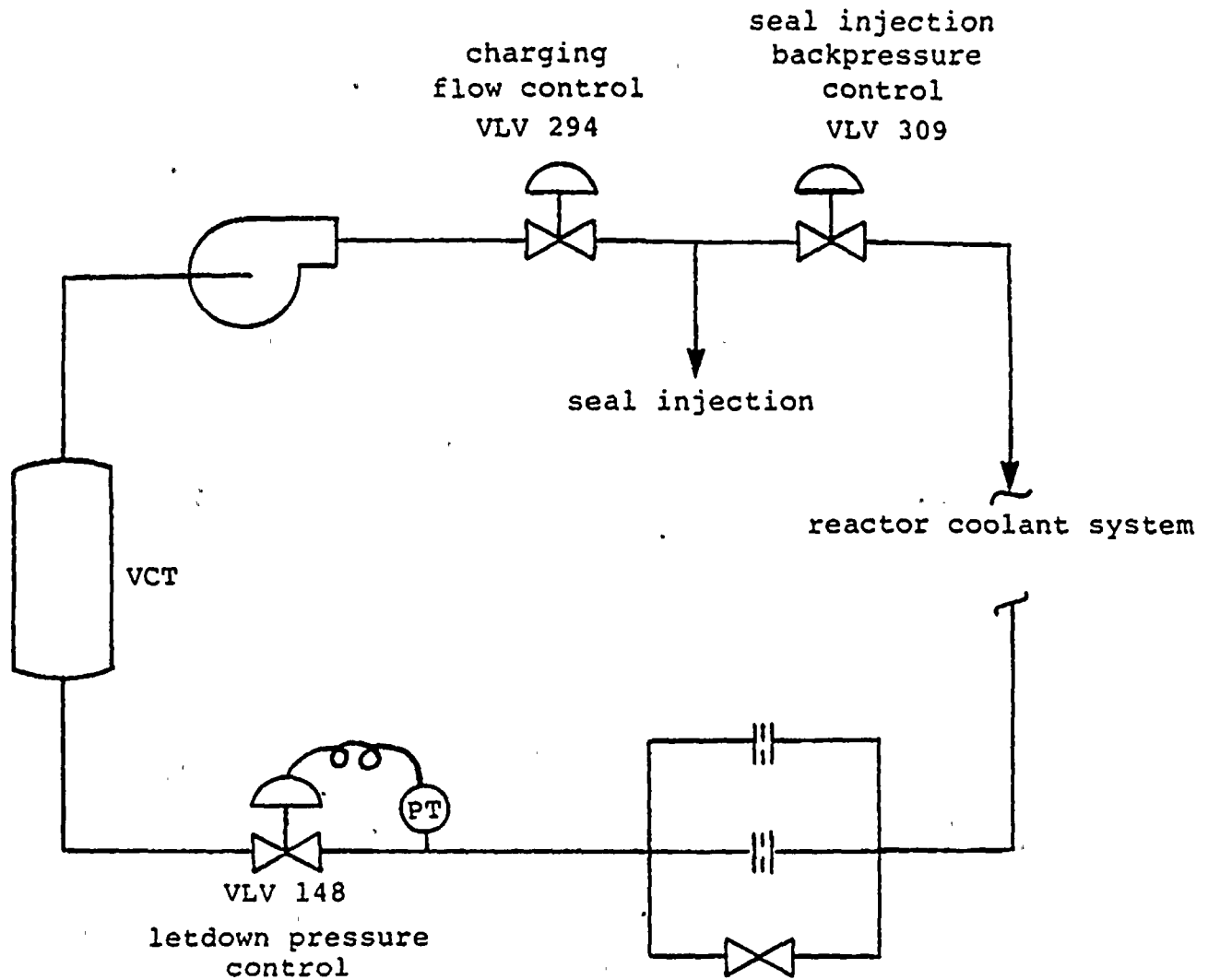
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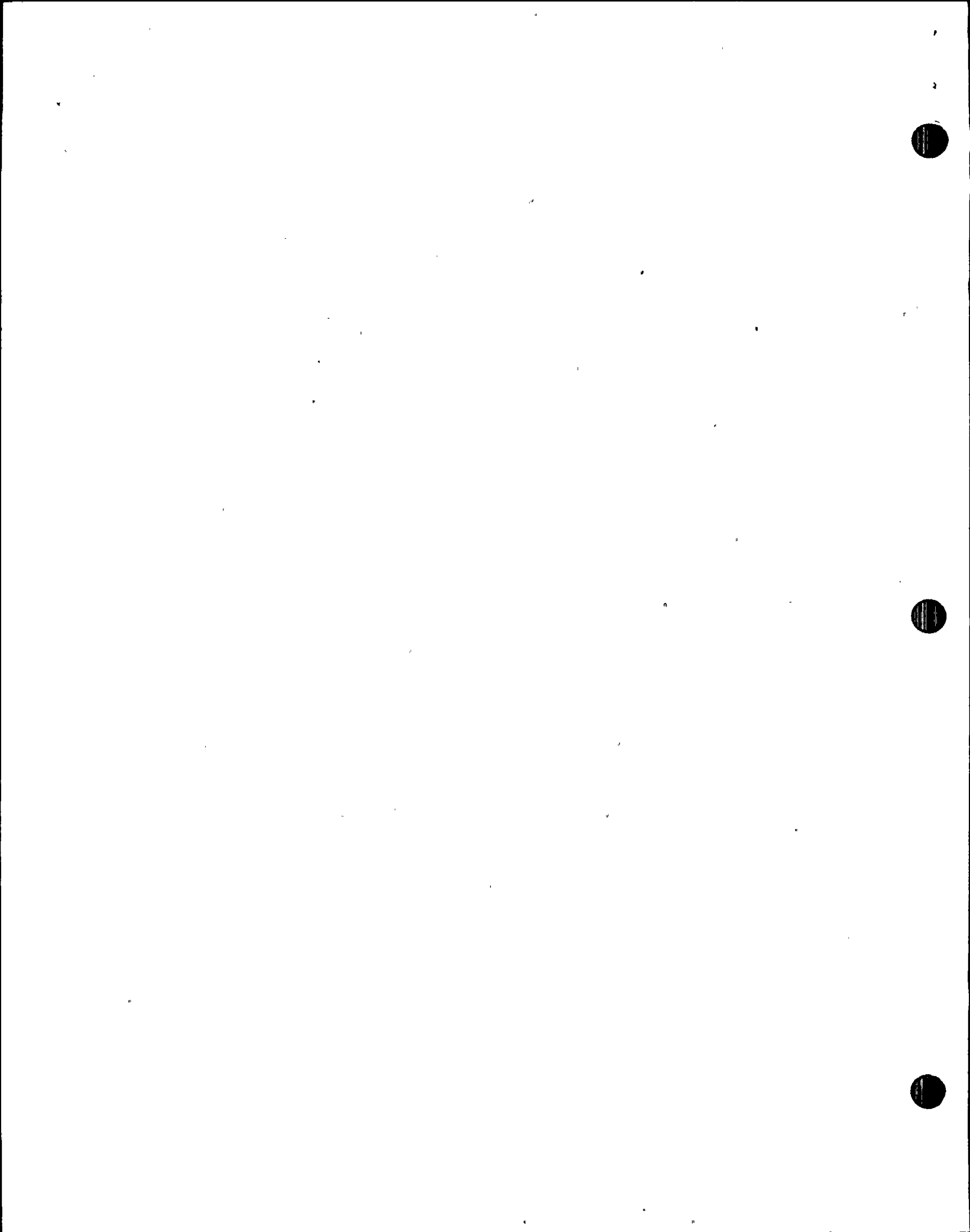


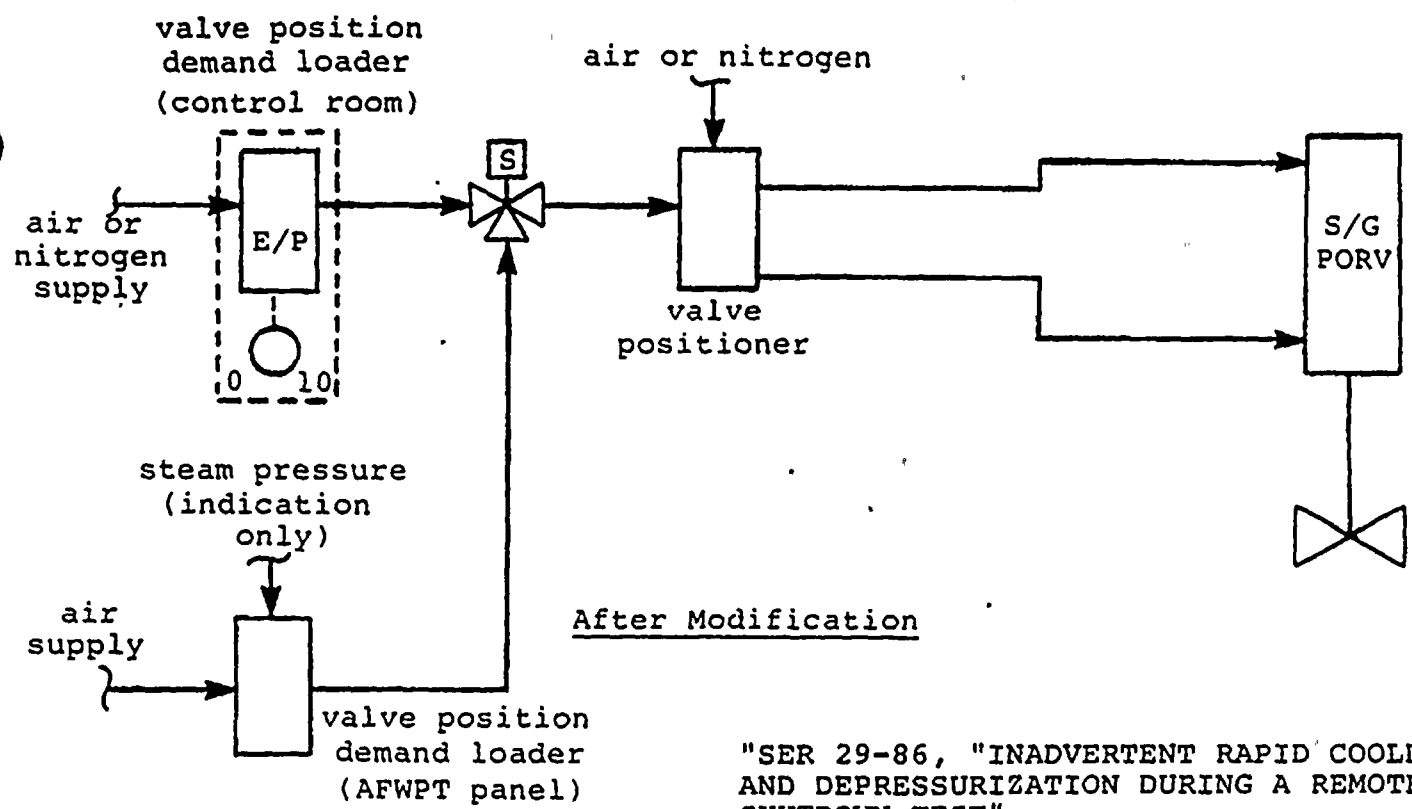
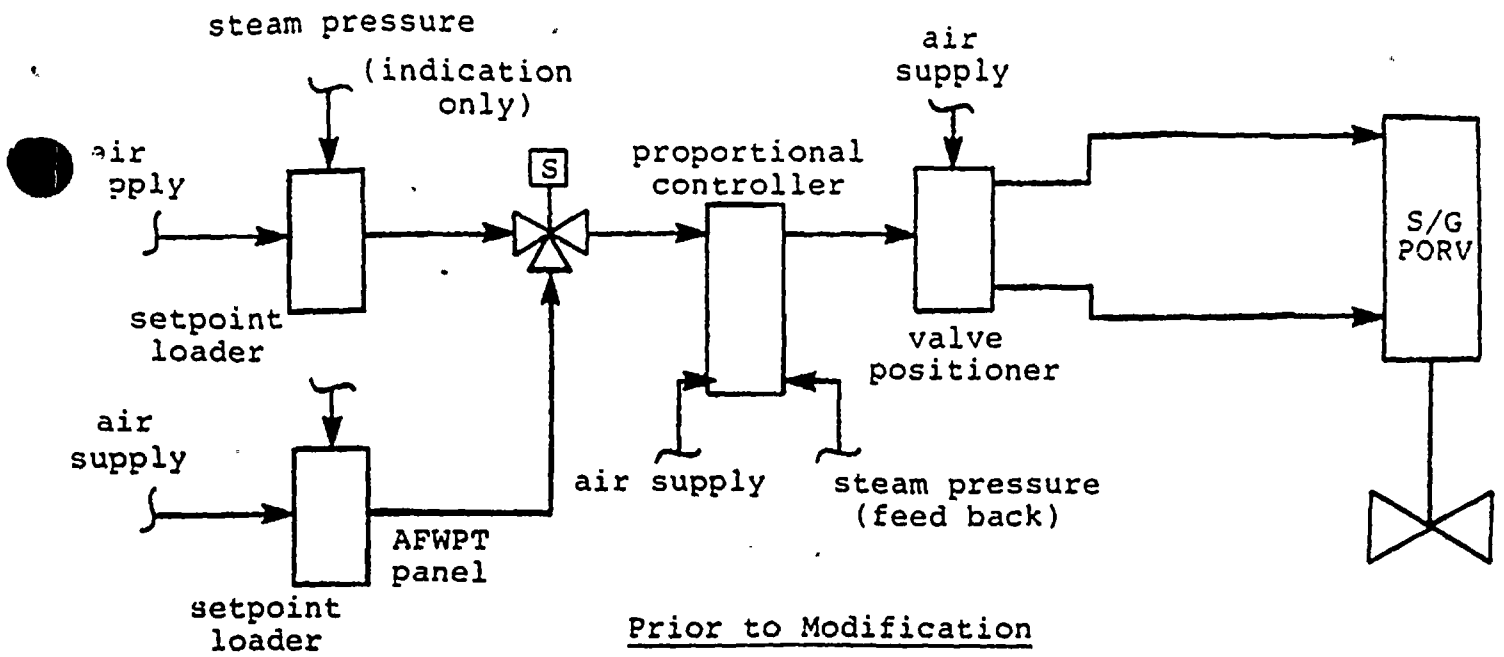


Simplified
Letdown/Charging Diagram

Figure 1

SER 29-86, "INADVERTENT RAPID COOLDOWN AND DEPRESSURIZATION DURING A REMOTE SHUTDOWN TEST"





Simplified Steam Generator

PORV Control Diagram

Figure 2

